Lesson 2

Analyzing Complex Environmental Problems

How do we understand complex environmental problems and figure out where to start when designing solutions?

In the face of pressing environmental problems, it is natural to want to jump straight into action and focus on an immediate solution. But in order to design successful, equitable, and lasting interventions, we need to take a step back and get a deep and contextualized understanding of the problem.

Many environmental problems have several stakeholders and interacting social, political, economic, and ecological contexts. These are known as complex, systemic, or 'wicked' problems. To understand them, we use *Systems Thinking* -- an approach that considers the elements, interconnections, and function or goal of the parts within a complex system (Meadows, 2008). In this lesson, we will use Systems Thinking to map and understand how systems function and interact, to identify leverage points and trade-offs, and ultimately, to plan and evaluate interventions.

To understand the drivers of complex environmental problems, you will:

- Analyze the complexity of a challenge to gain insights, understand the role and influence of human actors;
- Consider questions of justice and equity in systems, and how the power dynamics in a system influence equitable decision-making;
- Practice organizing, analyzing, and narrowing scope, and identify leverage points to understand potential ways to affect change in a system; and
- Get a sense of where to start with your chosen problem -- where in the system you want to focus.

Pre-Reading

First, we'll start with a primer on Systems Thinking. What is it, and why is it needed?

- What is a System? - this simple, climate-focused introduction shows how systems thinking can allow you to re-imagine the potential solution set for your problem.
- Tools for Systems Thinkers: The 6 Fundamental Concepts of Systems Thinking covers the key mindsets we'll employ throughout this lesson.
- WWF's The Art of Systems Change outlines fundamental tenets of systems thinking in environmental conservation, the behavior of complex systems, and guidelines for systems practice.

- Complexity of Coupled Human and Natural Systems explains concepts and phenomena inherent in any social ecological system, through case studies of a few example systems.
- Systems thinking for planning and evaluating conservation interventions shares concrete examples of how systems thinking tools can shift conservationists' approach to problem-solving.

To prepare for the in-class Decision Role Play, please read the following items and be prepared to discuss, build arguments, and propose decisions based on what you have learned.

- The Ames Anomaly: How 'A Small Town with a Pretty Big Idea' Came to Have the Only Resource Recovery Plant in the Country
- Long-range Air Transport of Dioxin from North American Sources to Ecologically Vulnerable Receptors in Nunavut, Arctic Canada
- Through this activity, we'll start to explore the connection between Systems Thinking and Environmental Justice; watch Environmental justice, explained for a brief background.

Once you've started to understand the complexity of a system, how do you choose where in the system you'll target your solutions, in order to drive change? We'll draw inspiration from Donella Meadows' classic Leverage Points: Places to Intervene in a System.

Lesson Content

VISUAL AID Primer: What is Systems Thinking?	We'll start with the basics of the Systems Thinking mindset: when is it needed, and how is it different from other approaches?
VIDEO A Systems Thinking Framework for Conservation	Dr. Jeni Cross shares why systems thinking is essential in conservation work, and what it can do to create just, equitable solutions with outsized impact. (Watch 1:00-4:30)
VIDEO Systems thinking: a cautionary tale (cats in Borneo)	Why is it so important to think in systems? This short video shows an example of the complex systems dynamics that can surface when we try to intervene with a seemingly simple technical solution.
VISUAL AID & HANDOUT What's at Stake: When Systems Interventions Fail	Here, we set the stakes for conservationists by sharing some examples of failed conservation interventions which could have been avoided by a better understanding of the system at hand. There is also a printable handout here.
ACTIVITY: DECISION ROLE PLAY Local Garbage in a Global Controversy	This simulation will put you in the shoes of stakeholders in an environmental decision to help you understand power structures and internalize the reality of how these decisions are made. It'll give you hands-on experience with the role of injustice, history, political systems, and the balance of power in systems analysis.

	The activity materials and directions are accessible via the link and we advise educators to condense the time allotted for speeches into one class period. *Afterwards, discuss: Which parts of the system was your team most focused on? What kind of change were you advocating for, preventing, or ignoring? How can environmental injustice be accounted for in global systems? After hearing all the arguments and proposals, do any additional solutions come to mind? Did the process include all the voices needed to make a just decision?*
VISUAL AID Tools for Systems Analysis	There are many tools for making sense of complex systems. This is an overview of the primary ones we'll use in this lesson, plus some additional frameworks that you might explore.
ACTIVITY The Iceberg Model	This activity pushes you to investigate the patterns, systems, and values that drive an issue, to dig beyond the surface-level symptoms and find the real causes of a problem.
MAP EXAMPLES System Map Examples: Food System Map and Saving Water for Nature Map	System maps help us start to visualize and understand the complexity of wicked problems. *Take some time to explore these maps and consider: what types of elements are captured within each of these maps (e.g. living/nonliving, types of stakeholders, resources, ideas, and structures)? Do you notice anything unexpected, any patterns or trends?*
ACTIVITY Interactive Causal Loop Visualization	This simulator allows you to experience causal loops in action. As you add in more elements, complex dynamics quickly emerge. *After experimenting with the simulation, go back to the System Map Examples from above. What causal loops can you spot in these examples, and what implications would this have if you intervened at different points in the system?*
VISUAL AID Identifying Leverage Points in Systems	Once we've mapped a system, how do we decide where to intervene? Donella Meadows' framing of Leverage Points helps us assess the different places we might intervene in a system, and balance the level of impact and difficulty we'd see at each.
ASSIGNMENT Map Your System	Challenge your assumptions about your topic, and better understand the system around your chosen challenge, by creating a systems map. Then, you'll choose a spot in the system where you think an intervention could have outsized impact.

Curious to learn more? There are additional resources for students, and alternative lesson content for educators, in the Explore More Section.