

Systems Thinking

Foundational Knowledge

- 1.1 | Remember the concept of a dynamic system and the elements within a model of a dynamic system: system boundary, surroundings;
- 1.2 | Understand (and be able to explain) the conceptual difference between open and closed systems;
- 1.3 | Know the earth is essentially a closed system;
- 1.4 | Know that all material or energy input to (or output from) the system must be created from existing material or energy;
- 1.5 | Remember that there are graphical tools that can be used to model a system and its behavior (interactions, consequences);
- 1.6 | Understand the relationship between events, patterns and system behavior;
- 1.7 | Remember that the global economic/social system involves interactions between human behavior (society and economy) and the natural world (environment);
- 1.8 | Know that the economic system is embedded inside the social system, both of which are embedded in the environmental system (“the global marketplace”).

Application

- 2.1 | Identify components that make up a system by analyzing events and patterns;
- 2.2 | Identify what events (or measures) serve as indicators for the behavior of the system;
- 2.3 | From a list of possible factors, eliminate those that are likely to have negligible impact;
creative:
- 2.4 | Create different system boundaries that lead to different systems solutions;
practical:
- 2.5 | Create a schematic graph that depicts the behavior of a particular event (or measure) over time;
- 2.6 | Using a causal loop diagram, evaluate the consequences of changes within a dynamic system (i.e., what happens when those changes ripple through the system?);
- 2.7 | Recognize the interdependency of components within a complex system;
- 2.8 | 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;
- 2.9 | Manage projects which requires system understanding (e.g., life cycle assessment, supply chain network analysis).

Integration

- 3.1 | Connect the ideas of systems thinking to the rest of the modules (e.g., concept of sustainability, consequences of population growth, material flow, energy flow, water system);
- 3.2 | 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);
- 3.3 | Relate ideas of events and patterns of consumer behavior (including ones' own) to the larger global system.
- 3.4 | Be able to make connections between events and patterns from very different areas, such as political, social, health and safety, environmental, manufacturing, sustainability, economic;
- 3.5 | Be able to construct causal loop diagrams that portray the behavior of a dynamic system.

Human Dimension

- 4.1 | Know that they are part of dynamic local and global systems (“society”);
- 4.2 | Know that their behavior (actions and inactions) can affect the systems;
- 4.3 | Know that they have great power (“self-authorship”) as an engineer to improve or worsen the larger systems;
- 4.4 | Know that they are amongst those with the highest income in the global marketplace (if they earn more than US\$20K per year they are in the 80% percentile of income in the global economic system.)
- 4.5 | Know that others are also participants and/or victims of the global system;
- 4.6 | Know that they share common resources with others in the global system;
- 4.7 | Social injustice (or inequity) pushes systems toward instability (social and political) and eventually collapse;
- 4.8 | Global economic systems often accumulate resources in one sub-system (powerful societies) at the expense of another part of the sub-system (less powerful societies);
- 4.9 | Know that overcoming systemic problems requires collaboration amongst different parts/ people within the system.

Caring

- 5.1 | Feel they are personally important in term of overcoming our global society’s sustainability challenges;
- 5.2 | View all disciplines as important for tackling challenges caused by the global economic system (i.e., as high human purpose);
- 5.3 | Be more interested in improving the health and welfare for all living beings;
- 5.4 | Value perspectives from other disciplines.

Learning How to Learn

definition: Designing and executing a plan for learning what one needs to learn.

- 6.1 | Identify what one needs to learn to achieve a learning objective;
- 6.2 | Formulate relevant questions around 6.1;
- 6.3 | Identify resources for information to answer questions from 6.2;
- 6.4 | Answer 6.2 by synthesizing information found through self-directed learning;
- 6.5 | Practice the virtues of critical thinking when evaluating new information:
1. Intellectual integrity, **2.** Intellectual humility, **3.** Confidence in Reason, **4.** Intellectual Perseverance, **5.** Fairmindedness, **6.** Intellectual Courage, **7.** Intellectual Empathy, **8.** Intellectual Autonomy

What impact do I want this module experience to have on students, that will still be there a year or more after the course is over?