

Assessment A | **Systems Thinking**
Engineer's Role in Society
 Individual/team project 2-3 hours

Targeted Learning Objectives

- 1.5 Remember that there are graphical tools that can be used to model a system and its behavior (interactions, consequences)
- 2.7 Recognize the interdependency of components within a complex system
- 3.2 Recognize interdependencies of different systems
- 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
- 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 are have great power (“self-authorship”) as an engineer to improve or worsen the larger systems;
- 5.1 Know that others are also participants and/or victims of the global system;
- 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

Scenario

How Does Your Conduct Impact Society?

Imagine that you are now working as an engineering at _____, where you _____. As an engineer, you are bound to the Code of Ethics, established by the profession and captured in the National Society of Professional Engineer’s “Engineer’s Creed”. The shared engineering values and standards of conduct are described in the Code of Ethics Fundamental Cannons and the Engineer’s Creed.

a | Create a causal loop diagram that illustrates how decisions that you might make as an engineer directly or indirectly influence society as described in the NSPE Engineer’s Creed.

b | Based on the linkages that you created in your causal loop diagram, discuss three specific, but different actions that you might take as an engineer and how these actions could fulfill the engineer’s societal mission described in the NSPE Engineer’s Creed.

| Objectives | Criterion | Standards |
|-----------------|---------------------------------|--|
| 6.1-6.4 | self-directed learning | 5 PROFICIENT Independently able to identify what information one needs to learn to complete the assignment, determines an appropriate source of the information, educates oneself on the information and uses the information to complete the assignment; 3-4 DEVELOPING Needs varying degrees of minor assistance in completing the task; 0-2 BELOW EXPECTATIONS Needs assistance in completing the task, doesn’t know where to start; |
| 2.7, 3.4, 4.1-3 | making connections | 5 PROFICIENT Clearly articulates how three specific and different actions that they can take in their engineering role will directly and/or indirectly impact society; uses substantive rationale; 3-4 DEVELOPING Articulates the link between action and impact, but the linkage is not clear, or the actions and impact are similar in character (e.g., all economic); uses substantive rationale; 0-2 BELOW EXPECTATIONS Omits or uses vague rationale; Linkages between action and impact are unclear; |
| 3.5 | visually expressing connections | 5 PROFICIENT Creates a clear map of the connections that can be used to trace direct and/or indirect links between actions and impact; 3-4 DEVELOPING Creates a map that is not cohesive and/or complete in terms of the connection between actions and impact; 0-2 BELOW EXPECTATIONS Creates a map with incorrect connections or one that does not connect actions with impact |



Assessment B | **Systems Thinking**
Tragedy of the Commons
 Team project, 3-4 hours

Targeted Learning Objectives

- 1.1 Remember the concept of a dynamic system and the elements within a model of a dynamic system: system boundary, surroundings
- 1.3 Know the earth is essentially a closed system
- 1.7 Remember that the global economic/social system involves interactions between human behavior (society and economy) and the natural world (environment)
- 2.4 Create different system boundaries that lead to different systems solutions
- 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
- 3.2 Recognize interdependencies of different systems
- 3.3 Relate ideas of events and patterns of consumer behavior (including ones' own) to the larger global system.
- 3.5 Be able to construct causal loop diagrams that portray the behavior of a dynamic system
- 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
- 4.6 Know that they share common resources with others in the global system
- 5.1 Feel they are personally important in term of overcoming our global society's sustainability challenges
- 6.3 Identify resources for information to answer questions
- 6.4. Answer questions by synthesizing information found through self-directed learning
- 6.4 Answer 6.2 by synthesizing information found through self-directed learning

Scenario

How Does Tragedy of the Commons Happen?

The concept of the Tragedy of the Commons is "widely accepted as a fundamental contribution to ecology, population theory, economics and political science." Find the article "Tragedy of the Commons" and understand the basic idea. Based on the understanding, you

- a. Give examples of tragedy of the commons happened in your community, or globally.
- b. Create a causal loop diagram for the example you find and explains why tragedy of the commons happens.
- c. Based on your causal loop diagram, discuss if there is technical solutions to tragedy of the commons and how we can solve it.

| Objectives | Criterion | Standards |
|--|---|--|
| 1.1,1.3 | explaining fundamental facts and concepts | 5 PROFICIENT Clearly explains the concept of system boundary and the linkage between system boundary or type of a system and tragedy of the commons; 3-4 DEVELOPING Uses the concept of system boundary or type of a system, but the explanation is not clear; 0-2 BELOW EXPECTATIONS Omits the concept of system boundary or type of a system in the explanation; |
| 1.7, 2.7, 3.2, 3.3, 4.1, 4.2, 4.6, 5.1 | making connections | 5 PROFICIENT Clearly articulates why tragedy of the commons happens, how we can solve it and what is their role in the solutions; uses substantive rationale; 3-4 DEVELOPING Articulates the link between human behavior and impact and interdependency of environmental, social and economic systems, but the linkage is not clear; uses substantive rationale; 0-2 BELOW EXPECTATIONS Omits or uses vague rationale in the explanation; Vaguely discusses the solutions; |

Tragedy of the Commons

Team project, 3-4 hours

| Objectives | Criterion | Standards |
|------------|---------------------------------|--|
| 2.4 | creative thinking | 5 PROFICIENT Clearly discusses the possible solutions under different scenarios including different system boundaries; 3-4 DEVELOPING Realizes the different solutions exist under different scenarios, but the discussion is vague; 0-2 BELOW EXPECTATIONS Omits the possible solutions under different scenarios; |
| 2.6, 3.5 | visually expressing connections | 5 PROFICIENT Creates a clear map of the connections that can be used to trace direct and/or indirect links between actions and impact; 3-4 DEVELOPING Creates a map that is not cohesive and/or complete in terms of the connection between actions and impact; 0-2 BELOW EXPECTATIONS Creates a map with incorrect connections or one that does not connect actions with impact |
| 6.3, 6.4 | self-directed learning | 5 PROFICIENT Independently able to identify what information one needs to learn to complete the assignment, determines an appropriate source of the information, educates oneself on the information and uses the information to complete the assignment; 3-4 DEVELOPING Needs varying degrees of minor assistance in completing the task; 0-2 BELOW EXPECTATIONS Needs assistance in finding information and completing the task; |

Assessment C | Systems Thinking

Population and Technology

Interdisciplinary Team Project, 9 hours

Targeted Learning Objectives

- 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);
- 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;
- 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;
- 3.2 Recognize interdependencies of different systems
- 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.
- 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 are have great power ("self-authorship") as an engineer to improve or worsen the larger systems;
- 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;
- 5.1 Know that others are also participants and/or victims of the global system;
- 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

Scenario

Is population the dominant variable in the global climate change and habitat loss?

Imagine that you are working at a company that manufactures and sells consumer electronics with 3% of the global market share. Your firm is in the process of realigning its mission and core values. One proposal is to launch a new campaign around the theme of global citizenship and focusing on restoring wildlife habitat and reducing the impact of anthropogenic climate change. The chief financial officer of the company contends that global population is the sole factor driving these two outcomes, so the company can have no impact on them. Your team has been asked to present a substantive case that illustrates that population is not the sole variable and that your company can in fact make decisions within its mission of making and selling consumer electronics that reduce the contributions to climate change and aid the restoration of wildlife habitat.

Suggested team strategy

- 1** | Brainstorm a complete list of possible linkages with the two outcomes (restoring wildlife habitat, reducing impact of climate change);
- 2** | From that list, attempt to link outcomes;
- 3** | List areas that need to be researched to validate linkages with facts;
- 4** | Research linkages to find facts to support the linkages.

Assessment C | **Systems Thinking**

Population and Technology

Interdisciplinary Team Project, 9 hours

| Objectives | Criterion | Standards |
|------------------------------|---------------------------------|--|
| 6.1-6.4 | self-directed learning | <p>5 PROFICIENT Independently able to identify what information one needs to learn to complete the assignment, determines an appropriate source of the information, educates oneself on the information and uses the information to complete the assignment;</p> <p>3-4 DEVELOPING Needs varying degrees of minor assistance in completing the task;</p> <p>0-2 BELOW EXPECTATIONS Needs assistance in completing the task, doesn't know where to start;</p> |
| 2.1-3, 2.6, 2.8 | critical thinking | <p>5 PROFICIENT Includes a eight or more appropriate components within the causal loop diagram; Can explain how changes in one component within the system ripple through to affect the outcomes;</p> <p>3-4 DEVELOPING Includes a only three to seven appropriate components within the causal loop diagram; Can explain how changes in one component within the system ripple through to affect the outcomes;</p> <p>0-2 BELOW EXPECTATIONS Includes components that have marginal or no impact on the outcomes; Includes one or two appropriate components.</p> |
| 2.7, 3.2-4, 4.1-6, 5.1 1.6-7 | making connections | <p>5 PROFICIENT Clearly articulates how eight or more specific and different actions they take in their company will directly and/or indirectly impact the two outcomes; uses substantive rationale;</p> <p>3-4 DEVELOPING Articulates the link between action and impact, but the linkage is not clear, or the actions and impact are similar in character (e.g., all economic); uses substantive rationale;</p> <p>0-2 BELOW EXPECTATIONS Omits or uses vague rationale; Linkages between action and impact are unclear;</p> |
| 3.5, 1.5 | visually expressing connections | <p>5 PROFICIENT Creates a clear map of the connections that can be used to trace direct and/or indirect links between actions and impact;</p> <p>3-4 DEVELOPING Creates a map that is not cohesive and/or complete in terms of the connection between actions and impact;</p> <p>0-2 BELOW EXPECTATIONS Creates a map with incorrect connections or one that does not connect actions with impact</p> |