



Educating for Sustainable Development: What Will it Take?

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HARVARD
GRADUATE SCHOOL OF EDUCATION



NEXT LEVEL
LAB

Three Necessary Shifts

- Educating for Global Collectivity
- Educating for Complexity
- Educating for EarthXDesign

A top-down view of several hands of various skin tones, each gently cradling a small green seedling with dark soil. The hands are arranged in a circle, creating a sense of collective care and unity. The background is dark and slightly blurred, emphasizing the hands and plants.

Educating for Global Collectivity: Thinking Like an Earthling



Dr. Jill Tarter

**Astronomer, Chair Emeritus of the Center for SETI
Research (Search for Extraterrestrial Intelligence)**

“...if you sit and listen to me talk or anyone talk or think about SETI, you got to realize that it is putting on a mirror up to everyone on the planet and the message is, “You, you are all the same when compared to something else out there. And I think that this is the perspective, the cosmic perspective that we need globally in order to attack the challenges that we heard about earlier with respect to energy and water security and food security. We need to think and act as one species. We are earthlings. [Quoting Scharf, he says] “On a finite world [that’s us], a cosmic perspective isn’t a luxury, it is a necessity.” So you all have a homework assignment. When you get back to your social media, go into your profiles and change the first thing that you say about yourself to the fact that you are an earthling and then act like it.”

A photograph of three wooden chairs arranged in a circle in a grassy forest. The chairs are made of dark wood. The chair on the left has a green cushion. The chair in the middle has a grey cushion. The chair on the right has a black cushion. The background is a dense forest of birch trees with green foliage. The text "Moral Musical Chairs" is overlaid in white in the center of the image.

Moral Musical Chairs

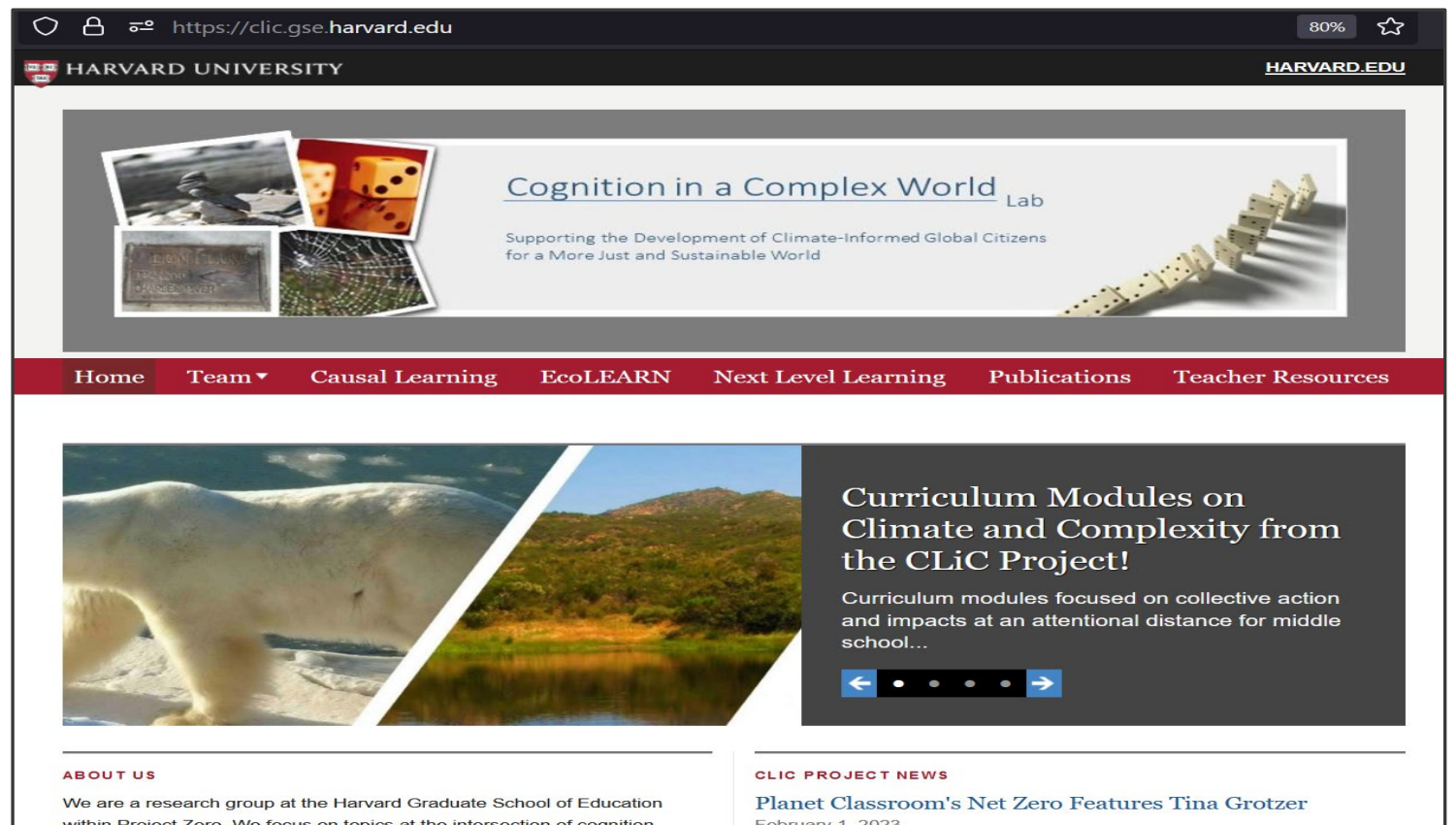
How it works...

- Learners consider what perspectives might relate to the situation with support from their teacher in helping them to consider what voices should be at the table.
- They gather information about each—being mindful of the need to set their own lenses aside as much as possible and supported by the teacher in this preparation.
- They play MMC with one chair per role to consider the perspectives (imagining that they could be anyone in the scenario).
- The teacher lightly facilitates as needed to help to deepen the conversation through questions to explore different perspectives and conflicting needs.

Moral Musical Chairs: Essential Questions

- Realizing My Own Lens Through Contrast to Others: What perspective do I hold?
- Recognizing Dominant and Silenced Voices: What voices am I not hearing?
- Understanding Other Lenses: What perspectives might other voices bring and what influences them?
- Adopting Other Lenses to View Particular Situations: How do I see the situation differently through this lens?
- Stepping Out of my Own Stance: What might I decide to do if I didn't know which role in the complex situation I will inhabit?

Relevant Papers:



The screenshot shows the homepage of the CLiC project website. At the top, the URL is <https://clic.gse.harvard.edu>. The header includes the Harvard University logo and the text "HARVARD UNIVERSITY" and "HARVARD.EDU". The main banner features the title "Cognition in a Complex World Lab" and the subtitle "Supporting the Development of Climate-Informed Global Citizens for a More Just and Sustainable World". Below the banner is a navigation menu with links: Home, Team, Causal Learning, EcoLEARN, Next Level Learning, Publications, and Teacher Resources. The main content area has a large image of a polar bear and a landscape, with the text "Curriculum Modules on Climate and Complexity from the CLiC Project!" and a description: "Curriculum modules focused on collective action and impacts at an attentional distance for middle school...". Below this is a section titled "ABOUT US" with the text: "We are a research group at the Harvard Graduate School of Education within Project Zero. We focus on topics at the intersection of cognition..." and a section titled "CLIC PROJECT NEWS" with the text: "Planet Classroom's Net Zero Features Tina Grotzer February 1, 2023".

Grotzer, T.A., Solis, S.L., & Derbiszewska, K. (2017). Leveraging fourth and sixth graders' experiences to reveal understanding of the forms and features of distributed causality. *Cognition and Instruction* 26(1), 1-47.

Grotzer, T.A. & Solis, L.S. (2023). Thinking like an Earthling: Children's reasoning about individual and collective action related to environmental sustainability, *Topics in Cognitive Science*, <http://doi.org/10.1111/tops.12650>.



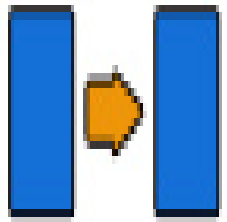
Educating for Complexity

Human cognitive architecture is not particularly well adapted for perceiving, attending to, and reasoning about complexity...

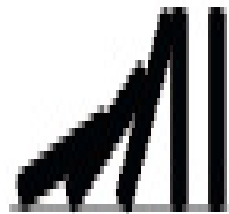
Simplifying Default Assumptions

1. linear (vs. non-linear)
2. direct (vs. indirect)
3. uni-directional (vs. bi-directional)
4. sequential (vs. simultaneous)
5. obvious (vs. non-obvious)
6. local (vs. spatially distant)
7. event-based (vs. processes or steady states)
8. immediate (vs. delayed)
9. deterministic (vs. probabilistic)
10. active or intentional agents (vs. non-agentive)
11. centralized (vs. decentralized)

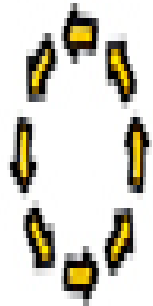
Causal Patterns:



Linear



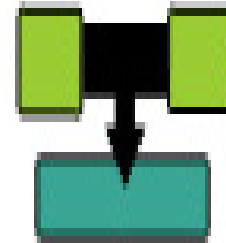
Domino



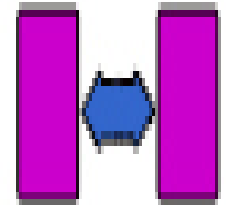
Cyclic



Spiraling



Relational



Mutual

Humans find it difficult to reason about:

- Extended, Indirect Effects
- Feedback Loops
- Time Delays
- Spatial Gaps
- Non-Obvious Causes
- Reasoning at Different Levels (Individual Organisms and Population Levels)
- Interdependencies
- Scale Processes and Steady States
- Reasoning About Balance and Flux
- Emergence and Distributed Causality
- Non-Incremental Effects/Tipping Points

Distributed Causality

A causal structure in which agency is distributed across multiple actors

whose actions collectively result in emergent outcomes. The emergent effects are:

- on a much larger scale than the individual ones;
- may be aligned with individual intentionality or not;
- may be part of one's awareness or not.



Action at an Attentional Distance

Refers to instances of spatially discontinuous causes and effects in which the causes and effects reside in different attentional frames.





Non-Obvious Variables

It is difficult to attend to what we can't see. Mechanisms that are non-obvious often escape our attention. We don't allow for causeless effects but until we can see effects, we don't look for causes.

Learning to Teach About Complexity: Books and Curriculum Resources for Educators

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<http://www.causalpatterns.org>

Causal Patterns in Science

a professional development resource

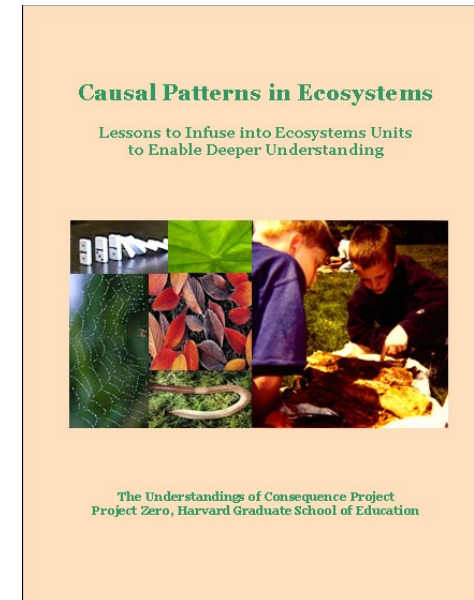
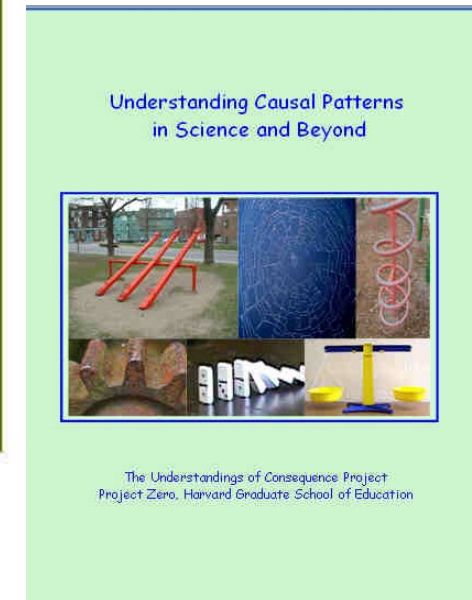
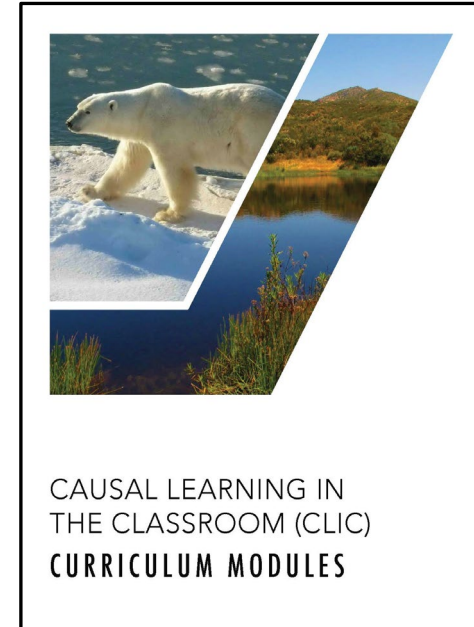
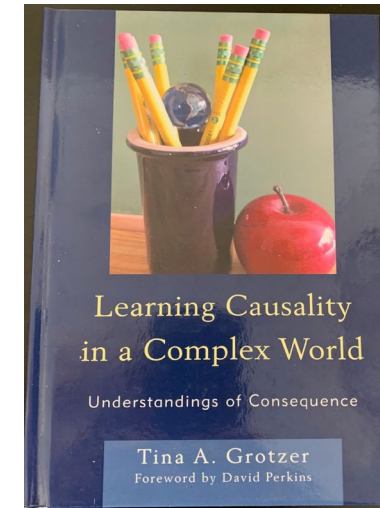
This site shows you how to teach the causal patterns embedded in the science curriculum so that students emerge with deeper understanding. It links to and supports use of the *Causal Patterns in Curriculum Series* (see *About Us* section).

You'll find examples of students' thinking, activities, assessments, classroom tips, and the rationale and supporting research behind this approach. General science examples and in-depth examples from Ecosystems and Density are given.

You will learn to identify the patterns and how students struggle unless they grasp them, to teach and assess understanding of the patterns at the same time you teach the science, and to make it all work in your classroom.

Causal Patterns	Using this Web site	 RECAST Activities
 What Teachers Say	Project Intro Enter	 Causality & Misconceptions
 Assessing Understanding	Resources & Curricula	 Making it work in the classroom

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Sample Publications on the Research Studies:

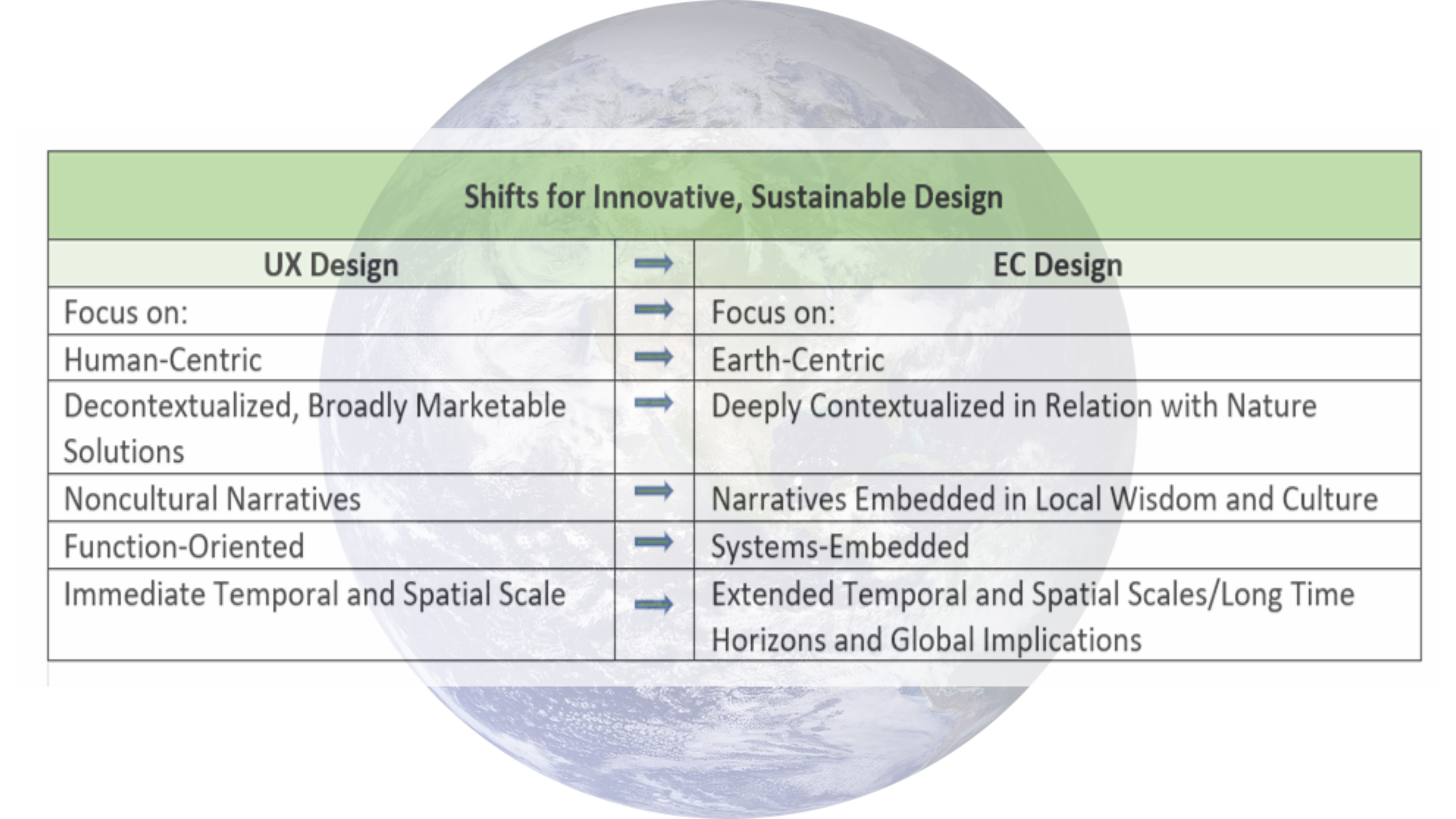
- Solis, S. L., Grotzer, T.A. & Curtis, K.N. (2019). “There must be a cat nearby”: Kindergarteners’ reasoning about ‘Action at an Attentional Distance.’” *Journal of Educational and Developmental Psychology*, 9(2), 182-202.
- Cuzzolino, M.P., Grotzer, T.A. Tutwiler, M.S., & Torres, E.W. (2019). An agentive focus may limit learning about complex causality and systems dynamics: A study of seventh graders' explanations of ecosystems. *Journal of Research in Science Teaching*. 56(8), 1083-1105.
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- Grotzer, T.A., Solis, S.L., & Derbiszewska, K. (2017). Leveraging fourth and sixth graders’ experiences to reveal understanding of the forms and features of distributed causality. *Cognition and Instruction* 26(1), 1-47.
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- Grotzer, T.A., Powell, M. Kamarainen, A.K., Courter, C., Tutwiler, M.S., Metcalfe, S. & Dede, C. (2015). Turning transfer inside out: The affordances of virtual worlds and mobile devices in real world contexts for teaching about causality across time and distance in ecosystems. *Technology, Knowledge, and Learning* , Vol. 19(3). Available on-line, Dec. 24, 2014, DOI: 10.1007/s10758-014-9241-5.
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- Grotzer, T.A., Kamarainen, A., Tutwiler, M.S, Metcalfe, S, & Dede, C. (2013). Learning to reason about ecosystems dynamics over time: The challenges of an event-based causal focus. *BioScience*, 63(4), 288-296.
- Grotzer, T.A. (2003). Learning to understand the forms of causality implicit in scientific explanations. *Studies in Science Education*, 39, 1-74.
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EarthXDesign

Why do We Need EarthXDesign?

- Innovation and design in all aspects of life will be essential for continuing to meet the challenges of a warming planet.
- While there are approaches to innovation and design, much of it is human-centric and not particularly well-suited to issues of sustainability and the climate crisis.
- Human experience depends upon Earth systems and dynamics.
- The climate crisis requires new, high leverage forms of broad innovation in terms of non-local approaches and autonomous adaptation in terms of local design.
- Existing research on creative thinking can be leveraged to inform earth-centric approaches to design.
- UX Design and EarthXDesign should not be in competition!



Shifts for Innovative, Sustainable Design

UX Design	➔	EC Design
Focus on:	➔	Focus on:
Human-Centric	➔	Earth-Centric
Decontextualized, Broadly Marketable Solutions	➔	Deeply Contextualized in Relation with Nature
Noncultural Narratives	➔	Narratives Embedded in Local Wisdom and Culture
Function-Oriented	➔	Systems-Embedded
Immediate Temporal and Spatial Scale	➔	Extended Temporal and Spatial Scales/Long Time Horizons and Global Implications



What about designs that already exist around us? How can we make them more Earth-Resonant?



Analyzing for Features of Earth Resonant Design:

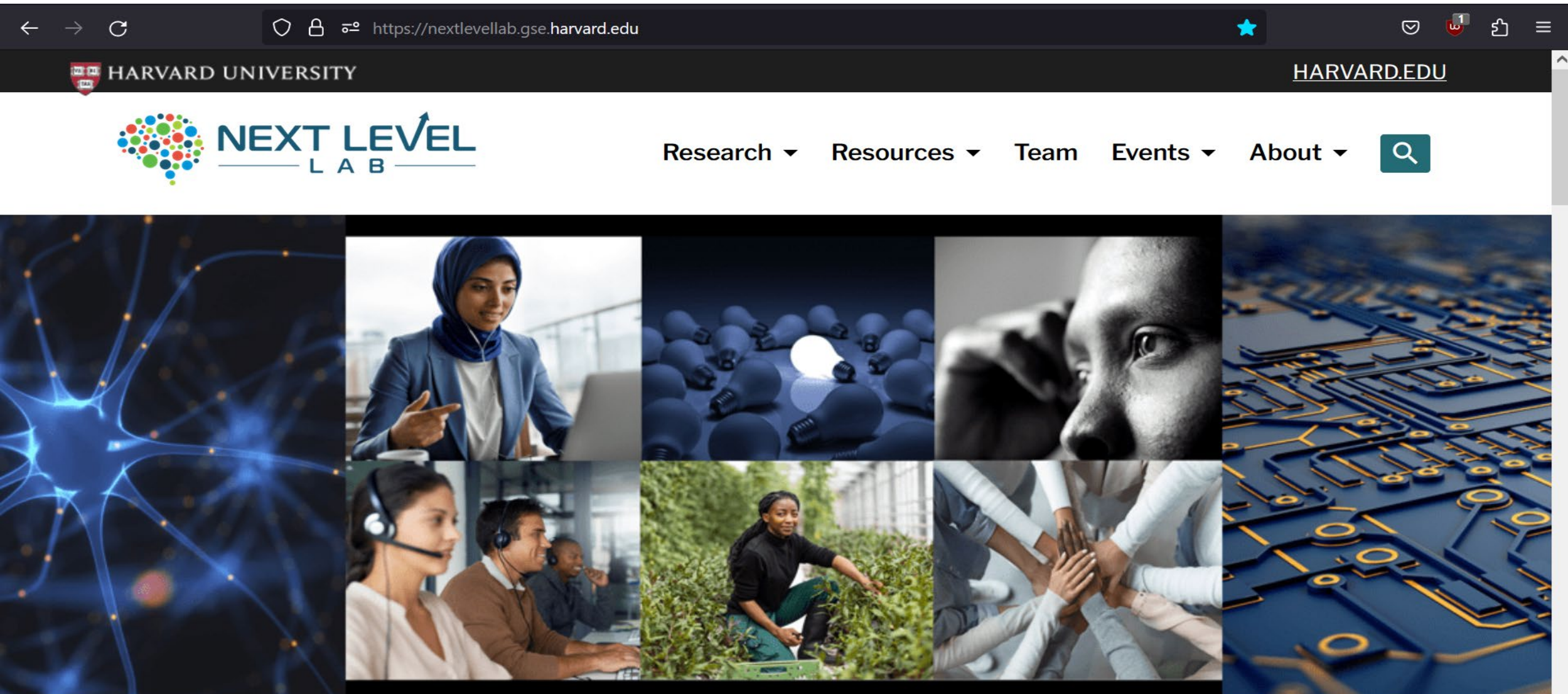
Ask:

- Does it include consideration for the planet? For non-human inhabitants of the planet? Or only people?
- Can it be sustained over time? Does it introduce new problems?
- Are implicit assumptions revealed/analyzed/re-considered? Turned inside out?
- Are the extended, possibly unanticipated effects traced out and considered?
- Does it address sensitivity, ability and inclination to enact behavior change?
- Does it address environmental issues? injustice issues? health issues?
- Do you see paths to acceptance?
- Are there opportunities for autonomous adaptation? local wisdom? centralized, but non-local expertise? An integration of the two?
- Is it a centralized solution? ...distributed solution?

Three Necessary Shifts: Are We Up It?

- Educating for Global Collectivity
- Educating for Complexity
- Educating for EarthXDesign

Explore our website to learn more about the Next Level Lab....



➤ Established with Funding from Accenture Corporate Giving