

5. Helping to Connect the Dots

Nurturing and Building on the Natural Systems Intelligence of Children

Linda Booth Sweeney

How can parents through everyday conversations and activities nurture their children's capacity to think in systems terms? How can educators build an environment that leads children to see the patterns that make a difference? In this article, educator and writer Linda Booth Sweeney points out that thinking about systems means paying attention to the interrelationships, patterns, and dynamics that surrounds us—and that children are naturally attuned to this. In cultivating systems literacy, you build upon this natural understanding to help promote this integrated way of thinking with the children in your life.

The road construction project around the local rotary had been going on for over a year. As a result, the whole town was cranky. One afternoon, my son and I drove the rotary just before 5 o'clock, along with throngs of irritable commuters anxious to get home. Tempers were short and the sound of car horns pierced the air. Pointing to the tangle of traffic in front of us, my then four-year-old asked: "Mommy, what happens when everyone says, 'Me first!'"

I was used to his asking questions. Typically Jack asked about categories ("Animals aren't people, are they?") or how things work ("Why do bees kiss the flowers?") or facts ("How hot is the center of the earth?"). But this question was different; this one had to do with causes and consequences. I considered talking to him about the cost of maximizing



One of the essential components of higher-order thinking is the ability to think about a whole in terms of its parts and, alternatively, about parts in terms of how they relate to one another and to the whole.”

—Chapter 11 (“Common Themes”) in *Benchmarks for Scientific Literacy: A Tool for Curriculum Reform, Project 2061, American Association for the Advancement of Science (Oxford University Press, 1993)* <http://www.project2061.org/about/default.htm>.

individual gain but held back and asked instead: “What do you think would happen if everyone said, ‘Me first!’?”

He pressed his nose against the window, paused and said, “Well, there might be a lot of accidents. Or maybe even a huge crash!”

“Can you think of other times when everyone says ‘me first’?” I was thinking about gas guzzlers, Napster, and our overcrowded community pool.

Jack responded, “You know how you said it’s not good to let the water run when we brush our teeth, ‘cause if everyone did that the reservoir would go down? Well, it’s kind of like that.”

At the age of four, he was already aware enough of systems to make a complex observation: the rotary and the reservoir were common resources. Like water, air, and playgrounds, these are resources that many people use and for which no individual is solely responsible. Moreover, in asking the question, “What happens when everyone says me first!” my son recognized the impact of individual decisions on the larger whole. Without knowing it, he stepped right into the middle of the greatest dilemma in commons-related issues: each individual action is defensible on its own, but they can combine to have devastating impact on the larger whole.

Many children intuitively grasp the nature of systems as Jack did. They can see, for instance, how a common but limited resource, such as water, air, land, highways, fisheries, energy, or minerals becomes overloaded or over-used, and how everyone experiences diminishing benefits. But they don’t always have many opportunities to develop those insights into a systems awareness that will serve them all their lives. Parents, educators, and other adults can help them learn to “connect the dots”: to see beyond the surface, to recognize interconnections and dynamics among people, places, events, and nature, and to begin thinking about how to use those interconnections to improve their world.

Where do our children learn to think this way? How do you nurture a child’s natural intelligence about systems and help him or her to become systems literate? How can you confirm for your children what they already know: that their world is interconnected and dynamic, a tightly woven web of related, interacting elements and processes and, as such, is indeed meaningful? How can this insight become an underlying learning aesthetic with which they can build their lives?

WHY SYSTEMS LITERACY MATTERS

Children today are growing up in a world in which oil spills, global warming, economic breakdowns, food insecurity, institutional malfeasance, biodiversity loss, and escalating conflict are all too commonly at

the top of the news. For children to make sense of these catastrophes, they must become aware of the causes and consequences in a slew of interconnected systems, including families, local economies, the environment, and more. Ideally, we want our children to take what author Edith Cobb calls “a reticulate approach” (resembling a net or network) to knowledge and sense making.

To be literate means to have a well-educated understanding of a particular subject, like a foreign language or mathematics. In many fields, the knowledge must be comprehensive and capable enough that you can put it to use. Systems literacy represents that level of knowledge about complex interrelationships. It combines *conceptual knowledge* (knowledge of system principles and behaviors) and *reasoning skills* (for example, the ability to place situations in wider contexts, see multiple levels of perspective within a system, trace complex interrelationships, look for endogenous or “within-system” influences, be aware of changing behavior over time, and recognize recurring patterns that exist within a wide variety of systems).

When people aren't literate about systems, too many human activities are like those cars jammed into the roundabout: unaware of the pattern that connects them and thus prone to exploitive and destructive results. Systems literacy is a prerequisite for realizing the kinds of aspirations that people increasingly have in an interconnected world but that seem impossible to achieve from a fragmented point of view. As the poet, novelist, and essayist Wendell Berry puts it, “We seem to have been living for a long time on the assumption that we can safely deal with parts, leaving the whole to take care of itself. But now the news from everywhere is that we have to begin gathering up the scattered pieces, figuring out where they belong, and putting them back together. For the parts can be reconciled to one another only within the pattern of the whole thing to which they belong.”

When children learn about systems and become more explicitly systems literate, their worldview shifts. In *The Power to Transform*, Stephanie Pace Marshall explains that the value of nurturing systems literacy comes from “the power of an alternative worldview.” She continues, “When we perceive and experience wholeness, we are transformed. We no longer see nature, people, events, problems, or ourselves as separate and unconnected.”

One natural consequence is greater compassion for others. This is a part of people's makeup that can get suppressed by the prevailing culture in many places but that can be uncovered and drawn out by experience and learning. When children look for the connection between

Edith Cobb, *The Ecology of Imagination in Childhood*. (Columbia University Press, 1977).

Research on children's and adults' intuitive understandings of complex systems shows that deep misconceptions about the dynamics of complex systems persist, even among highly educated adults. Research in dynamic decisionmaking shows that when adults are faced with dynamically complex systems—containing multiple feedback processes, time delays, nonlinearities and accumulations—performance is biased and suboptimal. See, for example:

Tina Grotzer, “Learning to Understand Forms of Causality in Scientifically Accepted Explanations,” *Studies in Science Education*, 39 (2003): 1–74.

John D. Sterman, “Misperceptions of Feedback in Dynamic Decision Making,” *Organizational Behavior and Human Decision Processes*, 43(3) (1989): 301–335.

John D. Sterman and Linda Booth Sweeney, “Understanding Public Complacency About Climate Change: Adults' Mental Models of Climate Change Violate Conservation of Matter,” *Climatic Change* 80(3-4) (2007): 213–238.

themselves and other people, places, events, and species, they no longer feel like outsiders looking in at others' worlds. They are now insiders, experiencing the connection to "other" as the farmer is connected to the soil and the salmon is connected to the river.

Another consequence is that children start to see themselves as part of, rather than outside of, nature. Imagine that a twelve-year-old, living in a suburban village, is presented with two pictures of a lawn. The first is filled with wildflowers and looks somewhat messy and random. The second is lush, green, neat, orderly, well-groomed, and obviously well-fertilized. Which is more beautiful? The second image, of course, represents the way that a beautiful lawn is conventionally expected to look in many communities, and many twelve-year-olds would pick it. But a systems-literate student might well prefer the disorderly lawn. He or she would know that that the lawn worked with the landscape's natural processes, encouraging a diverse group of plants and animals to grow, maintaining its own ecological balance and adding little or no waste to the ecosystems around it. On the other hand, the orderly, straight, groomed lawn could only survive by contradicting natural processes. It would require ongoing management, and its continued success would lead to a variety of unintended negative consequences: greenhouse gas emissions from the lawn mower, use of fossil fuels to make chemical fertilizers and treatments, the death of beneficial insects from pesticides, the added economic costs of lawn supplies and maintenance and the stress this puts on the family's budget, the removal of some plants allowing others to overrun the ecosystem (potentially causing the need for more pesticides), and the run-off of chemicals into local water sources with unknown effects.

As they grow up and learn about the economy, climate, education, energy, poverty, waste, disease, war, peace, demographics, and sustainability, children who are systems literate will tend to look at all these issues as interrelated. From the systems perspective, nothing stands alone: my climate is your climate, your infectious disease is my infectious disease, your food shortage is my food shortage. Systems literacy makes people less likely to blame a single cause for challenges and problems. Instead, it becomes a habit to look for recurring patterns that exist among a wide variety of systems, to seek out indicators of interrelated causes (knowing that very complex causes can leave deceptively simple tracks), and to conduct thought experiments to anticipate how the functioning of a living system will change if a part or a process is changed. Systems thinkers recognize that big actions can have small consequences—and vice versa. They seek diversity, knowing that living systems depend on the variety,

complexity, and abundance of species to be healthy and resilient. They look for closed loops of production and consumption, where waste from one source can be “food” for another. They question the assumption that bigger is always better.

Paying attention to living systems also raises awareness of Earth’s (or biosphere’s) pace of change, often in stark contrast to the hurried, mechanistic pace of the technosphere. Systems literacy makes it easier to see the commons: the shared gifts of nature such as water, air, land, fish, and also the shared efforts of our communities, upon which we depend and for which we are all responsible.

Learning about systems, and about living systems in particular, can help children come to a deeper, more compassionate, more accurate, and more sustainable sensibility about what is beautiful, what is peaceful, and what is essential.

Stephanie Pace Marshall, *The Power to Transform: Leadership That Brings Learning and Schooling to Life* (Jossey-Bass, 2006).