

# Teaching Sustainability

## Competencies across the Disciplines

A Guide for Instructors

August 2024

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**The Scaling Up Sustainability Across the Curriculum Community of Practice,  
Association for the Advancement of Sustainability in Higher Education (AASHE)**

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## Introduction: How to Use this Guide

Members of AASHE's Scaling Up Sustainability Across the Curriculum Community of Practice produced this guide for instructors in our curriculum development workshops and for others who seek to integrate sustainability across the curriculum in higher education.

### **Our goals were to:**

- Help instructors understand the similarities and differences among the sustainability competencies frameworks produced by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the revised version, entitled the Key Competencies in Sustainability Framework (KCSF), so that instructors can decide whether to teach with one or both of these frameworks, and can map connections among the sets of competencies and ways of teaching them.
- Support instructors to integrate sustainability competencies into their courses by identifying and developing curricular and pedagogical resources, resources for assessing student learning, and relevant examples of the scholarship of teaching and learning in this field.

**We encourage all readers to familiarize themselves briefly with the UNESCO and KCSF frameworks** by reading the next section, which summarizes these two frameworks.

**Readers interested in revising program-level learning outcomes and curricula** (for a school or department, for example) will especially benefit from considering the frameworks in their entirety, and how their program can teach all of the competencies as an interrelated whole.

**Instructors interested in incorporating one or more of the competencies into their teaching** are encouraged to identify which competencies are most relevant to the instructors' courses, and to focus on the sections that provide resources for teaching each of these competencies. These resources include:

- Definitions of each competency
- Relevant student learning outcomes, organized by the levels of Bloom's Taxonomy (see Appendix A)
- Key concepts and methods
- Pedagogies and assessments of student learning (for additional resources, search the curriculum repositories listed in Appendix B)
- Examples of relevant scholarship of teaching and learning

**Instructors who are looking for insights on how to teach about a specific topic** (such as food, water, or policy) should use the find command to search the full document for the range of sustainability competencies that can be taught in relation to the topic.

**Readers interested in offering professional development for their faculty or students to use the competencies** may want to use the brief handout that defines the competencies and provides example pedagogies in Appendix C, as well as the [online tutorial on the KCSF sustainability competencies](#) for instructors and students.



University of San Francisco Environmental Monitoring students learn to measure "flow" in the Gleeson Library Reflecting Pool.

Image: [zzzrandyzzz](#)

## 1. Comparing the UNESCO and GCSE Sustainability Competencies

Based on a comprehensive literature review, Wiek et al. (2011) defined sustainability competencies as "knowledge, skills, and attitudes that enable successful task performance and problem-solving ... with respect to real-world sustainability problems, challenges, and opportunities" (p. 204). These authors emphasized that sustainability education should not simply aim to teach individual competencies but also the interrelationships among them, which form a unified whole.

Drawing on de Haan (2010), Rieckmann (2012), and Wiek et al. (2011), the United Nations Educational, Scientific and Cultural Organization defined eight cross-cutting sustainability competencies relevant to the United Nations Sustainable Development Goals (SDGs). These competencies include systems thinking, anticipatory thinking, normative thinking, strategic thinking, collaboration, critical thinking, self-awareness, and integrated problem-solving (UNESCO, 2017, p. 10). To assess these competencies, UNESCO and Arizona State University scholars created the SDG Fitness Test, comprising 24 questions about four real-world scenarios (UNITAR, 2022).

Drawing on a Delphi Study conducted by Brundiers et al. (2021), an expert group convened by the Global Council for Science and the Environment (GCSE) developed a subsequent version of the UNESCO competencies framework called the Key Competencies in Sustainability Framework (KCSF). The KCSF was intended more specifically for higher education, for preparing students to enter professional settings, and to serve as accreditation standards for higher education sustainability programs (Brundiers et al., 2023). While much of the UNESCO framework remains in the KCSF version, there are differences in some titles and definitions of competencies. Table 1.1 outlines the key competencies for sustainability and the respective definitions from the UNESCO and KCSF frameworks.

**Table 1.1. UNESCO and GCSE Sustainability Competencies**

Competency	Definition
<b>UNESCO:</b> Systems thinking	<b>UNESCO:</b> The ability to recognize and understand relationships, to analyze complex systems, to think of how systems are embedded within different domains and different scales, and to deal with uncertainty.
<b>KCSF:</b> Systems thinking	<b>KCSF:</b> The ability to collectively analyze complex systems across different domains, sectors, and spatial and temporal scales using analytical concepts like cause-effect structures, cascading effects, inertia, feedback loops, interdependencies, and other systemic features.

Competency	Definition
<p><b>UNESCO:</b> Anticipatory</p> <p><b>KCSF:</b> Futures thinking</p>	<p><b>UNESCO:</b> The ability to understand and evaluate multiple futures – possible, probable, and desirable; to create visions for the future; to apply the precautionary principle; to assess the consequences of actions; and to deal with risks and changes.</p> <p><b>KCSF:</b> The ability to collectively explore future developments and states, specifically to anticipate how sustainability challenges might evolve or occur over time (scenarios). This also includes collectively analyzing, crafting, and evaluating desired future states (visions). These visualizations of the future provide a foundation for researching evidence-supported alternative development pathways.</p>
<p><b>UNESCO:</b> Normative</p> <p><b>KCSF:</b> Values thinking</p>	<p><b>UNESCO:</b> The ability to understand and reflect on the norms and values that underlie one’s actions; and to negotiate sustainability values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge, and contradictions.</p> <p><b>KCSF:</b> The ability to collectively identify, analyze, map, apply, reconcile, and negotiate sustainability principles, goals, and targets, as well as trade-offs. This also includes the ability to be aware of and specify one’s own values. Because sustainability is an inherently normative concept centered on equity among people, between people and the environment, and across generations, values-thinking competency includes engaging with principles and practices emphasizing concepts of justice, equity, diversity, and inclusion.</p>
<p><b>UNESCO:</b> Strategic thinking</p> <p><b>KCSF:</b> Strategic thinking</p>	<p><b>UNESCO:</b> the ability to collectively develop and implement innovative actions that further sustainability at the local level and further afield.</p> <p><b>KCSF:</b> The ability to collectively design transformational systemic interventions, transitions, and governance strategies while accounting for strategic leverage points, power dynamics, uncertainty and surprises as well as social and organizational learning in navigating these strategies.</p>
<p><b>UNESCO:</b> Collaboration</p> <p><b>KCSF:</b> Interpersonal</p>	<p><b>UNESCO:</b> The ability to learn from others; to understand and respect the needs, perspectives, and actions of others (empathy); to understand, relate to, and be sensitive to others (empathic leadership); to deal with conflicts in a group; and to facilitate collaborative and participatory problem-solving.</p> <p><b>KCSF:</b> The ability to motivate, enable, and facilitate collaborative and participatory sustainability research and collective problem-solving processes, and facilitate multi-, inter-, and transdisciplinary knowledge building and integration, which includes Western scientific knowledge as well as traditional ecological knowledge and indigenous knowledge and wisdom.</p>

Competency	Definition
<p><b>UNESCO:</b> Critical thinking</p> <p><b>KCSF:</b> (Not applicable)</p>	<p><b>UNESCO:</b> The ability to question norms, practices, and opinions; to reflect on one's values, perceptions, and actions; and to take a position in the sustainability discourse.</p>
<p><b>UNESCO:</b> Self-awareness</p> <p><b>KCSF:</b> Intrapersonal</p>	<p><b>UNESCO:</b> The ability to reflect on one's role in the local community and (global) society; to continually evaluate and further motivate one's actions; and to deal with one's feelings and desires.</p> <p><b>KCSF:</b> The ability to be aware of one's own emotions, desires, thoughts, and behaviors as well as one's positionality and role in global society and in the local community. Intrapersonal competency involves the ability to reflect and act with self-awareness and to regulate, motivate, and continually evaluate one's actions and improve oneself, drawing on and developing emotional intelligence and resilience.</p>
<p><b>UNESCO:</b> Integrated problem-solving</p> <p><b>KCSF:</b> Integrated problem-solving</p>	<p><b>UNESCO:</b> The ability to apply different problem-solving frameworks to complex sustainability problems and develop viable, inclusive, and equitable solution options that promote sustainable development, integrating the other competencies.</p> <p><b>KCSF:</b> The ability to solve complex sustainability problems in integrated ways i.e., the ability to work with others to integrate problem analysis, sustainability assessment, visioning and strategy building, and to prepare for implementing the co-created solution in the real world. This includes the ability to articulate the individual contributions of the previous key competencies to sustainability problem-solving processes and being familiar with different problem-solving frameworks and able to select the appropriate one to develop viable solution option in context-sensitive ways, recognizing that sustainability problem-solving is a long-term, iterative and collective process between planning, realization, adjustment and evaluation.</p>
<p><b>KCSF:</b> Implementation</p> <p><b>UNESCO:</b> (Not applicable)</p>	<p><b>KCSF:</b> The ability to collectively carry out and realize planned sustainability strategies (e.g., sustainability action plan) on the ground, including implementation, adaptation, transfer, and scaling, in effective and efficient ways. Working toward a sustainability-informed vision over time involves monitoring and evaluating the realization process on the ground, addressing emerging challenges, and making adjustments.</p>

## 2. Systems Thinking Competency

### Definitions

<p><b>UNESCO:</b> Systems thinking</p>	<p><b>UNESCO:</b> The ability to recognize and understand relationships, to analyze complex systems, to think of how systems are embedded within different domains and different scales, and to deal with uncertainty.</p>
<p><b>KCSF:</b> Systems thinking</p>	<p><b>KCSF:</b> The ability to collectively analyze complex systems across different domains, sectors, and spatial and temporal scales using analytical concepts like cause-effect structures, cascading effects, inertia, feedback loops, interdependencies, and other systemic features.</p>

### Learning Outcomes

Here we provide examples of student learning outcomes associated with the systems thinking competency, organized according to Bloom's Taxonomy (see Appendix A), from simpler to more complex learning objectives. These learning outcomes are drawn especially from Brundiers et al. (2023), and supplemented by ASUSOS (n.d.) and Zhang & Vanasupa (n.d.).

**Remember:** Recalling facts and concepts, including retrieving, recognizing, and recalling relevant knowledge from long-term memory.

- Define key concepts of systems thinking.
- Describe some benefits of systems thinking in sustainability problem-solving.
- Recall the concept of a dynamic system and the elements within a model of a dynamic system, such as system boundary.
- Articulate that the earth is essentially a closed system.
- Articulate that all material or energy input to (or output from) the system must be created from existing material or energy.

**Understand:** Constructing meaning from oral, written, and graphic messages by exemplifying, classifying, summarizing, inferring, locating, recognizing, reporting, translating, or explaining.

- Explain how sustainability problems have emerged (from a historical, cultural, and spatial perspective).



- Describe in principle how different personal (and professional) activities contribute to, or solve or mitigate sustainability problems.
- Describe how multiple, different intervention points are relevant for sustainability problem-solving.
- Explain the conceptual difference between open and closed systems.
- Explain the relationship between events, patterns and system behavior.

**Apply:** Using information in new situations, or carrying out a procedure for executing, implementing, solving, interpreting, operating, or sketching.

- Identify components that make up a system and define a system's boundary by analyzing events and patterns.
- Identify what events (or measures) serve as indicators for the behavior of the system.
- Discuss how modifying a driver changes the problem constellation (how interventions in drivers play out in a system).

**Analyze:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose, differentiating, organizing, comparing, contrasting, distinguishing, examining, experimenting, questioning, or testing.

- Analyze an existing system's structure, describing its properties, processes, and behaviors (e.g., nonlinearity, emergence, path dependence, balancing and reinforcing loops, leverage, drivers).
- Use graphical tools to model a system and its behavior (interactions, consequences).
- Apply systems thinking to analyze the concept of sustainability, and phenomena such as population growth, material flows, energy flows, water flows, etc.
- Recognize interdependencies of different systems (e.g., a nuclear power plant relies on a large reservoir of cold water as does the local ecosystem within that same body of water).
- Relate events and patterns of consumer behavior (including one's own) to the larger global economic system.
- Make connections between events and patterns from very different areas, such as political, social, health and safety, environmental, manufacturing, environmental, or economic systems.

**Evaluate:** Making judgments based on criteria or standards by checking, critiquing, weighing, arguing, defending, judging, or justifying a position.

- Select, modify, combine and apply appropriate systems thinking methods (e.g., modeling, network analysis, robustness analysis) for analyzing systems, identifying problems that pertain to sustainability, and developing solutions.
- Critically reflect on one's own ways of systems thinking in the context of different ways of acquiring knowledge, including different scientific methods and traditional knowledge systems.
- Examine sustainability challenges as decision challenges, including how stakeholder interests, values, needs and influences become key drivers in problems and systems.

**Create:** Producing new or original work by assembling elements to form a coherent or functional whole, or reorganizing elements into a new pattern or structure; generating, planning, or producing; designing, constructing, developing, formulating, or authoring.

- Develop, describe, and bound a system that captures the ecological, economic, and social elements and the relationships between them.
- Create basic systems diagrams of sustainability problems, using some empirical data to illustrate elements of the problem (e.g., adverse effects, feedback loops, stocks, processes, fluxes).
- Create a schematic graph that depicts the behavior of a particular event (or measure) over time.
- From the knowledge of a system and behavior-over-time graphs, create a causal loop diagram involving the major events (or measures) within a system.
- Diagnose a problem, create an intervention or alternative system to address the problem, or delineate alternative initial conditions that could lead to a more sustainable state.

## Concepts and Methods

Below is a summary of major concepts and methods associated with systems thinking, adapted from Brundiers et al. (2023).

Concepts	Methods
Systems and systems dynamics (non-linearity, time, lags, surprises, uncertainty, etc.)	Descriptive methodologies ("thick" description, narrative research methods)
Feedback loops, complex cause-effect chains (surface vs. root causes, attractors), cascading effects, thresholds, tipping and leverage points, legacy, inertia, resilience,	Modeling methods Qualitative methods (e.g., concept maps, network analysis)

Concepts	Methods
<p>adaptation, structuration, etc.</p> <p>Variables/indicators, systems, sub-systems, structures (e.g., archetypes), functions, elements/stocks and processes/interconnections/fluxes</p> <p>People and social systems: values and attitudes, ideologies, preferences, needs, collective perceptions, motives, actions and habits, decisions, power, tactics, politics, policies, laws, institutions, culture, etc.</p> <p>Across multiple temporal and spatial scales: local to global, short to long-term</p> <p>Across multiple and/or coupled domains: society, environment (ecosystems), economy, technology, etc.</p>	<p>Quantitative modeling and simulations (e.g., STELLA, Life Cycle Assessment, Systems Mapping)</p> <p>Institutional-, decision-, governance-, and social-systems analysis, actor analysis, constellations analysis, syndrome approach and methods operationalizing Cultural Historical Activity Theory (CHAT)</p> <p>Methods to identify archetypes, leverage points, intervention points for disruption</p> <p>Participatory systems approaches, including participatory modeling, role-playing games and simulations</p> <p>Geographic Information Systems</p>

## Pedagogies and Assessments

Below are links to example lesson plans, assignments, and assessments of student learning about systems thinking and sustainability.

### Natural Sciences

#### *Biology*

[Hydrologic Balance and Climate Change](#)

[The Carbon Cycle](#)

[Oceans in Peril: Pressures on Ocean Ecosystems](#)

#### *Environmental Studies and Sciences*

[Systems Thinking Course](#)

[Introduction to Systems Thinking \(Sustainability 101 assignment\)](#)

[History of Food Systems](#)

[Energy from and to the Earth](#)

[Systems Thinking: Rio Grande River Flow](#)

[Future of Food](#)

## **Social Sciences**

*Sociology*

[Systems thinking](#)

*Political Science*

[Major Storms and Community Resilience](#)

[Regulating Carbon Emissions](#)

## **Arts & Humanities**

[Humanity and Its Futures: Systems Thinking Approaches](#)

## **Engineering**

[Urban Landscapes and Water Use](#)

[Urban Hydrology](#)

[Low Impact Development and Green Infrastructure](#)

[Urban Water - Atmospheric Environment Interactions](#)

## **Business and Economics**

*Economics*

[Climate Change from the Socio-Environmental Systems Perspective](#)

[Financial Incentives of Open Access Resource Overuse](#)

[International Economics, Development, and Growth](#)

*Management*

[Systems Thinking for Sustainable Development and Enterprise](#)

## **Health and Social Work**

[Composting Toilets](#)

[Global Food Security](#)

## **Law and Policy**

[Policy & Governance of Sustainable Systems](#)

## [Policy Coherence and Systems Thinking for Sustainable Development](#)

### **Interdisciplinary**

[Open University Systems Thinking Course \(Open Access\)](#)

[Teach Systems Thinking \(Resources for Teaching Systems Thinking\)](#)

[Systems Thinking Module](#) (and see [this article](#) and [webinar](#) on how to use the module)

[Teaching Students About Systems Thinking](#)

[Resources for Teaching Systems Thinking](#)

*Systems Maps, Concept Maps, Mind Maps*

[Using Concept Mapping to Experientially Introduce Systems Thinking](#)

[Mind Mapping: A Systems Thinking Application for Change Management](#)

[Seeing Systems: Peace, Justice, and Sustainability Discussion Activity](#)

*Systems Models, Computer Models*

[Stella](#)

[ENROADS](#)

[Loopy](#) and [Visualizing Systems](#)

[The Systems Thinker](#)

*General Assessments*

[Assessment of Competency-based Sustainability Learning to Foster Systems Thinking and Critical Thinking](#)

[Assessing Systems Thinking: A Tool To Measure Complex Reasoning Through Ill-Structured Problems](#)

[Essay Assessments: Interdisciplinary and Systems Thinking](#)

### **Scholarship of Teaching and Learning**

Below are examples of research on teaching and learning about the systems thinking competency.

**Natural Sciences***Biology*

[The Theoretical Nature of Systems Thinking. Perspectives on Systems Thinking in Biology Education](#)

*Environmental Sciences and Studies*

[Teaching Systems Thinking Webinar](#)

[Social Responsibility and the World of Nature: An Interdisciplinary Environmental Studies Course for Inspiring Whole System Thinking and Environmental Citizenship](#)

[Examining Undergraduate Students' Systems Thinking Competency Through a Problem Scenario in the Context of Climate Change Education](#)

*Chemistry*

[Exploring Opportunities to Incorporate Systems Thinking Into Secondary and Tertiary Chemistry Education Through Practitioner Perspectives](#)

[Integrating the Molecular Basis of Sustainability into General Chemistry through Systems Thinking](#)

[Introduction to Systems Thinking for the Chemistry Education Community](#)

[Systems Thinking Approaches for International Green Chemistry Education](#)

[Applications of Systems Thinking in STEM Education](#)

[Systems Thinking for Education about the Molecular Basis of Sustainability](#)

**Social Sciences**

[Assessing \(Social-Ecological\) Systems Thinking by Evaluating Cognitive Maps](#)

[Educating Systems Thinking for Sustainability: Experience with a Developing Country](#)

[Integrating Social Science Research to Advance Sustainability Education](#)

**Arts & Humanities**

[Essays on Systems Thinking: Applications for Art Education](#)

[Systems Thinking and Interdisciplinarity in Disciplinary Design Education](#)

[Teaching Sustainability, Ethics and Scientific Writing: An Integrated Approach](#)

**Engineering**

[Systems Engineering in University Education with Focus on Systems Thinking](#)

[Sustainable Systems Engineering Course Design: Design for Systems and Society](#)

[Analyzing Sustainable Practices in Engineering Projects: A Systemic Approach](#)

[The Case for Systems Thinking in Undergraduate Engineering Education](#)

### **Business and Economics**

[Using Systems Thinking to Educate for Sustainability in a Business School](#)

[The Power of Art to Foster Systems Thinking. One of the Key Competencies of Education for Sustainable Development \(for a Management Course\)](#)

### **Health and Social Work**

[Planetary Health Pedagogy: Preparing Health Promoters for 21st-Century Environmental Challenges](#)

### **Law and Policy**

[Promoting Systems Thinking and Pro-Environmental Policy Support through Serious Games](#)

[\(Systems\) Thinking Like a Lawyer](#)

[Systems Thinking and the Law in the Age of the Anthropocene](#)

### **Interdisciplinary**

[What is Systems Thinking? A Review of Selected Literature Plus Recommendations](#)

[A Complete Set of Systems Thinking Skills](#)

[Systems Thinking for Systems Leadership: Promoting Competency Development for Graduate Students in Sustainability Studies](#)

[Systems Thinking for Campus Sustainability: Utilizing the University of Central Florida Campus as a Living Laboratory](#)

[Thinking Skills in Two Undergraduate Sustainability Courses: A Comparison of Teaching Strategies](#)

[Fostering Students' Systems Thinking Competence for Sustainability by Using Multiple Real-World Learning Approaches](#)

[Using the U.N. SDGs to Foster Systems Thinking in Incoming First-Year Students \(for STEM\)](#)

[Systems Thinking \(for evaluation\)](#)





### 3. Anticipatory or Futures Thinking Competency

#### Definitions

<p><b>UNESCO:</b> Anticipatory</p>	<p><b>UNESCO:</b> The ability to understand and evaluate multiple futures – possible, probable, and desirable; to create visions for the future; to apply the precautionary principle; to assess the consequences of actions; and to deal with risks and changes.</p>
<p><b>KCSF:</b> Futures thinking</p>	<p><b>KCSF:</b> The ability to collectively explore future developments and states, specifically to anticipate how sustainability challenges might evolve or occur over time (scenarios). This also includes collectively analyzing, crafting, and evaluating desired future states (visions). These visualizations of the future provide a foundation for researching evidence-supported alternative development pathways.</p>

#### Learning Outcomes

Here we provide examples of student learning outcomes associated with the anticipatory or futures thinking competency, organized according to Bloom’s Taxonomy (see Appendix A), from simpler to more complex learning objectives. These learning outcomes are drawn especially from Brundiers et al. (2023) and supplemented by ASUSOS (n.d.; 2024).

**Remember:** Recalling facts and concepts, including retrieving, recognizing, and recalling relevant knowledge from long-term memory.

- Describe the basic structure of future thinking methods, including scenario construction, forecasting, backcasting, and visioning.
- Define concepts of the future – such as uncertainty, likelihood, plausibility, and desirability – as they pertain to sustainability.
- Describe the intergenerational concepts of sustainability.
- Describe some benefits of futures thinking in sustainability problem-solving.

**Understand:** Constructing meaning from oral, written, and graphic messages by exemplifying, classifying, summarizing, inferring, locating, recognizing, reporting, translating, or explaining.

- Explain the types of knowledge that methods of futures thinking generate and how they can be used in sustainability problem solving activities.
- Explain sustainability-related concepts of the future, such as short-term versus long-term trends, uncertainty, path dependency, likelihood, plausibility, consistency and desirability.

- Discuss how emotions, including hope and fear, influence futures thinking.
- Interpret science fiction representations of sustainability futures and what these fictions see as the main drivers and outcomes of the future.

**Apply:** Using information in new situations, or carrying out a procedure for executing, implementing, solving, interpreting, operating, or sketching.

- Outline basic scenarios and visions for one's own life and for familiar systems (like one's school) on different timescales; expand on these to a more global perspective.
- Use existing models, scenarios, and simulations to project future consequences of actions and interventions across different scales.

**Analyze:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose, differentiating, organizing, comparing, contrasting, distinguishing, examining, experimenting, questioning, or testing.

- Distinguish different concepts about the future, including short-term and long-term views, and the meaning of possible, probable, plausible, and desirable future states.
- Compare and contrast different cultural concepts of time and the future, and their implications for thinking about sustainability.
- Anticipate in principle (sketch trajectories of) how one's personal life, as well as personal and professional activities, might evolve over time and how they might contribute to, mitigate, or solve future sustainability problems.

**Evaluate:** Making judgments based on criteria or standards by checking, critiquing, weighing, arguing, defending, judging, or justifying a position.

- Evaluate key historical and cross-cultural ideas of the future, recognizing that different groups have different ideas about the future.
- Critically reflect on one's own thinking about the future in the context of one's own background and values.
- Articulate and critically reflect on future consequences of actions and interventions across different scales.
- Evaluate the assumptions employed by sustainability models, scenarios, visions, and simulations.

**Create:** Producing new or original work by assembling elements to form a coherent or functional whole, or reorganizing elements into a new pattern or structure; generating, planning, or producing; designing, constructing, developing, formulating, or authoring.

- Select, modify, combine and apply appropriate futures thinking sustainability methods to construct scenarios, develop simulations, or envision future states.
- Design a process to engage the public, scientists, and/or policy leaders in well-informed deliberation and decision-making about sustainable futures.
- Create artistic representations of sustainability futures that communicate what you see as the main drivers, potential outcomes, and desirable states.
- Create a vision for the future through a participatory process.

## Concepts and Methods

Below is a summary of major concepts and methods associated with anticipatory and futures thinking, adapted from Brundiers et al. (2023).

Concepts	Methods
<p>Concepts of time, including temporal phases (past, present, future), temporal scales (short, long), states, continuity (dynamics, paths), non-linearity</p>	<p>Backcasting and envisioning methods (e.g., story-telling and narrative research)</p>
<p>Concepts of future developments (predictions, scenarios, visions) and related epistemic status (probability, possibility, desirability) and uncertainty</p>	<p>Scenario methodology, including modeling</p> <p>Forecasting from statistical and simulation models</p> <p>Anticipatory multi-methodologies</p>
<p>Concepts of inertia, path dependency, non-interventions vs. concepts of disruptive interventions and pathways</p>	<p>Participatory Action Research, anticipatory approaches (including Delphi and future workshop)</p>
<p>Concepts of consistency and plausibility of future developments, unintended consequences</p>	<p>Iterative approach to dealing with the future: as time passes one approaches the "future" and continually refines one's concept of the future</p>
<p>Concepts of risk, intergenerational equity, cross-cultural perspectives, precaution, anticipatory governance, biophysical limits</p>	<p>Community visioning</p>
<p>Concepts of creativity, imagination, "real utopias," and emotions (fear, hope, etc.)</p>	

## **Pedagogies and Assessments**

Below are links to example lesson plans, assignments, and assessments of student learning about the anticipatory or futures thinking sustainability competency.

### **Natural Sciences**

#### *Chemistry*

[Calculating Resilience, Tipping Points, and Restoration for Lakes at Risk from Acid Rain](#)

#### *Environmental Science*

[Climate Change and Food Security](#)

[Future Climate Change, Population Growth, and Water Issues](#)

[Future of Food—Climate Change Predictions Capstone Project](#)

[Water Science and Society—Future Scenarios](#) and [Climate Models](#)

[Climate Change Impacts on the Northwest Passage](#)

[Predicting Effects of Climate Change on Soil Loss](#)

#### *Biology*

[Modern CO<sub>2</sub> Accumulation](#)

[Atmospheric Carbon: Can We Offset the Increase?](#)

[Gulf Stream Heat Budget and Europe's Mild Climate](#)

[Biology—Scientific Method and Historical Precipitation](#)

### **Social Sciences**

#### *Environmental Studies*

[Scenario Planning Societal Collapse Scenario](#)

[Regional Sea level Changes, A Tale of Two Cities \(New York and Southern CA\)](#)

[Future Food Scenarios Capstone Project](#)

#### *Communication*

[Teaching Risk and Crisis Communication in the Context of Natural Disasters](#)

[Using "Dante's Peak" to Discuss Response to Risk](#)

## *Sociology*

[Climate Action Simulation](#)

[Social Ecology Syllabus](#)

[Future Thinking and Strategies Course Syllabus](#)

## **Arts & Humanities**

[Speculative Fiction and the Environment in 20th-Century America Syllabus](#)

[Graduate Seminar Aesthetics and the Anthropocene Syllabus](#)

[The Environment in German Sci-Fi and Fantasy Syllabus](#)

## **Engineering**

[Runoff Generation from Varying Land Surfaces](#)

[Managed Retreat/Multi-Layered Protection](#)

[Climate and Energy Syllabus](#)

[Hydrotopia Syllabus](#)

[Capstone Project: Urban Water Portfolio](#)

[The Nile's Sinking Future](#)

[Water Sustainability in Cities—Planning and Decision Making](#)

## **Business and Economics**

[Economic Geology](#)

[Financial Incentives of Open Access Resource Overuse](#)

[Economics—Abating Carbon Emissions](#)

[Land Management—State Electricity on Google Earth](#)

[Modeling Future Climate Predictions & Costs](#)

## **Health and Social Work**

[The Future of Food](#)

[The Changing Geographic Distribution of Malaria with Global Climate Warming](#)

[Exercise in a Changing Climate](#)

[Future of Food - Food Access and Food Deserts Summative Assessment and Capstone Project](#)

## **Law and Policy**

[Dynamic Integrated Climate Economy \(DICE\) Modeling](#)

[Scenarios, Plans, & Future Cities](#)

[Development Policy and Practices](#)

[Simulation of International Negotiations to Reduce Greenhouse Gas Emissions](#)

## **Interdisciplinary**

[Introductory Video to Futures Thinking](#)

[In-Class Visioning Activity](#)

[EnRoads Climate Solutions Simulator](#)

[Teach the Future - Teaching Tools](#), [Textbook](#), and [Resource Bank](#)

## **Scholarship of Teaching and Learning**

Below are examples of research on teaching and learning about the anticipatory or futures thinking competency.

### **Natural Sciences**

[Facilitating Transformative Science Education through Futures Thinking](#)

[Using COVID-19 to Teach Sustainability Futures Thinking](#)

[Futurising Science Education: Students' Experiences From a Course on Futures Thinking and Quantum Computing.](#)

[The Impact of Building a Training Program According to the Dimensions of Environmental Citizenship for Biology Teachers in their Future Thinking](#)

### **Social Sciences**

[Imagine a World in which: Using scenarios in Political Science](#)

[Thinking about Future/Democracy: Towards a Political Theory of Futurity](#)

[Building Capacities for Transformative Change towards Sustainability: Imagination in Intergovernmental Science-Policy Scenario Processes](#)

[Future Scenarios for Socio-Ecological Production Landscape and Seascape](#)

**Arts & Humanities**

[Fictional Narratives for Environmental Sustainability Communication](#)

[Education for Sustainability: Developing Ecocritical Literature Circles in the Student Teacher Classroom](#)

[Imagining The Sustainable Future through the Construction of Fantasy Worlds](#)

[Science Fiction and Social Justice: Teaching Students to Consider Ethics, Sustainability, and Diversity Issues](#)

**Engineering**

[Framing Teaching for Sustainability in the Case of Business Engineering Education: Process-Centric Models and Good Practices](#)

[Engineers of the Future: Using Scenarios Methods in Sustainable Development Education](#)

[The Use of Engineering Design Scenarios to Assess Student Knowledge of Global, Societal, Economic, and Environmental Contexts](#)

**Business and Economics**

[Supporting Scenario Design in Planning Long-Term Business Strategies Based on Sustainability Scenarios](#)

[Narrating Future\(S\) with Others: Teaching Strategic Sustainability Management in a Relational Key](#)

[Scenario Planning as a Causal Evaluation Tool for IoT Business Model Innovation](#)

**Health and Social Work**

[Student Nurses Exposed to Sustainability Education Can Challenge Practice: A Cohort Study](#)

[Can a Sustainability and Health Scenario Provide a Realistic Challenge to Student Nurses and Provoke Changes in Practice? An Evaluation of a Training Intervention](#)

[A Cohort Study of Sustainability Education in Nursing](#)

## **Law and Policy**

[Using Scenarios to Assess Policy Mixes for Resource Efficiency and Eco-Innovation in Different Fiscal Policy Frameworks](#)

[The Use of Scenarios in Legal Education to Develop Futures Thinking and Sustainability Competencies](#)

[Exploring the Usefulness of Scenario Archetypes in Science-Policy Processes: Experience across IPBES Assessments](#)

## **Interdisciplinary**

[Beyond Colonial Futurities in Climate Education](#)

[Imagining the School of the Future through Computational Simulations: Scenarios' Sustainability and Agency as Keywords](#)

[Competencies and Pedagogies for Sustainability Education: A Roadmap for Sustainability Studies Program Development in Colleges and Universities](#)

[Pedagogies of Preparedness: Use of Reflective Journals in the Operationalisation and Development of Anticipatory Competence](#)

[Connecting Competences and Pedagogical Approaches for Sustainable Development in Higher Education: A Literature Review and Framework Proposal](#)

[Field Notes: Teaching Climate Change in Higher Education \(blog\)](#)

[Worry & Hope: What College Students Know, Think, Feel and Do about Climate Change](#)

[Beyond Sustainability: Positioning Regenerative Futures In a Philippine State University](#)

[Teacher Agency and Futures Thinking](#)

[Teaching Futures Thinking Literacy and Futures Studies in Schools](#)



## 4. Normative or Values Thinking Competency

### Definition

<p><b>UNESCO:</b> Normative</p>	<p><b>UNESCO:</b> The ability to understand and reflect on the norms and values that underlie one’s actions; and to negotiate sustainability values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge, and contradictions.</p>
<p><b>KCSF:</b> Values thinking</p>	<p><b>KCSF:</b> The ability to collectively identify, analyze, map, apply, reconcile, and negotiate sustainability principles, goals, and targets, as well as trade-offs. This also includes the ability to be aware of and specify one’s own values. Because sustainability is an inherently normative concept centered on equity among people, between people and the environment, and across generations, values-thinking competency includes engaging with principles and practices emphasizing concepts of justice, equity, diversity, and inclusion.</p>

### Learning Outcomes

Here we provide examples of student learning outcomes associated with the normative or values thinking competency, organized according to Bloom’s Taxonomy (see Appendix A), from simpler to more complex learning objectives. These learning outcomes are drawn from Brundiers et al. (2023), and supplemented by ASUSOS (n.d.), Markkula Center for Applied Ethics (n.d.), Normandale Community College (2023), Nova Southeastern University (2024), and Zinser (2020).

Note that the normative/values thinking competency addresses both individual ethics and systemic justice issues.

**Remember:** Recalling facts and concepts, including retrieving, recognizing, and recalling relevant knowledge from long-term memory.

- Describe the basic structure of values-based methods, including sustainability assessments and visioning; link these methods with the types of knowledge they generate and their use in sustainability problem-solving activities.
- Describe some benefits of values-thinking in sustainability problem-solving.
- Describe anthropocentric and biocentric approaches to environmentalism.

**Understand:** Constructing meaning from oral, written, and graphic messages by exemplifying, classifying, summarizing, inferring, locating, recognizing, reporting, translating, or explaining.

- Distinguish claims of fact from claims of value in sustainability contexts (with the understanding that facts are also defined within social contexts).
- Explain the difference between intrinsic and extrinsic values, and between holistic and individualistic ethical systems.
- Describe intra- and inter-generational equity and explain their importance for sustainability.
- Explain the influence of values on stakeholder actions and activities.
- Explain key sustainability principles, why they are part of the overarching concept of sustainability, and how they are used in values thinking (e.g., justice, equity, human dignity, fairness; social-ecological systems integrity, responsibility).
- Explain normative concepts, including goals, values, ethics, equity and justice, and recognize that human thoughts and actions are based on values.
- Recognize ethical and justice issues specific to the context of the environment.
- Explain how one's own values shape behavior that affects others.

**Apply:** Using information in new situations, or carrying out a procedure for executing, implementing, solving, interpreting, operating, or sketching.

- Explain theories and concepts of ethics and justice and apply them to a variety of sustainability issues.
- Identify the impacts and trade-offs, as seen from various justice/ethics perspectives, of different courses of action.
- Apply normative principles specific to sustainability – such as socio–ecological system integrity, livelihood sufficiency and opportunity (and for whom/what, including nonhumans), and intergenerational equity – to diverse situations or issues.
- Apply environmental ethics and justice frameworks to assess complex current events.
- Clarify one's own values and incorporate environmental ethics into everyday decision-making.

**Analyze:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose, differentiating, organizing, comparing, contrasting, distinguishing, examining, experimenting, questioning, or testing.

- Analyze ethical and justice issues to arrive at reasoned responses to sustainability problems that take into account their environmental, economic, and social dimensions.
- Recognize and explain differences in normative values among individuals, groups, and cultures, and understand how these differences guide their behavior and impact sustainability visions.

- Analyze the ethical and equity aspects involved in the approaches to the environment taken by diverse spiritual, economic, legal, and cultural perspectives.
- Explain the ways in which environmental understandings are intertwined with and influenced by spiritual, cultural, and socio-economic factors.

**Evaluate:** Making judgments based on criteria or standards by checking, critiquing, weighing, arguing, defending, judging, or justifying a position.

- Evaluate competing ethical and justice claims that inform environmental debates, such as those made by the conservation, preservation, environmental justice, and sustainable development traditions.
- Evaluate reasons used to support sustainability decisions and their underlying values and normative assumptions.
- Identify and justify one's own sustainability values, preferences, and norms, and use them to defend a position on a contemporary issue.
- Assess how your sustainability values have been influenced by your social-economic and cultural positionality (class, race/ethnicity, gender, sexual orientation, nationality, physical ability, etc.)
- Identify who had the power to set the agenda, voice opinions, and set the parameters for what should matter in a sustainability decision-making process, and analyze whose voices were missing from that process.
- Develop both critical and empathic evaluations of others' values related to sustainability, and how others' prioritize these values differently.
- Select indicators and targets to assess the sustainability impacts of one's personal and employment activities, and how they might be more ethical and just.
- Navigate and negotiate value conflicts or dilemmas that may arise in sustainability projects, and critically reflect on the participants' norms, values, and preferences.

**Create:** Producing new or original work by assembling elements to form a coherent or functional whole, or reorganizing elements into a new pattern or structure; generating, planning, or producing; designing, constructing, developing, formulating, or authoring.

- Respond to calls for environmental justice by proposing a decision-making process about a sustainability issue that would expand the influence of marginalized communities whose livelihoods and wellbeing are affected by the decision.
- Articulate and employ diverse normative understandings or principles about the value of the natural world to generate alternative solutions to environmental problems.

- Propose a new sustainability policy that effectively addresses a problem of justice, equity, human or animal rights, or rights of nature.
- Create artistic representations of contemporary ethical debates or normative visions of sustainability.
- Design a new technology or product inspired by a particular normative vision of sustainability, such as environmental justice for marginalized communities.

## Concepts and Methods

Below is a summary of major concepts and methods associated with normative or values thinking about sustainability, adapted from Brundiers et al. (2023).

Concepts	Methods
Value self-awareness (what do I value?)	Envisioning methods (e.g., backcasting), in which visioning elements represent underlying values
Positionality, related privileges, normalized oppression, and biases	Individual values clarification methods (e.g., audit of individual or household energy consumption, moral dilemma discussions, role modeling)
Impacts on sustainability of colonialism, imperialism, capitalism, sexism, heterosexism, racism, ableism, ageism	Social values identification methods (e.g., surveys, interviews, focus groups, giving-voice-to-values, narrative research methods, philosophical debate, discourse analysis)
Intrinsic versus extrinsic values, worldviews, ethics, morals and moral obligations/ duties, religious values; legal pluralism, human rights, animal rights, and rights of nature, etc.	Multi-criteria assessment methods (normative component of assessment methods such as Life-Cycle Assessment, Multi-Attribute Utility Theory, Alternatives Assessment, sustainability indicators, cost-benefit analysis, etc.)
Sustainability principles, goals, targets, thresholds (tipping points)	Methods for power/equity analysis
Concepts of sustainability and justice: environmental justice (distributive, procedural, recognition, restorative, and epistemic justice, and just transitions); racial, economic, and gender justice; intergenerational and interspecies justice	Risk analysis, especially involving the interaction of cumulative environmental risks and social vulnerabilities
Concepts of fairness, equality, equity, responsibility, safety, well-being, social-ecological integrity, resilience, the precautionary principle	Sustainability efficiency analysis
(Un)sustainability of past, current or future states, (un)sustainability of current	Participatory methods (e.g. negotiation methods, reconciliation, consensus)

Concepts	Methods
<p>practices for ecosystem diversity and health, planetary boundaries</p> <p>Concepts of risk, harm, damage, dissent, power relations, imbalances, hegemonies</p> <p>Concept of reinforcing gains ("win-win") and tradeoffs</p>	<p>building, collective-memory work, action research conversations)</p>

## Pedagogies and Assessments

Below are links to example lesson plans, assignments, and assessments of student learning about normative or values thinking and sustainability.

### Natural Sciences

#### *Biology*

[The Demise of the Monarch Butterfly](#)

[Indigenous Food Relationships](#)

[Biology and Sustainability: Linkages to Buddhist and Indigenous Philosophical Perspectives](#)

[Biogeosciences—The Sixth Extinction Reading Quiz](#)

[Biogeosciences—The Sixth Extinction Letter to Potential Donors Assessment](#)

[Environmental Science—Scientific Debate and the Nature of Certainty Assessment](#)

#### *Environmental Geology*

[Land-Use Change and Stakeholders Simulation](#)

### Social Sciences

[Green Political Thought](#)

[Race, Space, and Environmental Justice](#)

[Land Use, Climate Change, and Cultural Imperialism in the Philippines and Malaysia](#)

[Land Use and Cultural Imperialism Writing Assessment](#)

[Geoscience Ethics Assessments](#)

### **Arts & Humanities**

[Applying Environmental Ethics to Current Events and Individual Choices](#)

[Environmental Ethics: Obligations to Nature](#)

[Global Environmental Literature: Consumerism at Home and around the Globe](#)

[Personal Waste Assessment and Performance](#)

[“Victorian Literature - Writing Water Then and Now” Writing Rubrics](#)

[Ethics of Fast Fashion Assignment Rubric](#)

### **Engineering**

[Sustainability and Robotics](#)

[Selecting Sites for Renewable Energy Projects](#)

[Colorado River Water Supply and Adaptation Strategies](#)

### **Business and Economics**

[Management: Creating Social, Environmental, and Economic Value](#)

[Sustainable Business Development: Roles of Consumers, Government, Private Institutions](#)

[Sustainable Behavior of Consumers, Firms, and Societies](#)

[Sustainable Global Enterprise](#)

[Building a Sustainable Future: Business Model Innovation as a Force for Good](#)

[Economics of Water Allocation Footprints Summative Assessment](#)

### **Health and Social Work**

[Epidemiology, Environmental Health, and Ethics](#)

[The Food We Eat Can Have a Positive Impact on Climate Justice](#)

[Tracking the Carbon Footprint and Medical Waste in Drug Design](#)

[The Impact of Globalization on Diet and Culture](#)

[Environmental Justice and Freshwater Resources Summative Assessment](#)

[Women, Children, Poverty and Water Assessment](#)

[Food Systems in Action Summative Assessment](#)

### **Law and Policy**

[The Externalities Game: Environmental Externalities, Collective Action Problems, and Negotiations](#)

[Greenhouse Gas Emissions Reduction Legislation Role-Play Exercise](#)

[Energy Culture as a Determinant of Countries' Positions in Climate Negotiations](#)

[Carbon Emissions Game and Op-Ed Writing Assessment](#)

[Managing the Risks of Lead Exposure](#)

### **Interdisciplinary**

[The Lifestyle Project: Reducing Personal Environmental Impacts](#)

[Egoism, the Tragedy of the Commons, Carbon Footprints, and Corporate Sustainability](#)

Ethical Implications of Climate Change - [Course](#) and [Syllabus](#)

[Environmental Justice in the Water Wars of Cochabamba, Bolivia Assessment](#)

### **Scholarship of Teaching and Learning**

Below are examples of research on teaching and learning about the normative and values thinking sustainability competency.

### **Natural Sciences**

[Integrating Green Chemistry into Chemistry Education](#)

[Education for Sustainability Meets Confucianism in Science Education](#)

[Environmental Sustainability in Education: Integration of Dilemma Stories into a STEAM Project in Chemistry Learning](#)

[Indigenous Values and Sustainability](#)

**Social Sciences**

[Disciplinary and Theoretical Approach to the Pro-Environmental Orientation of the Education for Sustainable Development](#)

[Curriculum for Citizenship and Sustainability](#)

[Sustainable Development and Values Education in the Jordanian Social Studies Curriculum](#)

**Arts & Humanities**

[Aesthetics and Education for Sustainability](#)

[Arts and Design Education for Sustainable Development](#)

[Art, Sustainability and Partnerships](#)

[Environmental Philosophy: A Biocultural Ethic Approach to Education and Ecotourism for Sustainability](#)

**Engineering**

[Sustainability Awareness in Engineering Curriculum through a Proposed Teaching and Assessment Framework](#)

[Sustainable Engineering Ethics: Teaching Sustainability as a Macroethical Issue](#)

[Teaching Ethics and Sustainability to Informatics Engineering Students, an almost 30 Years Experience](#)

[Engineering Students' Human Values as Rhizomatic Lines of Sustainability](#)

[Engineering Students' Conceptualizations of Sustainability](#)

[Design for Impact \(D4I\): A Framework for Teaching Sustainability in Engineering Design](#)

**Business and Economics**

[Emerging Perspectives On Sustainability In Business Schools: A Systematic Literature Review Of Pedagogical Tools In Teaching Sustainability](#)

[Reframing Business Sustainability Decision-Making with Value-Focussed Thinking](#)

[Thinking Globally, Teaching Sustainability: Embedding Sustainability in International Business Studies and Addressing Student Responses](#)



[Sustainability, Human Values and the Education of Managers](#)

### **Health and Social Work**

[Exploring the Potential of Ethics of Care for a Transformative Perspective of Sustainability in Social Work Education](#)

[Sustainability and the Common Good: Catholic Social Teaching and 'Integral Ecology' as Contributions to a Framework of Social Values for Sustainability Transitions](#)

### **Law and Policy**

[The Impact of Sustainability Awareness and Moral Values on Environmental Laws](#)

[Centring Knowledge Democracy within Policy-Making for Sustainability and Resilience: A Discussion of the Kenyan Drylands](#)

### **Interdisciplinary**

[Values Education for Sustainability in a Global Culture](#)

[The New Unimore Interdisciplinary Teaching on Transversal Sustainability Skills](#)

[Integrating Character Education and the Values Aspect of Environmental and Sustainability Education: An Interdisciplinary Study Exploring Common Ground, Tensions, and Feasibility](#)

[Holding Complexity: Lessons from Team-Teaching an Interdisciplinary Collegiate Course on Urban Sustainability](#)

[Approaching Vagueness: Teaching Critical Thinking with Sustainability as Metaphor](#)

## 5. Strategic Thinking Competency

### Definitions

<p><b>UNESCO:</b> Strategic thinking</p>	<p><b>UNESCO:</b> the ability to collectively develop and implement innovative actions that further sustainability at the local level and further afield.</p>
<p><b>KCSF:</b> Strategic thinking</p>	<p><b>KCSF:</b> The ability to collectively design transformational systemic interventions, transitions, and governance strategies while accounting for strategic leverage points, power dynamics, uncertainty and surprises as well as social and organizational learning in navigating these strategies.</p>

### Learning Outcomes

Here we provide examples of student learning outcomes associated with the strategic thinking competency, organized according to Bloom's Taxonomy (see Appendix A), from simpler to more complex learning objectives. These learning outcomes are drawn from Brundiers et al. (2023), and supplemented by ASUSOS (n.d.), CPAPP (2023), and Södertörn University (2022).

**Remember:** Recalling facts and concepts, including retrieving, recognizing, and recalling relevant knowledge from long-term memory.

- Describe the basic structure of building strategies for change (strategies such as transitions, interventions, resilience, and adaptation) toward sustainability.
- Describe some benefits of strategic thinking in sustainability problem-solving.

**Understand:** Constructing meaning from oral, written, and graphic messages by exemplifying, classifying, summarizing, inferring, locating, recognizing, reporting, translating, or explaining.

- Explain basic concepts of intentionality and decision-making in sustainability strategy.
- Explain common decision dilemmas in strategic interaction (i.e., situations with several actors who are entirely or partly dependent on each other for important outcomes) from the perspectives of individuals and systems.
- Explain theories of change relevant to sustainability.
- Explain concepts such as barriers, power dynamics, assets, roles, effectiveness, etc. as part of the overarching concepts of sustainability transitions, social learning, and organizational change.

- Explain concepts of strategic thinking as they relate to sustainability, such as leverage points, transition agendas, feasibility, stakeholder alliances and resistance.
- Explain strategic thinking regarding goal conflicts in biological, economic, and social systems.
- Explore strategies that could ensure that one's personal and job activities positively contribute to sustainability transitions.

**Apply:** Using information in new situations, or carrying out a procedure for executing, implementing, solving, interpreting, operating, or sketching.

- Describe how strategic thinking can be applied successfully to sustainability problems and how sustainability can be incorporated into strategic concepts.
- Define and apply sustainability strategies to one's academic program, campus operations, or campus-community relationships.
- Apply strategic thinking about sustainability in simulations or actual interactions with others through role-plays, games, or campus or community policy deliberations.

**Analyze:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose, differentiating, organizing, comparing, contrasting, distinguishing, examining, experimenting, questioning, or testing.

- Assess how natural, economic, and social systems interact to foster or prevent sustainability.
- Analyze and explain local, national, or global sustainability strategies, policies, or governance using a multidisciplinary approach.

**Evaluate:** Making judgments based on criteria or standards by checking, critiquing, weighing, arguing, defending, judging, or justifying a position.

- Identify factors that affect the success or failure of sustainability transitions and interventions.
- Measure the effectiveness of strategies against sustainability goals and targets on individual and organizational levels.
- Reason about ethical dilemmas in strategic interaction.
- Evaluate and contrast research methods to investigate strategic thinking.
- Critically reflect on one's own approach to strategic thinking about sustainability regarding effectiveness, alliances, and outcomes.
- Reflect on one's own behaviors, interpretations, and impulses in situations involving strategic interaction.

- Integrate sustainability principles into the development of one's personal and professional plans.

**Create:** Producing new or original work by assembling elements to form a coherent or functional whole, or reorganizing elements into a new pattern or structure; generating, planning, or producing; designing, constructing, developing, formulating, or authoring.

- Design and conduct a participatory action research project with a community partner aimed at identifying and advancing sustainability policies, practices, or products.
- Create a strategy for addressing a sustainability problem including scoping, goal setting, identifying targets and milestones, developing timelines, and developing assessment methods.
- Design strategies that intervene in a defined system or problem constellation, such as how to make your campus or a particular industry more sustainable.
- Select, modify, combine and apply appropriate strategic thinking tools and methods (e.g. risk assessments, transition management, gap analysis and SWOT analysis) for constructing strategies and interventions leading to sustainable solutions.
- Propose reforms of corporate or government policy or governance to address sustainability challenges.
- Design movements, campaigns, and other large-scale interventions for sustainability by choosing and integrating [social change methods](#).

## Concepts and Methods

Below is a summary of major concepts and methods associated with strategic thinking and sustainability, adapted from Brundiens et al. (2023).

Concepts	Methods
Intentionality, goals, objectives	Methods to design governance arrangements, policies, institutions, incentives and incentives structures
Mitigation and adaptation	
Leverage points: legal/regulatory, economic, social, educational	Methods to assess their effectiveness
Disruption, transgression, and creative destruction	Decision support methodologies
Measures of success, viability, feasibility, effectiveness	Transition management methodology

Concepts	Methods
Obstacles and barriers: resistance, reluctance, path dependency, habits, unintended consequences, inertia	Organizational (change) management, including methods to support social learning and reflexivity
Synergies	Participatory Action Research
Instrumentalization and alliances: critical friends, stakeholder networks, power dynamics	Methods to support changes in habits, behaviors and practices, including social-emotional learning to develop motivation to act, designing campaigns and movements, community organizing, etc.
Social learning: real world implications, political understanding, intervention timing, tuning for audience	Methods to build networks, form connections, identify allies
Social movements, resource acquisition and mobilization	Power analysis and mapping

## Pedagogies and Assessments

Below are links to example lesson plans, assignments, and assessments of student learning about strategic thinking and sustainability.

### Natural Sciences

[Renewable Energy and Environmental Sustainability](#)

[Coastal Processes, Hazards, and Society](#)

[Biogeochemical Assessment - Nutrient Challenge](#) (and [rubric](#))

[Biogeochemistry Assessment - Water Balance](#) (and [rubric](#))

[Addressing Energy-Related Environmental Injustice](#) (and [rubric](#))

### Social Sciences

[Lead in the Environment: Addressing Child Lead Poisoning](#)

[Community Flood Risk Assessment from Rising/Surging Seas Project](#)

[Mock United Nations Climate Negotiations Exercise](#) (and [rubric](#))

[Principles of Environmental Campaigns](#)

[Social Construction of E-Waste Issue and Campaigns](#)

[Global Strategic Communication Capstone](#)

[Environmental Advocacy Project](#)

[Carbon Emissions Regulation Op-Ed](#)

[Post-Disaster Recovery Plan](#) (and [rubric](#))

## **Arts & Humanities**

Digital Photography: Visualizing Sustainability Data Related to a Campus Sustainability Strategic Plan ([syllabus](#) and [assignment](#)).

[Designing Virtual Reality and Games to Teach Sustainability Strategies](#)

[Rhetorical Analysis of Community Organization's Strategic Communication about Water](#)

## **Engineering**

[Biomaterial Characterization - Green Design](#) (slide deck)

[Reinforced Concrete Design](#)

[Using MATLAB to Analyze Campus Waste Data and Create Recommendations](#)

[Diversity, Design, and Innovation in STEM](#)

[Urban Water Planning and Decision-Making Group Activity](#) (and [rubric](#))

## **Business and Economics**

[Business Strategy for Sustainability](#)

[Digital Strategies for Sustainability in Global Markets](#)

[Global Business Perspectives \(Management in Spain\)](#)

[Contemporary Business Issues: Climate Change](#)

[Hotel Management Simulation: Net Zero Climate Emissions](#)

[Making Sustainable Business Decisions in Four Different Industries and Their Effect on People \(Social\), Planet \(Environment\), and Profit \(Economics\)](#)

[The True Cost of Burning Coal](#)

## B-Academics

### **Health and Social Work**

[Environmental Health \(including Risk Management Strategies\)](#)

[Infancy, Environmental Impacts on Maternal & Infant Health](#)

[Courting Environmental Justice: Science, Community Knowledge and Public Health](#)

[Bridging Computer Science and Sustainable Transportation to Design an Equitable Green Future](#)

### **Law and Policy**

[Environmental Policy and Politics](#)

[Introduction to Environmental Policy](#)

[Policy and Governance in Sustainable Systems](#)

[Law, Sustainability, and Development](#)

[Using Sim City for Learning Sustainability](#)

### **Interdisciplinary**

[Adapting to a Changing World](#)

[Environmental Management for Sustainability](#)

[Using Food Security in Introduction to Urban Sustainability](#)

[Map Your Local Hazards Module](#)

[Hydrotopia—Toward a Hydraulic Society in the American West](#)

[Interdisciplinary Problem-Solving Project for the Science Classroom \(and \[assessment guide\]\(#\)\)](#)

[A Game-Based Social Resilience Workshop: Thinking about Communal Response to Change \(and \[assessment guide\]\(#\)\)](#)

[Lead Change. Change the World](#)

## Scholarship of Teaching and Learning

Below are examples of research on teaching and learning about the strategic thinking sustainability competency.

### Natural Sciences

[Using COVID-19 to Teach Sustainability Futures Thinking](#)

### Social Sciences

[Social Science Pedagogy as a Way of Integrating Sustainable Education and Global Citizenship into the Initial Training of Pre-Primary Teachers](#)

### Arts & Humanities

[Explorations in Teaching Sustainable Design: A Studio Experience in Interior Design/Architecture](#)

[Strategic Thinking on the Teaching Reform of Environmental Design from the Future to the Present](#)

### Engineering

[Design for Impact \(D4i\): A Framework for Teaching Sustainability in Engineering Design](#)

[Sustainable Architectural Design Education: A Pilot Study in a 3rd Year Studio](#)

### Business and Economics

[Integrating Sustainability into Strategic Decision-Making: A Fuzzy AHP Method for the Selection of Relevant Sustainability Issues](#)

[The Need for Sustainability and CSR in Undergraduate Business Education](#)

[Corporate Strategy for Sustainability: Reflections of Prospective Entrepreneurs](#)

### Health and Social Work

[PH WINS and the Future of Public Health Education](#)

### Law and Policy

[The Role of Environmental Law Education for Sustainable Development](#)



**Interdisciplinary**

[Ground Truths: Community-Engaged Research for Environmental Justice](#)

[Developing a Multi-Hazard Mitigation Strategy](#)

[How to Become a Better Strategic Thinker](#)

[Active Learning as Enabler of Sustainability Learning Outcomes: Capturing the Perceptions of Learners During a Materials Education Workshop](#)

[A Design Thinking Approach to Teaching Sustainability](#)

[Strategic Sustainability by Serious Gaming: A Case Study of STRASUS](#)

## 6. Collaboration or Interpersonal Thinking Competency

### Definitions

<p><b>UNESCO:</b> Collaboration</p>	<p><b>UNESCO:</b> The ability to learn from others; to understand and respect the needs, perspectives, and actions of others (empathy); to understand, relate to, and be sensitive to others (empathic leadership); to deal with conflicts in a group; and to facilitate collaborative and participatory problem-solving.</p>
<p><b>KCSF:</b> Interpersonal</p>	<p><b>KCSF:</b> The ability to motivate, enable, and facilitate collaborative and participatory sustainability research and collective problem-solving processes, and facilitate multi-, inter-, and transdisciplinary knowledge building and integration, which includes Western scientific knowledge as well as traditional ecological knowledge and indigenous knowledge and wisdom.</p>

### Learning Outcomes

Here we provide examples of student learning outcomes associated with the collaboration or interpersonal thinking competency, organized according to Bloom's Taxonomy (see Appendix A), from simpler to more complex learning objectives. These learning outcomes are drawn from Brundiers et al. (2023), and supplemented by ASUSOS (n.d.), Hmelo-Silver (2004), and Suffolk University Boston (n.d.).

**Remember:** Recalling facts and concepts, including retrieving, recognizing, and recalling relevant knowledge from long-term memory.

- State the basic types, phases and techniques of teamwork and stakeholder engagement in sustainability projects.
- Define what interdisciplinary and transdisciplinary collaboration mean.
- List some of the benefits of interpersonal competency in sustainability problem solving.

**Understand:** Constructing meaning from oral, written, and graphic messages by exemplifying, classifying, summarizing, inferring, locating, recognizing, reporting, translating, or explaining.

- Explain general concepts critical to interpersonal interactions, including listening, oral/written communication, negotiation, conflict management and resolution, teamwork, stakeholder engagement, empathy, etc.
- Explain the basic benefits of listening, communication, teamwork, stakeholder engagement, and other interpersonal skills for one's personal (social) activities, civic engagement, and professional job.
- Understand the dynamics of effective group communication.

- Describe the characteristics and best practices of interpersonal communication and collaboration, teamwork, and project engagement.
- Understand the importance of a shared goal.
- Identify different groups of stakeholders relevant to a project.
- Identify for each of the different groups of stakeholders the appropriate communication approaches (medium, language, message) to engage them.

**Apply:** Using information in new situations, or carrying out a procedure for executing, implementing, solving, interpreting, operating, or sketching.

- Work effectively and respectfully in teams on projects, employing teamwork and project management concepts and tools.
- Demonstrate leadership skills both as a team leader and team member by overcoming barriers to collaboration, motivating team members, resolving conflicts, and ensuring the well-being of oneself and one's team.
- Demonstrate professional behavior as a team member and in stakeholder engagements by providing and receiving constructive feedback, coping with unanticipated challenges and high stress levels, and navigating disagreement and misunderstandings.
- Conduct stakeholder interviews in lower risk settings and identify and empathize with different perspectives and values.
- Participate in stakeholder engagements in supportive roles to allow for participatory observation/learning and practicing.
- Demonstrate team skills, including conflict resolution, negotiation, compromise, trust building and professional conduct.

**Analyze:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose, differentiating, organizing, comparing, contrasting, distinguishing, examining, experimenting, questioning, or testing.

- Analyze an audience in order to appropriately translate complex sustainability issues and convey effective messages using various communication platforms.

**Evaluate:** Making judgments based on criteria or standards by checking, critiquing, weighing, arguing, defending, judging, or justifying a position.

- Critically reflect on a team's and one's own communication and collaboration preferences and approaches.

**Create:** Producing new or original work by assembling elements to form a coherent or functional whole; reorganizing elements into a new pattern or structure through

generating, planning, or producing; designing, constructing, developing, formulating, or authoring.

- Design a process to engage stakeholders, the campus, or the community to address an environmental risk or sustainability policy decision.
- Facilitate a process for engaging the campus or the community in making sustainability policy recommendations by employing empathy and respecting values, beliefs, and norms of others.
- Apply the problem-based learning cycle (identify facts, generate hypotheses, identify knowledge deficiencies, apply new knowledge, abstraction, evaluation) to address a unique sustainability situation.
- Collaboratively organize an arts festival, teach-in, performance, or event about sustainability issues on your campus or in your community.

## Concepts and Methods

Below is a summary of major concepts and methods associated with the collaboration or interpersonal competency, adapted from Brundiers et al. (2023).

Concepts	Methods
<p>Functions, types, and dynamics of collaboration and stakeholder engagement (within and beyond academia; interdisciplinarity, transdisciplinarity)</p> <p>Strengths, weaknesses, success, and failure in teams; different levels of teamwork (ranging from information exchange to co-creation)</p> <p>Concepts of leadership, including personal and interpersonal leadership (e.g., distributed, transformative, pedagogic leadership)</p> <p>Concepts of trans-cultural thinking, pluralism, diversity</p> <p>Limits and opportunities of cooperation, competition, empathy (on individual and group levels), and compassion</p>	<p>Stakeholder analysis (e.g., interest vs. power matrix, who to include, why or why not?)</p> <p>Participatory methods involving stakeholders, including negotiation, mediation, deliberation, constructive conflict management methodology, consensus strategies, cooperative inquiry, integrative design</p> <p>Participatory methods for facilitation and reflection on group processes and structures</p> <p>Teamwork methods, such as developing team contracts, interpersonal communication (written, verbal, non-violent communication), and methods to resolve conflicts in teams</p> <p>Methods for mindfulness, compassion and empathy building in responsible decision</p>

Concepts	Methods
Concepts of solidarity, ethnocentrism, deceleration, bias towards ingroups Concepts of conflict management Concepts of emotional intelligence and multiple-intelligences framework	making; enhancing capacities to engage in discussion with open-mindedness and in a non-judgmental manner  Interdisciplinary and transdisciplinary research approaches, participatory action research, community-engaged research

## Pedagogies and Assessments

Below are links to example lesson plans, assignments, and assessments of student learning about the collaboration or interpersonal competency and sustainability.

### Natural Sciences

#### [Environmental Science](#)

[Addressing Energy-Related Environmental Injustice](#) (activity)

[Impacts of Environmental Change on Horses](#) (assessment)

[Geoscience Undergraduate Curricula](#) (collaborative research project)

[Global Changes and Sustainability](#) (collaborative research project)

### Social Sciences

[Community-Driven Research and Environmental Justice](#)

[Indigenous Sustainability & Environmental Justice](#)

[Stakeholder Collaboration: Organizing for Environmental Justice and Equitable Solutions](#)

[Stakeholder Outreach: Effective Communication of Complex Environmental Threats](#)

[Society & Sustainability](#)

[Environmental Stewardship and Social Justice](#)

[Field Work Planning & Investigation](#) (assessment)

**Arts & Humanities**

[Finding Our Place on a Changing Planet](#)

[Sustainable World](#)

[Finding Our Place on a Changing Planet](#) (final project)

[Using Media to Document Public Attitudes on Waste](#) (film/video project)

**Engineering**

[Earth Systems Engineering and Management](#) (team project)

[Technological, Social, and Sustainable Systems](#) (interdisciplinary approach)

[Water Sustainability in Cities](#) (team project)

**Business and Economics**

[Indigenous Sustainability Entrepreneurship](#)

[Business Strategy for Sustainability](#) (team assignments)

[Digital Strategies for Sustainability in Global Markets](#) (team consulting project)

**Health and Social Work**

[Community-Based Participatory Research](#)

[Urban and Environmental Health](#)

[Environment, Health & Technology](#) (interdisciplinary approach)

**Law and Policy**

[Role of Science and Scientists in Collaborative Approaches to Environmental Policymaking](#)

[Natural Resource Policy and Sustainability](#) (collaborative governance module)

[Policy & Governance Of Sustainable Systems](#) (interdisciplinary, collaborative research)

[Policy & Governance of Sustainable Systems](#) (collaborative policy analysis)

**Interdisciplinary**

[Advanced Community Based Participatory Research](#)

[Collaborative Planning for Sustainability](#)

[Collaboration Leadership for Environmental Professionals](#)

[Team Contracts for Collaborative Work](#)

[AACU Teamwork Rubric](#)

[Peer Evaluation for Team Projects](#)

[Stakeholder Mapping](#)

[Project Based Learning](#)

## **Scholarship of Teaching and Learning**

Below are examples of research on teaching and learning about the collaboration or interpersonal thinking competency.

### **Natural Sciences**

[Collaboration and Sustainability: Making Science Useful, Making Useful Science](#)

[The Advantages of Collaborative Learning in Science Lessons](#)

[Who Produces Knowledge? Transforming Undergraduate Students' Views of Science through Participatory Action Research](#)

### **Social Sciences**

[Leaving the Lectures Behind: Using Community-Engaged Learning in Research Methods Classes to Teach about Sustainability](#)

### **Arts & Humanities**

[Research Informed Sustainable Development through Art and Design Pedagogic Practices](#)

[Merging the Arts and Sciences for Collaborative Sustainability Action: A Methodological Framework](#)

[Arts Education and Sustainability: Promoting Citizenship and Collaborative Work](#)

**Engineering**

[Cross-Institution Collaborative Learning \(CICL\) to Connect Water Resources Design with Sustainability Analysis](#)

[Teaching Students to Collaborate with Communities: Expanding Engineering Education to Create a Sustainable Future](#)

[A Design-Based Learning Approach for Fostering Sustainability Competency in Engineering Education](#)

[Collaborative Learning with Sustainability-Driven Projects: A Summary of the eps@isep Programme](#)

**Business and Economics**

[Transactional Learning and Sustainability Co-Creation in a University – Business Collaboration](#)

[A Collaborative Game-Based Learning to Enhance Ecological Economics Teaching](#)

[Co-learning for Sustainable Design: The Case of a Circular Design Collaborative Project In Ireland](#)

[Why Collaboration Will Be Key to Achieving the Sustainable Development Goals](#)

**Health and Social Work**

[Education for Sustainable Healthcare: A Transdisciplinary Approach to Transversal Environmental Threats](#)

[Community-engaged Sustainable Health Care Education](#)

**Law and Policy**

[Facilitating Collaborative Partnerships in Education Policy Research: A Case of Multi-Stakeholder, Co-Investigation for Monitoring and Evaluation of Education for Sustainable Development](#)

[Reflections on Integrating the Political into Environmental Education through Problem-Based Learning and Political Ecology](#)

**Interdisciplinary**

[Student-Centered Learning and Sustainability: Solution or Problem?](#)



[Mapping a Sustainable Future through Conceptualization of Transformative Learning Framework, Education for Sustainable Development, Critical Reflection, and Responsible Citizenship: An Exploration of Pedagogies for Twenty-First Century Learning](#)

[Beyond Interpersonal Competence: Teaching and Learning Professional Skills in Sustainability](#)

[Learning Processes for Interpersonal Competence Development in Project-Based Sustainability Courses – Insights from a Comparative International Study](#)

[Community and Environmental Sustainability](#)

[Curriculum for Collaborative Learning in Sustainability at QUT](#)

[Social Design through Facilitation and Collaboration: Sustainability Education Experiments in Planning and Design Courses](#)

[Collaborative Learning Techniques: A Handbook for College Faculty](#)

[Getting Started With Team-Based Learning](#)

## 7. Critical Thinking Competency

<p><b>UNESCO:</b> Critical thinking</p> <p><b>GCSE:</b> (Not applicable)</p>	<p><b>UNESCO:</b> The ability to question norms, practices, and opinions; to reflect on one's values, perceptions, and actions; and to take a position in the sustainability discourse.</p>
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### Student Learning Outcomes

Here we provide examples of student learning outcomes associated with the critical thinking competency, organized according to Bloom's Taxonomy (see Appendix A), from simpler to more complex learning objectives. Some of these learning outcomes are adapted from the cognitive learning objectives for the United Nations Sustainable Development goals suggested in UNESCO (2017), as well as NIES (n.d.), ASUSDP (n.d.), SNSM (n.d.).

**Remember:** Recalling facts and concepts, including retrieving, recognizing, and recalling relevant knowledge from long-term memory.

- Define the pillars of sustainability – economic, environmental, and social – and why they are interrelated.
- Identify which human activities – on a global, national, local and individual level – contribute most to climate change.
- Recall statistics that describe inequalities of access to and attainment of sustainability education, and major reasons for these inequalities.
- Identify different energy resources and their respective advantages and disadvantages for sustainability.

**Understand:** Constructing meaning from oral, written, and graphic messages by exemplifying, classifying, summarizing, inferring, locating, recognizing, reporting, translating, or explaining.

- Explain trends and relationships in graphical data about sustainability issues.
- Find your own examples of sustainability-related journalism, or advertising or other strategic communication; summarize and question their claims.
- Drawing on research literature, explain why health campaigns succeed or fail to promote environmental health and well-being.

- Provide examples that demonstrate how education and lifelong learning opportunities for all can be key drivers of sustainable development.
- Summarize ways in which gender, income, race, ethnicity, religion, physical ability, or other factors affect the distribution of environmental burdens and benefits, and opportunities to participate in environmental decision making.
- Distinguish key concepts in sustainability – such as extreme and relative poverty, traditional environmental risk assessment and cumulative impacts assessment, etc.) and critically reflect on their underlying empirical and normative assumptions.
- Explain how sustainability problems are often characterized by uncertainty, complexity, and/or normative ambiguity or conflict.

**Apply:** Using information in new situations, or carrying out a procedure for executing, implementing, solving, interpreting, operating, or sketching.

- Apply sustainability-related conceptual frameworks, techniques, or tools in your discipline to represent the causes, scope, and/or potential remedies for a sustainability issue or problem.
- Use an online calculator to calculate your personal carbon, water, or waste footprint.
- Apply discipline-specific and context-specific skills for communicating standpoints on sustainability issues effectively through writing, speaking, and other forms of public discourse.

**Analyze:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose, differentiating, organizing, comparing, contrasting, distinguishing, examining, experimenting, questioning, or testing.

- Compare and contrast the major models of sustainability (such as the three pillars, the sustainability doughnut etc.) or sustainability discourses (conservation, preservation, environmental justice, etc.) – to identify their advantages, assumptions, and omissions.
- Identify and distinguish examples and techniques of advertising, strategic communication, journalism, research, and other forms of sustainability-related discourse.
- Analyze power structures and social and cultural systems that shape individual and communal life, social choices, and humanity's impact on the natural world in a local, national, or global context.
- Identify embedded biases and assumptions in social, political and economic systems and discourses as they shape human impacts on the natural world.

**Evaluate:** Making judgments based on criteria or standards by checking, critiquing, weighing, arguing, defending, judging, or justifying a position.

- Assess the accuracy and credibility of sustainability-related claims in examples of advertising, journalism, policy platforms, political communication, and other forms of public discourse.
- Evaluate and compare the sustainability of your and other communities' systems in meeting their needs for food, energy, transport, water, safety, waste treatment, inclusion or accessibility, education, integration of green spaces and disaster risk reduction.
- Assess the strengths, weaknesses, and gaps in your own sustainability education, including at your current institution.
- Conduct a failure analysis on a technology or technical system.
- Draw on rationales and frameworks for civic, professional, and personal engagement to articulate your role in contributing to a more sustainable world.
- Evaluate complex and changing problems from multiple analytical perspectives, considering alternative solutions and diverse ethical and cultural approaches.

**Create:** Producing new or original work by assembling elements to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing; designing, constructing, developing, formulating, or authoring.

- Develop an argument supported by evidence about how to address a sustainability challenge, such as renewable energy generation, participatory sustainable development, reducing plastics pollution, etc.
- Conduct original research on a sustainability issue and draw recommendations based on your evidence about norms, practices, or policies for individuals, groups, or societies.
- Develop informed judgments about the value and risk of emerging technologies for addressing sustainability.
- Design or redesign a technology that addresses an unsustainable norm, practice, or impact in your field.
- Create an artwork that represents a vision of a sustainable norm or practice, or well-researched recommendations for how to use materials more sustainably in a particular artistic medium.

## Concepts and Methods

Below is a summary of major concepts and methods associated with the critical thinking competency, adapted from UNESCO (2017), as well as NIES (n.d.), ASUSDP (n.d.), SNSM (n.d.).

Concepts	Methods
<p>Models of sustainability, sustainable development, and environmental justice</p> <p>Environmental discourses: conservation, preservation, animal liberation, rights of nature, anthropocentrism and ecocentrism, etc.</p> <p>Frameworks for sustainability education, including competencies, skills, knowledge, etc.</p> <p>Environmental uncertainty, complexity, and/or normative ambiguity or conflict</p>	<p>Textual interpretation: content analysis, discourse analysis, narrative analysis, etc.</p> <p>Techniques for analyzing argumentation and for surfacing and questioning assumptions (ideological analysis, analysis of stereotypes and biases, deconstruction, etc.)</p> <p>Environmental mapping (e.g., of burdens and amenities as they relate to race or income of populations)</p> <p>Environmental ethnography and auto-ethnography (photovoice, etc.)</p> <p>Curriculum and pedagogy design and assessment</p> <p>Evaluation research methods</p> <p>Risk assessment, alternatives assessment, vulnerabilities assessment, and analysis of cumulative impacts of risks</p> <p>Legal and policy analysis</p> <p>Failure analysis</p>

## Pedagogies and Assessments

Below are links to example lesson plans, assignments, and assessments of student learning about critical thinking and sustainability.

### Natural Sciences

[Developing Student Literacy on Risk, Resilience, and Strategies for Living with Disaster Uncertainty](#)

[Top 15 World Agricultural Commodities—Summative Assessment](#)

**Social Sciences**

[Know Your Audience! Audience Analysis Exercise to Increase Audience Centered Communication and Teaching of Risk and Resilience](#)

[Environmental Justice](#)

[Society and Sustainability](#)

[Urban Sustainability](#)

**Arts & Humanities**

[Exploring Environmental and Sustainability Issues and Policy Using Film](#)

[Writing and Critical Reasoning Issues in Sustainability](#)

[Issues in Sustainability](#)

[Writing about Sustainability](#)

**Engineering**

[Environmental Sustainability](#)

[Sustainability in Engineering](#)

[Failure Analysis](#)

**Business and Economics**

[Sustainability Reporting](#)

[Sustainable Business](#)

[Sustainability Driven Innovation](#)

**Health and Social Work**

[Climate Change, the Environment, and the Future of Public Health](#)

[Sustainability, Medicine, & Health](#)

[Introduction to Environmental Health](#)

**Law and Policy**

[Analysis Of Environmental Impact](#)

[Environmental Policy Analysis](#)

[Introduction to Environmental Policy and Planning](#)

[Environmental Law](#)

### **Interdisciplinary**

[Pathways to Sustainability – An Interdisciplinary Approach](#)

[Interdisciplinary Methods in Social-Ecological Research](#)

[Sustainability Project Assessment Rubric](#)

[Critical Thinking and Reflection Assessment Rubric](#)

[AACU VALUE Rubric for Critical Thinking](#)

### **Scholarship of Teaching and Learning**

Below are examples of research on teaching and learning about critical thinking and sustainability.

#### **Natural Sciences**

[Emerging Ideas in Sustainability Science: Critical Thinking and Lifelong Environmental Learning](#)

[Critical Thinking and Normative Competencies for Sustainability Science Education](#)

[The Trend of Critical Thinking Studies in Biology Education through Online Learning: A Systematic Review](#)

[Critical Thinking Skills of Environmental Changes: A Biological Instruction Using Guided Discovery Learning-Argument Mapping](#)

[Developing Critical Thinking Skills towards Biology Course Using Two Active Learning Strategies](#)

[Promoting Critical Thinking In General Biology Courses: The Case Of The White Widow Spider](#)

**Social Sciences**

[Social Science Pedagogy as a Way of Integrating Sustainable Education and Global Citizenship into the Initial Training of Pre-Primary Teachers](#)

[Leaving the Lectures Behind: Using Community-Engaged Learning in Research Methods Classes to Teach about Sustainability](#)

[Disciplinary-specific Critical Thinking in Sociology](#)

[Political Discourses as a Resource for Climate Change Education: Promoting Critical Thinking by Closing the Gap between Science Education and Political Education](#)

**Arts & Humanities**

[Making and Assessing Art in the Sustainability Classroom](#)

[Critical and Creative Thinking as a Form of Making in Art Education](#)

**Engineering**

[Supporting Sustainability Thinking in Postgraduate Design Education](#)

[Fostering Sustainability and Critical Thinking Through Debate—A Case Study](#)

[Sustainability and Critical Thinking in Civil Engineering Curriculum](#)

[Development of the Consumption Journey Tool to Improve Awareness and Critical Thinking on Sustainability in Engineering Students](#)

[Engineering Students' Conceptualizations of Sustainability](#)

**Business and Economics**

[Critical Approaches to Sustainability in the Business Communication Classroom: A Developmental Perspective](#)

[An Assessment of Critical Reflection in Management Education for Sustainability: A Proposal on Content and Form of Shared Value Rationality](#)

[Sustainable Business Ethics Education](#)

**Health and Social Work**

[Promoting Critical Thinking through Socratic Questions in Health Sciences Work-Integrated Learning](#)



[Environmental Social Work: Implications for Accelerating The Implementation of Sustainable Development in Social Work Curricula](#)

[Sustainability, Human Rights, and Environmental Justice](#)

### **Law and Policy**

[Environment and Sustainability Education Research as Policy Engagement: \(Re-\) Invigorating 'Politics as Potentia' in South Africa](#)

[Embedding Sustainability Literacy in the Legal Curriculum: Reflections on The Plymouth Model](#)

[Teaching Water Resource Economics for Policy Analysis](#)

### **Interdisciplinary**

[Emerging Ideas in Sustainability Science: Critical Thinking and Lifelong Environmental Learning](#)

[Education for Sustainable Development and Critical Thinking Competency](#)

[Visual Literacy Intervention for Improving Undergraduate Student Critical Thinking of Global Sustainability Issues](#)

[Approaching Vagueness: Teaching Critical Thinking with Sustainability as Metaphor](#)

## 8. Self-Awareness or Intrapersonal Competency

### Definition

<p><b>UNESCO:</b> Self-awareness</p>	<p><b>UNESCO:</b> The ability to reflect on one’s role in the local community and (global) society; to continually evaluate and further motivate one’s actions; and to deal with one’s feelings and desires.</p>
<p><b>KCSF:</b> Intrapersonal</p>	<p><b>KCSF:</b> The ability to be aware of one’s own emotions, desires, thoughts, and behaviors as well as one’s positionality and role in global society and in the local community. Intrapersonal competency involves the ability to reflect and act with self-awareness and to regulate, motivate, and continually evaluate one’s actions and improve oneself, drawing on and developing emotional intelligence and resilience.</p>

### Learning Outcomes

Here we provide examples of student learning outcomes associated with the self-awareness or intrapersonal competency, organized according to Bloom’s Taxonomy (see Appendix A), from simpler to more complex learning objectives. Some of these learning outcomes are adapted from Brundiers et al. (2023) and UNESCO (2017).

**Remember:** Recalling facts and concepts, including retrieving, recognizing, and recalling relevant knowledge from long-term memory.

- Define key concepts – such as privilege, power, intersectionality, capabilities, emotional intelligence – as they relate to sustainability.

**Understand:** Constructing meaning from oral, written, and graphic messages by exemplifying, classifying, summarizing, inferring, locating, recognizing, reporting, translating, or explaining.

- Describe one’s positionality within the community and global society, and which aspects of one’s identity are sources of privilege and power related to sustainability.
- Identify personal experiences and observations related to power and positionality, and their effects on individual thoughts and feelings (of safety, compassion, stress, connection, etc.) about sustainability, and on the broader culture’s views of sustainability.

- Identify how fundamental human rights and capabilities relate to sustainability, and their impact on personal well-being.
- Identify personal perspectives and their potential influence on sustainability views and decisions (e.g., about design, policy, rights and responsibilities, etc.)
- Identify sources of personal risk and resilience in the face of sustainability challenges, such as climate grief, environmental trauma, etc.

**Apply:** Using information in new situations, or carrying out a procedure for executing, implementing, solving, interpreting, operating, or sketching.

- Apply self-reflective techniques and skills (mindfulness, meditation, faith-based practices, etc.) to identify and regulate one's thoughts and emotions about sustainability or in response to sustainability crises.
- Apply techniques for checking one's implicit and explicit biases towards other people and the natural world.
- Employ techniques for checking personal bias in data analysis (such as tests for intercoder reliability, etc.)

**Analyze:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose, differentiating, organizing, comparing, contrasting, distinguishing, examining, experimenting, questioning, or testing.

- Engage in reflexive journaling or auto-ethnography to identify formative events, people, media messages, and so on, in one's personal sustainability biography; compare and contrast the results with a different person's biography.

**Evaluate:** Making judgments based on criteria or standards by checking, critiquing, weighing, arguing, defending, judging, or justifying a position.

- Assess how increased self-awareness, emotional intelligence, and resilience impact decision-making and interactions in advocacy efforts, fostering personal growth and effectiveness.
- Evaluate potential impacts of one's positionality on data gathering, analysis and interpretation, and consider the ethical implications.
- Assess the similarities and differences between one's rights and one's actual capabilities to influence sustainability issues – as a consumer, citizen, community member, and professional.

**Create:** Producing new or original work by assembling elements to form a coherent or functional whole, or reorganizing elements into a new pattern or structure; generating, planning, or producing; designing, constructing, developing, formulating, or authoring.

- Develop comprehensive self-care plans that integrate mindfulness practices, emotional regulation techniques, and community support systems to enhance resilience and sustain engagement in sustainability work.
- Develop advocacy campaigns or policy proposals informed by principles of healing or restorative justice, that aim to address root causes of oppression and promote holistic well-being within one's own life and community.
- Design a technology or create an artwork that reinforces capacities for resilience and flourishing for oneself and others.
- Author personal accounts of one's roles, attitudes, and responsibilities concerning sustainability issues.
- Create a personal development plan (PDP) to reflect on one's sustainability-related learning, performance, and achievement and to plan for personal, educational, and professional development.
- Construct a portfolio or ePortfolio to compile sustainability-related work, reflect on growth, and share items with professors, advisors, and potential employers.

## Concepts and Methods

Below is a summary of major concepts and methods associated with the self-awareness or intrapersonal competency, adapted from GCSE (2024) and UNESCO (2017).

Concepts	Methods
<p>Intersectionality: how groups' and individuals' multiple sources of identities (race, gender, class, etc.) result in unique combinations of discrimination and privilege.</p>	<p>Autoethnography</p> <p>Environmental psychology (ecopsychology): research and practice of meditation, mindfulness, nature therapy, etc.</p>
<p>Positionality and role in global society and in the local community, including environmental, social, and economic privileges and burdens or oppressions</p>	<p>Feminist, Black Feminist, and Queer theory and research methods for studying intersectionality and positionality</p>
<p>Self-regulation, self-motivation, self-evaluation and improvement, resilience</p>	<p>Healing justice, restorative justice, and reconciliation for understanding trauma and resilience, self-care and collective care, confronting personal experiences of collective history, repairing unjust relationships</p>
<p>Emotional intelligence: Understanding and managing one's own emotions and the emotions of others</p>	
<p>Capabilities and flourishing: people's capacity to achieve the lives they value</p>	<p>Analysis of human capabilities, flourishing, wellbeing, and happiness</p>

Concepts	Methods
<p>and to flourish, rather than merely having the right or freedom to do so</p> <p>Nature deprivation and the healing benefits of time spent in nature</p>	<p>Role-plays and subsequent reflections on one's thoughts, feelings, and actions</p>

## Pedagogies and Assessments

Below are links to example lesson plans, assignments, and assessments of student learning about the self-awareness or intrapersonal competency and sustainability.

### Natural Sciences

[An Activity to Introduce the Geoscience Perspective](#)

[Data Set Analysis](#)

### Social Sciences

[Who am I in a Changing Climate?](#)

[Engaging Contentious Political Issues](#)

### Arts & Humanities

[A Sense of Place Collage Essay](#)

[Rethinking Sustainability through the Humanities: Multi-Sensory Experience and Environmental Encounter Beyond the Classroom](#)

[A Lifestyle Project for the Humanities](#)

### Engineering

[Examining your Earthquake Hazard](#)

[Seismic Evaluation of Buildings](#)

### Business and Economics

[Water Footprints](#)

[Climate Change from the Socio-Environmental Systems Perspective](#)

**Health and Social Work**

[Education, Social and Emotional Learning](#)

[Predictions and Evacuation](#)

**Law and Policy**

[The Lifestyle Project](#)

**Interdisciplinary**

[Contemplative Inquiry on Climate Change: Playing with Perspectives](#)

[Afghan Poppies, Climate Change and War: Thinking Systemically About Us and Them](#)

[Justice, Power, and Activism: What the Goldman Environmental Prize Winners Teach Us about Resilience and Democracy](#)

[Identifying Misconceptions & Logical Fallacies](#)

**Scholarship of Teaching and Learning**

Below are examples of research on teaching and learning about the self-awareness or intrapersonal competency.

**Natural Sciences**

[Enhancing Decision-Making in STSE Education by Inducing Reflection and Self-Regulated Learning](#)

[Teaching Methods in Biology Education and Sustainability Education Including Outdoor Education for Promoting Sustainability—A Literature Review](#)

**Social Sciences**

[How Teachers Can Open Up for and Handle Poignant Experiences of the Conflictual Aspects of Sustainability Issues](#)

[Political Emotions in Environmental and Sustainability Education](#)

[‘Doing’ Socio-Political Sustainability in Early Childhood: Teacher-as-researcher Reflective Practices](#)

**Arts & Humanities**

[Achieving Sustainability in the Philosophy of Art Teaching and Learning](#)

[How Philosophizing the Dialogos Way Can Promote Education for Sustainable Development](#)

[Drawing Sustainability: Helping Students to Know What They Know](#)

[From the Art of Reflection to the Art of Noticing: A Shifting View of Self-Tracking Technologies' Role in Supporting Sustainable Food Practices](#)

**Engineering**

[Self-evaluation of Industrial Case Studies with Iterative Improvements to Support Chemical and Biological Systems Engineering and Sustainability Teaching and Learning](#)

[Teaching Engineering Ethics with Sustainability as Context](#)

[Reshaping Teaching for Sustainability in Business Engineering – A Pilot Study on Students' Outlooks and Learning Expectations](#)

[Self-Evaluation and Reflection for Professional Development of Chemical Engineering Students](#)

[Implementation of Transformative Sustainability Learning into Engineering Curriculum](#)

**Business and Economics**

[The Strategic Process of Developing Social Aspects of Sustainability through the Vision Reflection in Business Education](#)

[Matching International Business Teaching with the UN Sustainable Development Goals: Introducing Bi-directional Reflective Learning](#)

[Sustainability in Management Education: Contributions from Critical Reflection and Transformative Learning](#)

**Health and Social Work**

[Sustainability Pedagogy in Practice: An Example from Health Education](#)

[Expanding the Ecological Consciousness of Social Work Students: Education for Sustainable Practice](#)

[Integrating the Natural Environment in Social Work Education: Sustainability and Scenario-based Learning](#)

[Encouraging Self-Reflection in Social Work Students: Using Personal Construct Methods](#)

### **Interdisciplinary**

[Beyond Colonial Futurities in Climate Education](#)

[A Competency Framework to Assess and Activate Education for Sustainable Development: Addressing the UN Sustainable Development Goals 4.7 Challenge](#)

[Inner Development Goals: Background, Method and the IDG Framework](#)

[Inner Development Goals Phase 2 Research Report](#)

[Reflective Practices in Sustainability Education](#)

[The Use of Reflective Pedagogies in Sustainability Leadership Education—A Case Study](#)

[Student Perceptions of Reflection and the Acquisition of Higher-Order Thinking Skills in a University Sustainability Course](#)



## 9. Integrated Problem-Solving

### Definitions

<p><b>UNESCO:</b> Integrated problem-solving</p>	<p><b>UNESCO:</b> The ability to apply different problem-solving frameworks to complex sustainability problems and develop viable, inclusive, and equitable solution options that promote sustainable development, integrating the other competencies.</p>
<p><b>KCSF:</b> Integrated problem-solving</p>	<p><b>KCSF:</b> The ability to solve complex sustainability problems in integrated ways, i.e., the ability to work with others to integrate problem analysis, sustainability assessment, visioning and strategy building, and to prepare for implementing the co-created solution in the real world. This includes the ability to articulate the individual contributions of the previous key competencies to sustainability problem-solving processes and being familiar with different problem-solving frameworks and able to select the appropriate one to develop viable solution options in context-sensitive ways, recognizing that sustainability problem-solving is a long-term, iterative and collective process between planning, realization, adjustment and evaluation.</p>

### Learning Outcomes

Here we provide examples of student learning outcomes associated with the integrated problem-solving competency, organized according to Bloom's Taxonomy (see Appendix A), from simpler to more complex learning objectives. These learning outcomes are drawn from Brundiers et al. (2023), supplemented by CREducation Project (n.d.) and Portland Community College (n.d.).

**Remember:** Recalling facts and concepts, including retrieving, recognizing, and recalling relevant knowledge from long-term memory.

- Define general concepts of sustainability transition, transformation, etc.
- Describe local or prominent cases of social movements and organizational changes for sustainability.
- Identify and define central and secondary sustainability problems, problem-solving styles or frameworks, and methods.

**Understand:** Constructing meaning from oral, written, and graphic messages by exemplifying, classifying, summarizing, inferring, locating, recognizing, reporting, translating, or explaining.

- Describe some benefits of the integrated problem-solving competency and explain how the sustainability problem-solving competency integrates other competencies.
- Discuss associations between disparate facts and methods, which may be cross-disciplinary.
- Understand the roles of collaboration, risk-taking, multi-disciplinary awareness, and imagination in achieving creative responses to problems.
- Describe the historical roots of sustainability problems.
- Describe theories and methods that help to address sustainability challenges.
- Describe sustainability problem-solving techniques used by professionals in your field.

**Apply:** Using information in new situations, or carrying out a procedure for executing, implementing, solving, interpreting, operating, or sketching.

- Apply knowledge or theories you have learned in one situation to address a new sustainability problem.
- Apply a problem-solving framework and/or methods to an emerging sustainability problem.
- Apply the sustainability problem-solving competency to activities in one's own life, internships, and in and professional jobs.
- Select and use appropriate concepts and methods from a variety of disciplines to solve problems effectively and creatively.
- Interpret and use written, quantitative, and visual text effectively in presenting diagnoses and solutions to problems.

**Analyze:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose, differentiating, organizing, comparing, contrasting, distinguishing, examining, experimenting, questioning, or testing.

- Provide examples of how to combine each of the sustainability competencies with one additional competency (such as combining systems-thinking with futures-thinking) to solve a problem.
- Analyze data using concepts and methods associated with two or more sustainability competencies to understand a problem and explore potential solutions.

- Compare and contrast solutions that emerge from combining different sustainability competencies.

**Evaluate:** Making judgments based on criteria or standards by checking, critiquing, weighing, arguing, defending, judging, or justifying a position.

- Assess how the root causes of sustainability problems over time have limited the effectiveness of previous solutions.
- Justify your choice of multiple methods, concepts, and/or technologies associated with two or more sustainability competencies to research, solve, and present solutions to problems.
- Evaluate your understanding of a sustainability problem and potential solutions from different perspectives, especially of people who would question or disagree.

**Create:** Producing new or original work by assembling elements to form a coherent or functional whole, or reorganizing elements into a new pattern or structure; generating, planning, or producing; designing, constructing, developing, formulating, or authoring.

- Create original research, designs, plans, or artworks that analyze a sustainability problem and how it might be solved.
- Adapt previous solutions to new data and conditions.
- Create a sustainability solution that integrates multiple disciplines, perspectives, and other competencies.

## Concepts and Methods

Below is a summary of major concepts and methods associated with the integrated problem-solving competency, adapted from Brundiens et al. (2023).

Concepts	Methods
Processes, transitions and transformations (and other change dynamics)	Transition management
Roadblocks and barriers (resistance to change)	Organizational change management
Triggers and supporting factors	Mapping interventions and intended outcomes
Social movements, and organizational change and learning	Adaptation research methodology
Shifting power, politics, and authority, and their roles in transition processes	Integrated foresight and backcasting or mitigation

Concepts	Methods
	Actionable and transformational planning methodologies  Transdisciplinary case studies  Transformational sustainability research framework

## Pedagogies and Assessments

Below are links to example lesson plans, assignments, and assessments of student learning about the integrated problem-solving competency and sustainability.

### Natural Sciences

[Determining Carbon Storage in Garcelon Bog](#)

[Interdisciplinary Problem Solving: Sustainable Water Systems](#)

[Environmental Problems](#)

[The Interconnected Nature of the Atmosphere, Hydrosphere, and Biosphere \(Modeling the Carbon Cycle Assessment\)](#)

[Investigating Oceanographic Issues and Solutions \(Human Impacts on Oceans Assessment\)](#)

[A Growing Concern \(Agricultural Fact Sheet and Recommendations Assessment\)](#)

[Human's Dependence on Earth's Mineral Resources—Phosphorus Mining and Impacts \(Addressing Phosphate Extraction Assessment\)](#)

### Social Sciences

[Theories in Environmental Social Sciences](#)

[Environmental Sociology](#)

[Data Set Analysis \(Assessment Using Qualitative and Quantitative Data\)](#)

[Major Storms and Community Resilience \(Town Hall Meeting Assignment\)](#)

**Arts & Humanities**

[Philosophical & Theoretical Foundations of Sustainability Leadership in Education](#)

[Philosophy & the Environment](#)

**Engineering**

[Problem Solving for Sustainable Engineering \(Lesson Plan\)](#)

[Current Environmental Issues, Sustainability and Sustainable Development](#)

[Environmental Engineering Analysis Tools](#)

[Engineering Design for a Sustainable Future](#)

[Urban Water Atmospheric Environment Interactions \(Urban Heat Islands and Flooding Assessment\)](#)

[Water Sustainability in Cities—Planning and Decision Making \(Sustainable Water Design Assessment\)](#)

[Ocean Sustainability and Geoengineering \(Carbon Geoengineering Assessment\)](#)

**Business and Economics**

[Challenges and Solutions in Business Sustainability](#)

[Business and Environmental Sustainability](#)

[Environmental Economics and Regulation](#)

[Economics - Tragedy of the Commons \(Assessments\)](#)

**Health and Social Work**

[Health and Sustainability](#)

[Environmental Health Policy & Practice](#)

[Intervening in Global Public Health, Sustainability, and Preventive Medicine](#)

[Regional Case Study Community Action Plans \(Food Security Assessment\)](#)

[Women and Water \(Safe Drinking Water Assessment\)](#)

[Managing the Risk of Lead Exposure \(Policy Memo Assessment\)](#)

## **Law and Policy**

[Energy & the Environment](#)

[International Environmental Politics](#)

[Environmental Policy Analysis](#)

[Policy & Governance of Sustainable Systems](#)

## **Interdisciplinary**

[Life Cycle Assessment Modeling](#)

[Environmental Problem Solving through Inquiry and Dialogue](#)

[Problem-Solving for a Sustainable Transition](#)

[AACU VALUE Problem Solving Value Rubric](#)

[Gamification - Blog Post on Designing Learning with Games and Simulations](#)

[Case-Based Learning Guide and Examples](#)

[Rubric for Assessing Feedback in Problem Solving in STEM](#)

[Rubric for Assessing Analytics in Problem Solving in STEM](#)

## **Scholarship of Teaching and Learning**

Below are examples of research on teaching and learning about the integrated problem-solving competency.

## **Natural Sciences**

[Exploring Innovative Strategies in Problem Based Learning to Contribute to Sustainable Development: A Case Study](#)

[Teaching Discipline-Based Problem Solving](#)

[Integrating Problem- and Project-Based Learning Opportunities: Assessing Outcomes of a Field Course in Environment and Sustainability](#)

[Beyond Structure-Function: Getting at Sustainability within Biomimicry Pedagogy](#)

[Teaching Sustainability and Environmental Justice in Undergraduate Chemistry Courses](#)

[Becoming an Actionable Scientist: Challenges, Competency, and the Development of Expertise](#)

### **Social Sciences**

[Tackling Wicked Problems in Teaching and Learning: Sustainability Issues as Knowledge, Ethical and Political Challenges](#)

[Sustainability: Teaching an Interdisciplinary Threshold Concept through Traditional Lecture and Active Learning](#)

[From Polyyps to Politics: Using a Coral Reef Living Laboratory in a Politics of Sustainability Course](#)

### **Arts & Humanities**

[Integrating Sustainability Issues into English Language Courses at University](#)

[Teaching Sustainable Development and Environmental Ethics: The IBMB-Concept of Bringing Theory and Practical Cases Together](#)

[Philosopher-as-Liaison? Lessons from Sustainable Knowledge and American Philosophy](#)

### **Engineering**

[Reshaping Teaching for Sustainability in Business Engineering – A Pilot Study on Students' Outlooks and Learning Expectations](#)

[Wicked Problems in Engineering Education: Preparing Future Engineers to Work for Sustainability](#)

[Embedding Sustainable Development \(SD\) and Interdisciplinary Project Based Learning \(PBL\) in the EPS: An Opportunity to Break Down Silos in Engineering](#)

[Sustainable Development Needs: A Transformed Engineering Education](#)

### **Business and Economics**

[Problem-Posing in Management Classrooms for Collective Sustainability Transformation](#)

[Lenses on the Post-Oil Economy: Integrating Entrepreneurship into Sustainability Education through Problem-Based Learning](#)

[Incorporating Global Sustainability in the Business Language Curriculum](#)

[Collaborative Problem Solving in a Complex Governance System: Amsterdam Airport Schiphol and the Challenge to Break Path Dependency](#)

### **Health and Social Work**

[Can a Sustainability and Health Scenario Provide a Realistic Challenge to Student Nurses and Provoke Changes in Practice? An Evaluation of a Training Intervention](#)

[A Sustainability Framework to Guide Community Assessment and Problem Solving](#)

### **Law and Policy**

[The Green Building Project: Promoting Political Science Learning through a Collaborative Research Approach](#)

[Sustainability Policy-Making as a Dynamic, Agent-Based System of Systems](#)

[Applying Enquiry and Problem Based Learning to Mission-Oriented Innovation Policy: From Policy to Pedagogy to Teaching and Learning Practice](#)

### **Interdisciplinary**

[A Framework for Teaching Socio-Environmental Problem-Solving](#)

[A General Problem-Solving Approach for Wicked Problems: Theory and Application to Chemical Weapons Verification and Biological Terrorism](#)

[Rethinking Environmental Education: Reflections on AAU UNESCO Center Certificate Course of Problem-Based Learning](#)

[Assessment Strategies for Enquiry and Problem-based Learning](#)

[Overcoming the Terrors of the Either/Or](#)

[Sustainability Education: A Dance Between Knowledge and Experience](#)

[A Slippery Cousin To 'Development'? The Concept of 'Impact' in Teaching Sustainability in Design Education](#)



## 10. Implementation Competency

### Definitions

<p><b>KCSF:</b> Implementation</p> <p><b>UNESCO:</b> (Not applicable)</p>	<p><b>KCSF:</b> The ability to collectively carry out and realize planned sustainability strategies (e.g., a sustainability action plan) on the ground, including implementation, adaptation, transfer, and scaling, in effective and efficient ways. Working toward a sustainability-informed vision over time involves monitoring and evaluating the realization process on the ground, addressing emerging challenges, and making adjustments.</p>
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### Learning Outcomes

Here we provide examples of student learning outcomes associated with the implementation competency, organized according to Bloom's Taxonomy (see Appendix A), from simpler to more complex learning objectives.

**Remember:** Recalling facts and concepts, including retrieving, recognizing, and recalling relevant knowledge from long-term memory.

- Define the goals, objectives, scope, and metrics for evaluating one's sustainability project, plan, or strategy.
- Define basic concepts of implementation, such as transfer, scaling, monitoring, adaptation, and evaluation..

**Understand:** Constructing meaning from oral, written, and graphic messages by exemplifying, classifying, summarizing, inferring, locating, recognizing, reporting, translating, or explaining.

- Describe common funding sources, organizational dynamics, processes, challenges, and monitoring and evaluation criteria and techniques for implementing a sustainability project or plan in your field.
- Identify common legal and ethical considerations relevant to project or campaign implementation in your field.

**Apply:** Using information in new situations, or carrying out a procedure for executing, implementing, solving, interpreting, operating, or sketching.

- Research and apply lessons from the approaches and outcomes of similar sustainability plans, projects, or strategies implemented by others.
- Select an appropriate organizational structure (e.g., coalition, network, affinity groups) and decision-making processes (e.g., hierarchical, decentralized, consensus-based) for your project.
- Identify and make plans to address likely barriers, benefits, and incentives for stakeholders of one's plans during implementation.
- Identify and adapt agreements, contracts, or memoranda of understanding used to implement similar projects to participants in your project.
- Employ appropriate frameworks to guide implementation of your plans (e.g., design thinking, social marketing, direct action, community organizing, asset-based community development, litigation).
- Develop mechanisms for ongoing evaluation and adaptation, in response to evolving circumstances and outcomes.

**Analyze:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose, differentiating, organizing, comparing, contrasting, distinguishing, examining, experimenting, questioning, or testing.

- Explain how multiple strategies can make complementary contributions to larger projects or campaigns (such as social media and face-to-face outreach, or community organizing, policy advocacy, and litigation).
- Assign appropriate roles and responsibilities to members of your group or organization based on an analysis of their skills and interests, and the needs of the situation.
- Establish timelines for completing phases and/or reaching milestones for the project or strategy.
- Conduct pilot tests, trials, or proof-of-concept projects to test for viability, effectiveness, and unforeseen problems.

**Evaluate:** Making judgments based on criteria or standards by checking, critiquing, weighing, arguing, defending, judging, or justifying a position.

- Adapt and employ techniques for performing formative and summative evaluation of one's sustainability project or campaign during implementation.

**Create:** Producing new or original work by assembling elements to form a coherent or functional whole, or reorganizing elements into a new pattern or structure; generating, planning, or producing; designing, constructing, developing, formulating, or authoring.

- Cultivate strategic capacity in change groups through diverse and relevant knowledge and connections, effective decision-making processes, and strong relationships.
- Creatively implement strategies toward a sustainable solution, including adapting these strategies based on progress or setbacks.
- Adapt, scale or replicate one's sustainability project, plans, or strategy in new situations.
- Adapt and extend one's plans to new populations and places.
- Create new organizations, coalitions, or networks to strengthen and extend one's plans.

## Concepts and Methods

Below is a summary of major concepts and methods associated with the implementation competency, adapted from Brundiers et al. (2023) and UNESCO (2017).

Concepts	Methods
Goals, objectives, scope, and metrics for projects, plans, or strategies	All methods included in the <a href="#">Social Change Wheel</a>
Adaptation, transfer, scaling, monitoring, and evaluation	Design thinking (prototyping, testing, user experience research, etc.)
Social movements, social entrepreneurship, social innovation	Social marketing, campaign design, strategic communication, framing and messaging
Organizational behavior, organizational change	Evaluation research - formative and summative, short-term and long-term
	Action research, participatory action research, community-engaged research and learning
	Community organizing, organizational development and management, nonviolent direct action
	Asset-Based Community Development (ABCD)

## **Pedagogies and Assessments**

Below are links to example lesson plans, assignments, and assessments of student learning about the implementation competency and sustainability.

### **Natural Sciences**

[Applied Sustainability](#)

[Sustainability in Action](#)

[Applied Sustainability in Contemporary Culture](#)

### **Social Sciences**

[Social Action](#)

[Transformations: Commoning and Social Action](#)

[Research and Sustainable Development](#)

[Collective Action and Advocacy Sustainability Studies Program](#)

[Environmental Justice: Race, Class, Equity, and the Environment](#)

[Environmental Justice Practicum: The Central Valley](#)

[Climate Justice and Social Action](#)

[Transformative Food Systems Seminar](#)

[Food Justice, Community, and Peace](#)

[Sustainable Solutions to Poverty](#)

[Games for Sustainability](#)

### **Arts & Humanities**

[Religion, Ecology, & Environmental Ethics](#)

### **Engineering**

[Solar Structures](#)

**Business and Economics**

[Social Entrepreneurship and Sustainable Development](#)

**Health and Social Work**

[Case Study Group Work-Problem Identification](#)

[Social Work Practice with Communities & Organizations](#)

**Law and Policy**

[Campus Greenhouse Gas Emissions Inventory](#)

[Collective Urban Policy Change](#)

**Interdisciplinary**

[Action to Enhance Sustainability](#)

[Applied Sustainability](#)

[Center for Story-Based Strategy \(Strategic Communication Materials\)](#)

[Change! A Student Guide to Social Action](#)

[Community Toolbox \(Social Change Materials\)](#)

[Guide to Public Narrative from the Leading Change Network](#)

[Have the Talk: Climate Conversations](#)

[Lead Change, Change the World](#)

[Momentum Community \(Community Organizing Training Materials\)](#)

[Teaching Social Action](#)

**Scholarship of Teaching and Learning**

Below are examples of research on teaching and learning about the implementation competency.

## **Natural Sciences**

[Integrating Deep Ecology and Adaptive Governance for Sustainable Development: Implications for Protected Areas Management](#)

[Addressing Sustainable Development: Promoting Active Informed Citizenry through Trans-Contextual Science Education](#)

[Natural Science Education Concept for Sustainable Development](#)

## **Social Sciences**

[A Sociology of Climate Change Responses](#)

[Teaching Urban Sociology and Urban Sustainability on Two Feet, Two Wheels, and in Three Cities: Our Experience Teaching Sustainable Cities in North America](#)

[A Case Study of Sustainability and Civic Engagement in a Sociology of Food Course](#)

## **Art and Humanities**

[A Global Humanities Approach to the SDGs](#)

[Teaching Art a Greener Path: Integrating Sustainability Concepts of Interior Design Curriculum into the Art Education Curriculum](#)

## **Engineering**

[Systematic Review of How Engineering Education Is Advancing the SDGs](#)

[Implementation of the New Urban Agenda on a Local Level: An Effective Community Engagement Methodology for Human-Centered Urban Design](#)

## **Business and Economics**

[Promoting Education for Sustainability through Game-Based Learning: Using the Sustainable Strategies Game to Improve Students' Knowledge and Skills of Sustainable Business Practices](#)

[Framing Teaching for Sustainability in the Case of Business Engineering Education: Process-Centric Models and Good Practices](#)

[Meeting the Growing Demand for Sustainability-Focused Management Education: A Case Study of A PRME Academic Institution](#)

[Defining Sustainability Core Competencies in Business and Management Studies Based on Multinational Stakeholders' Perceptions](#)

[Integrating Sustainability in the Business Administration and Management Curriculum: A Sustainability Competencies Map](#)

[The Tempered Radicals: How Employees Push Their Companies—Little by Little—To Be More Socially Responsible](#)

### **Health and Social Work**

[Integrating Sustainability Development Education Program In Nursing to Challenge Practice Among Nursing Interns In Health Care](#)

[Implementing Environmental Sustainability Educational Intervention in Dental Hygiene Instruction](#)

### **Law and Policy**

[Effective Adaptive Governance of Socio-Ecological Systems \(SES\)](#)

[Climate Adaptation as Strategic Urbanism: Assessing Opportunities and Uncertainties for Equity and Inclusive Development in Cities](#)

[Transition Management for Sustainable Development: A Prescriptive, Complexity-based Governance Framework](#)

[Collaborations in Environmental Initiatives for an Effective “Adaptive Governance” of Social–Ecological Systems: What Existing Literature Suggests](#)

### **Interdisciplinary**

[What Motivates Students to Be Sustainability Change Agents in the Face of Adversity?](#)

[A Process for Transition to Sustainability: Implementation](#)

[Teaching Innovation and Sustainability through International Interactive Workshops](#)

[Project-based Learning for Environmental Sustainability Action](#)

[Effectiveness of Education for Sustainability: The Importance of an Action-Oriented Approach](#)

[Innovation Challenges: Developing Sustainability Competencies through Experiential Learning](#)

[Empowering Lecturers and Students with Constructivist, Community-Engaged Pedagogies to Support Sustainable Development Goals](#)



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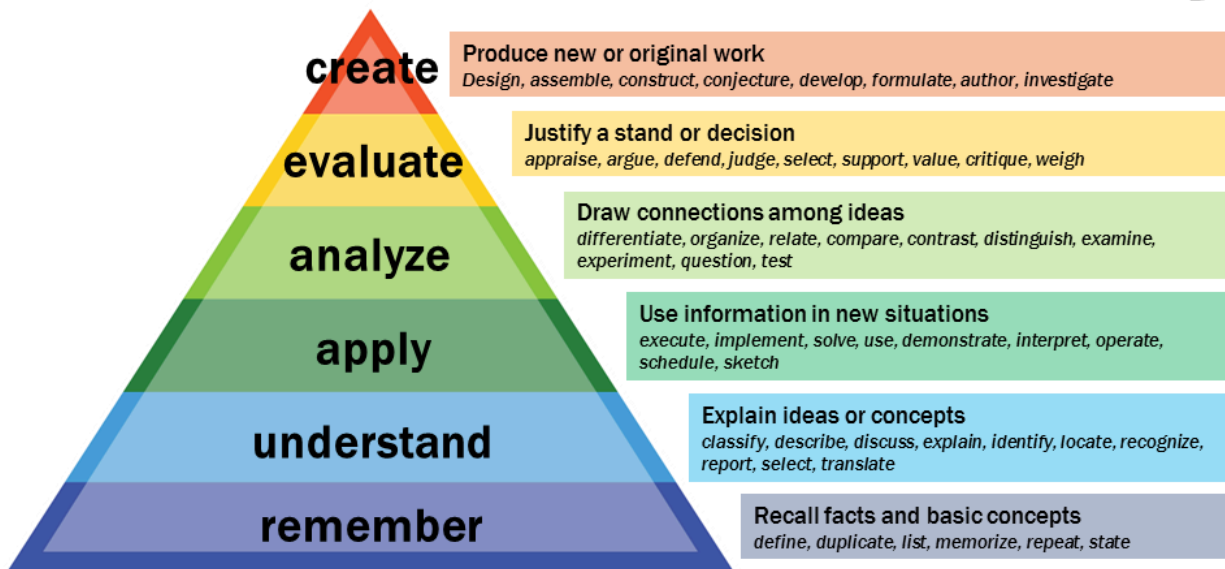
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## Appendix A. Bloom's Taxonomy

This well-known taxonomy is widely used by instructors to write student learning outcomes, and to design well-aligned curriculum, pedagogy, and assessments. Simpler learning objectives, such as understanding and remembering, are listed at the base of the taxonomy, while more complex learning outcomes are listed at the top. Benjamin S. Bloom and his colleagues developed the original version of the taxonomy in 1956. Shown here is a revised version developed in 2001 by a team of psychological and educational researchers (Anderson & Krathwohl, 2001). For more about the uses and versions of Bloom's taxonomy, see Armstrong (2010).

### Bloom's Taxonomy



 Vanderbilt University Center for Teaching

Source: Armstrong (2020)

## Appendix B. Curriculum Repositories

This handout includes a list of curriculum repositories where you can search for syllabi, lesson plans, cases, and other teaching materials.

### Contents

All Disciplines	1
Business	2
Environmental Justice and Integral Ecology	3
K-12 Education	4

### All Disciplines

[AASHE Curriculum Hub](#) - Search for materials in your discipline. If your university is an AASHE member ([check whether they are a member here](#)), you can create an account using your university e-mail to access “members only” materials.

[Disciplinary Associations Network for Sustainability \(DANS\)](#) - AASHE’s collection of links to resources on sustainability in all disciplines.

[Environmental Sociology Syllabi and Instructional Materials](#) - Broad range of materials relevant to the social sciences.

[SCU Public Curriculum Repository](#) - Example lesson plans and syllabi taught at SCU (available to anyone).

[SCU Curriculum Repository](#) - A slightly larger version that includes syllabi that we don't have permission to share beyond SCU (only available to SCU participants logged into your SCU Google accounts).

[InTeGrate Teaching Materials](#) - Search for materials in your discipline or for interdisciplinary resources. Especially strong on geosciences and STEM, but also how they can be integrated into other fields.

[Sustainable Development Goals - Resources for Educators](#) - UNESCO. “A collection of pedagogical resources, ideas for classroom activities, multimedia education resources and good practices for each of the 17 SDGs, as well as [global SDG resources](#) designed for three education levels.” Also, a fun way to connect to individual actions: [Good Life Goals](#).

ESD Expert Net (n.d.). [Teaching the Sustainable Development Goals](#). Bonn: Engagement Global. - Learning objectives and case studies related to each SDG.

[The United Nations Sustainable Development Goals Project](#) - Sources on how to teach the SDGs using inquiry-based and project-based learning.

[Teaching Resources for Faculty](#) - Santa Clara University Center for Sustainability page of resources, including 24 ways to integrate sustainability into your courses, student project ideas, and other resources on teaching sustainability.

[Compass Education](#) - A global movement of educators for a sustainable world. Provides tools to promote systems thinking, experiential learning pedagogy, global systems, and sustainability.

[OER Commons Climate Education](#) - Climate-related teaching resources for K-12 and higher education.

[MIT Climate Portal](#) - Syllabi, curricula, and pedagogy for teaching about climate issues in multiple disciplines.

[CLEAN](#) - Climate and energy teaching materials for K-higher education.

[SERC Assessment Tools](#) - Can be adapted to assess student learning in sustainability courses.

[INTEGRATE Learning Assessments](#) - Can be adapted to assess student learning in sustainability courses.

## **Business**

[Aspen Institute Center for Business Education](#) - Teaching materials and current events articles organized by discipline, industry, topic and region. [Ideas Worth Teaching](#) are weekly bulletins that are easily incorporated into courses.

[Ignited](#) - Teaching materials organized by topic (e.g., Accounting & Finance, Economics, etc.), material type (case study, exam, data set, etc.), and students (undergraduate, graduate, etc.). Created for and by Jesuit Business School educators, but applicable to non-Jesuit educators too.

[Page Prize Database](#) - Award-winning syllabi and modules from University of South Carolina's Darla Moore School of Business.

[B Academics](#) - Teaching, research, and professional development resources for paying members.

## Environmental Justice and Integral Ecology

[SCU Environmental Justice and the Common Good Initiative](#) - Including a [guide](#) and [example projects](#) of community-driven research for environmental justice (on food, water, climate, the electronics industry, and law). [Standing up for racial and environmental justice now](#) - statements on the connections between racial and environmental justice for Black, Asian, Latinx, and disabled people, with links to current resources, organizations, and actions. (You could assign your students to research and write additional statements, and share them with the Initiative.)

[Teaching and Learning Environmental Justice](#) - Teaching materials, curricula, and other resources on environmental justice and related topics—like indigenous environmentalism, ecofeminism, EJ and health, community engagement, and environmental racism—for both K-12 and higher education.

[Environmental Justice Activity Collection](#) - Lesson plans and assignments for teaching environmental justice across the disciplines, like English and especially geography, at the university level. The website also provides other teaching materials for teaching sustainability through workshops and webinars.

[Teaching Sustainability and Environmental Justice in the Humanities and Social Sciences](#) - How to incorporate materials from the geosciences in humanities and social science courses at the university level.

[Environmental Justice in the Context of Sustainability](#) - Includes many ideas for teaching environmental justice in the sciences with examples and guidance for different approaches at the university level.

[Online Learning Opportunities: A Guide to Digital Environmental Justice Education in the Age of COVID-19](#) - Created by West Harlem Environmental Action, this guide includes lessons for grades 9-12, some of which can be adapted for introductory college courses.

[How to Construct an Environmental Justice Lesson Plan](#) - A guide created by Pitzer College students includes some common class exercises used to teach EJ at the high school level or above. This may be particularly applicable to introducing environmental justice outside of the sciences.

[Equitable Sustainability Literacy Guide](#) - Learning tools and resources for teaching introductory environmental justice, including environmental racism, Indigenous rights, ecofeminism, climate migration, and food justice aimed at the both institutions and companies

[United States Environmental Protection Agency Learning Center](#) - Training portal with online resources to build the capacity of EPA's partners to advance environmental justice, including instruction in how to use EPA's tools and databases like mapping and data tools, community focused tools, and guides to EPA grant applications.

[21 Day Catholic Enviro Justice Challenge](#) - Lessons and links on EJ and integral ecology, incorporating spiritual exercises, created by the Ignatian Solidarity Network. Can be used in a course or in informal learning contexts, such as student or faculty/staff organizations.

[Climate Justice Instructional Toolkit](#) - Lessons and slides for teaching climate justice across the curriculum.

## **K-12 Education**

[All We Can Save](#) - Lesson plans, discussion guides, and more on the climate crisis.

[CLEAN](#) - Climate and energy teaching materials for K-higher education.

[Climate Justice Projects](#) - Example projects developed by teachers in a Chicago Teachers Union professional development program for a variety of K-12 classes.

[EcoRise](#) - Environmental justice curricula aligned with a variety of state standards.

[Educators for Social Change \(E4SC\)](#) - Environmental justice lessons, curricula, toolkits.

[Environmental and Climate Change Literacy Projects](#) - This initiative's goal is to "educate all of California's high school graduates to be literate in climate change and environmental justice issues and solutions" by working to advance "PK-12 climate and environmental literacy, justice and action through an innovative partnership between the UC-CSU systems". See their [projects](#) and [steps to get involved](#) for more information.

[Global Oneness Project](#) - Multimedia stories and lesson plans on ecology for grades 3-12.

[Groundwork USA](#) - Introductory EJ curriculum for high school students.

[North American Association for Environmental Education](#) - A broad array of resources for environmental educators, mostly focused on K-12. See especially the NAAEE's [K-12 Environmental Education: Guidelines for Excellence](#) and [A Framework for K-12 Science Education](#) and [College, Career, and Civic Life Standards](#).

[Ten Strands](#) - An initiative that works "collaboratively with state government, local education agencies, environmental education providers, community-based organizations, and funders to ensure that teachers have access to high-quality instructional materials that address Common Core State Standards, Next Generation Science Standards, History–Social Science Standards, and support English language learners."

[California Catholic Environmental Literacy Hub](#) - Includes curricula for 4th, 7th, and 11th grades, many lesson plans, and links to environmental education organizations in California.



## Appendix C. Sustainability Competencies and Pedagogies Handout

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Competency	Definition	Example Pedagogies
Systems thinking	<p><b>UNESCO:</b> The ability to recognize and understand relationships, to analyze complex systems, to think of how systems are embedded within different domains and different scales, and to deal with uncertainty.</p> <p><b>KCSF:</b> The ability to collectively analyze complex systems across different domains (society, environment, economy, etc.) and across different spatial and temporal scales (local to global; past, present, future), thereby considering change agents, cause-effect structures, cascading effects, inertia, feedback loops, and interdependencies as well as other systemic features related to sustainability issues.</p>	<ul style="list-style-type: none"> <li>• <b>Games, simulations, and models</b> to explore patterns, cause and effect, and change under different circumstances.</li> <li>• <b>Case studies or current news stories</b> to identify transparent and hidden connections. Local and global examples to highlight the interconnectedness.</li> <li>• <b>Institutional analysis</b> to review existing practices, mechanisms, and procedures.</li> <li>• <b>Group discussions</b> to identify hidden and visible flows.</li> </ul>
Anticipatory thinking	<p><b>UNESCO:</b> The ability to understand and evaluate multiple futures – possible, probable, and desirable; to create visions for the future; to apply the precautionary principle; to assess the consequences of actions; and to deal with risks and changes.</p>	<ul style="list-style-type: none"> <li>• <b>Journaling</b> to reflect on the consequences associated with certain choices.</li> <li>• <b>Scenarios</b> to develop alternative ends or map out possible outcomes. Scenarios can be written, visual, auditory, embodied, kinesthetic, and/or verbal.</li> </ul>
Futures thinking	<p><b>KCSF:</b> The ability to collectively explore future developments and states, specifically to anticipate how sustainability problems might evolve or occur over time (scenarios), considering concepts such as inertia, path dependencies, and triggering events. It also includes the ability to collectively analyze, evaluate, and craft rich "pictures" of future visions, which provide a foundation for researching evidence-supported alternative development pathways.</p>	<ul style="list-style-type: none"> <li>• <b>Macrohistory</b> to seek patterns of change or consider historical trends.</li> </ul>
Normative	<p><b>UNESCO:</b> The ability to understand and reflect on the norms and values that underlie one's actions; and to negotiate sustainability values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge, and contradictions.</p>	<ul style="list-style-type: none"> <li>• <b>Modeling good practice</b> to demonstrate a strong sense of fairness and social justice in the classroom for performance beyond the classroom.</li> <li>• <b>Debates and group discussions</b> to ask questions, clarify and analyze their values, and explore others' values in a safe space.</li> </ul>
Values thinking	<p><b>KCSF:</b> The ability to collectively identify values and to map, analyze, and specify values, as well as the ability to apply, reconcile, and negotiate sustainability values, principles, goals, and targets, as well as trade-offs. As sustainability is an inherently normative concept centered on intra- and intergenerational justice and equity among people and between people and the environment, values-thinking competency includes engaging principles and practices emphasizing justice, equity, diversity, and inclusion.</p>	<ul style="list-style-type: none"> <li>• <b>Active listening/participation and role-play</b> to understand another person's perspective.</li> <li>• <b>Culturally responsive teaching</b> to ensure topics are appropriate for the grade level, culture, and community.</li> <li>• <b>Diversity/global learning*</b> to explore cultures, life experiences, and different worldviews.</li> </ul>

Competency	Definition	Example Pedagogies
Strategic	<b>UNESCO:</b> the ability to collectively develop and implement innovative actions that further sustainability at the local level and further afield.	<ul style="list-style-type: none"> <li>● <b>Inquiry- and project-based instruction</b>, such as designing, evaluating, and adapting policies, programs, action plans.</li> <li>● <b>Place-based learning</b> to address real-world problems and solutions.</li> <li>● <b>Reflections</b> to evaluate personal and group progress.</li> <li>● <b>Games and puzzles</b> to analyze and test strategies and contingency plans for unintended consequences.</li> <li>● <b>Mapping</b> intervention strategies to build the necessary knowledge and skills to create change.</li> </ul>
Strategic thinking	<b>KCSF:</b> The ability to collectively design and plan to implement transformational (systemic) interventions, transitions, and transformative governance strategies toward sustainability while accounting for strategic leverage points, power dynamics, uncertainty, surprises, and social and organizational learning in navigating these strategies.	
Collaboration	<b>UNESCO:</b> The ability to learn from others; to understand and respect the needs, perspectives, and actions of others (empathy); to understand, relate to, and be sensitive to others (empathic leadership); to deal with conflicts in a group; and to facilitate collaborative and participatory problem-solving.	<ul style="list-style-type: none"> <li>● <b>Collaborative assignments and projects*</b> to learn how to work with others to analyze and solve problems.</li> <li>● <b>Intensive writing*</b> to produce and revise various forms of writing for different audiences in different disciplines.</li> <li>● <b>Community-Based Learning*</b> to provide direct experience with issues, apply what learning in real-world settings, analyze and solve community problems, and reflect.</li> </ul>
Interpersonal	<b>KCSF:</b> The ability to motivate, enable, and facilitate collaborative and participatory sustainability research and collective problem-solving processes. Additionally, interpersonal competency is the ability to facilitate collective and inclusive co-production of knowledge and collaboration across academic disciplines (interdisciplinary collaboration), between academic and societal communities (transdisciplinary collaboration), and across diverse ways of knowing (epistemologies) and being (ontologies).	
Critical thinking	<b>UNESCO:</b> The ability to question norms, practices, and opinions; to reflect on one's values, perceptions, and actions; and to take a position in the sustainability discourse.	<ul style="list-style-type: none"> <li>● <b>Stimulus activities</b>, such as viewing or making creative works, initiating reflection or discussion.</li> <li>● <b>Critical reading and writing</b> to analyze viewpoints, futures, and values.</li> <li>● <b>Fieldwork</b> to link theory to real-world examples.</li> </ul>
Self-awareness	<b>UNESCO:</b> The ability to reflect on one's role in the local community and (global) society; to continually evaluate and further motivate one's actions; and to deal with one's feelings and desires.	<ul style="list-style-type: none"> <li>● <b>Critical incidences</b> to consider personal perspectives and actions in light of an ethical dilemma.</li> <li>● <b>Reflexive accounts</b> to consider personal roles, attitudes, and responsibilities concerning sustainability issues.</li> <li>● <b>Personal development planning (PDP)</b> to reflect on learning, performance, and achievement and to plan for personal, educational, and career development.</li> <li>● <b>ePortfolios*</b> to electronically compile work, reflect on growth, and share items with professors, advisors, and potential employers.</li> </ul>
Intrapersonal	<b>KCSF:</b> The ability to consciously and proactively engage as a change agent for sustainability. This involves being aware of one's own emotions, desires, thoughts, and behaviors, as well as one's positionality in society and one's role in the local community and (global) society. Building on this, intrapersonal competency involves the ability to reflect and act on that self-awareness and to regulate, motivate, and continually evaluate one's actions and improve oneself, drawing on competencies of emotional intelligence.	

Competency	Definition	Example Pedagogies
Integrated problem-solving	<p><b>UNESCO:</b> The ability to apply different problem-solving frameworks to complex sustainability problems and develop viable, inclusive, and equitable solution options that promote sustainable development, integrating the other competencies.</p> <p><b>KCSF:</b> The ability to select an appropriate problem-solving framework developed for complex sustainability problems and to apply the selected framework to collective approaches that jointly develop viable solution options as a result of meaningfully integrating problem analysis, sustainability assessment, visioning, and strategy-building and to jointly plan to implement the co-created solution options on the ground.</p>	<ul style="list-style-type: none"> <li>● <b>Problem-based learning</b> to research issues, develop action plans and evaluate processes.</li> <li>● <b>Undergraduate research*</b> to involve students in addressing contested topics, empirical observation, technology development, and excitement from working to answer important questions.</li> </ul>
Implementation	<p><b>KCSF:</b> The ability to collectively carry out and realize (on the ground) a planned solution over time, working toward a sustainability-informed vision. This involves collaborating with others to monitor and evaluate the realization process and address emerging challenges (adjustments), recognizing that sustainability problem-solving is a long-term, iterative process between planning, realization, adjustment, and evaluation.</p>	<ul style="list-style-type: none"> <li>● <b>Capstone projects*</b>, such as a research paper, a performance, or an art exhibit, to integrate and apply previous learning.</li> <li>● <b>Internships*</b> to provide students with direct work experience and to give them the benefit of supervision and coaching from professionals.</li> <li>● <b>Social action projects</b> that provide students with opportunities to advance a plan of action they developed on campus, in a community, or in local, state, national, or global policy arenas.</li> </ul>

## NOTES

UNESCO definitions of competencies are adapted from [UNESCO \(2017\)](#). Key Competencies in Sustainability Framework (KCSF) definitions of competencies are from [Brundiens et al. \(2023\)](#); see also [Brundiens et al. \(2021\)](#), [de Haan \(2010\)](#), [Rieckmann \(2012\)](#), [Wiek et al. \(2011\)](#), and [Wiek et al. \(2016\)](#).

Pedagogies are adapted from [AAC&U \(n.d.\)](#), [Cotton & Winter \(2010\)](#), [Daffron & Caffarella \(2021\)](#), and [Warren et al. \(2014\)](#).

\* Denotes high-impact learning practices identified by [AAC&U \(n.d.\)](#).

An online tutorial on the KCSF sustainability competencies for instructors and students is at [sites.google.com/asu.edu/gcselevel1/home](https://sites.google.com/asu.edu/gcselevel1/home) and an introductory portal is at [keycompetencies.sustedu.org/#](https://keycompetencies.sustedu.org/#)