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Understanding Complexity in Biology Education

Complex systems are prevalent in many scientific fields, and at all scales – from the micro scale of a single cell or molecule to macro complex systems such as ecosystems. Such natural systems are typically dynamic and often held in states of equilibrium with other interdependent systems, and the interactions within and between them can be unpredictable. Understanding the complexity of natural systems can therefore be extremely challenging, but is nevertheless crucial for an adequate understanding of what they are and how they work.

The term “systems thinking” has become synonymous with developing a coherent understanding of complex biological processes and phenomena. For researchers and educators alike, understanding how students’ system thinking develops is an essential prerequisite to developing and maintaining pedagogical scaffolding that facilitates students’ ability to fully understand the system’s complexity. My presentation will provide key insights from the current research community, introducing issues such as:

- a) How conceptual representation with models can not only promote deeper systems understanding, but also make it possible to identify the development of system thinking capacities within individual learners.
- b) How different design elements of computer-based learning environments promote complex systems thinking and facilitate students’ ability to regulate their learning.
- c) How students might benefit from explicit guidance in using system language, and in drawing clear connections between the various aspects of the complex system, and how such guidance can be used to help students to visualize and reason about biological complex problems.
- d) How pedagogical scaffolding approaches can help students draw connections between different levels of biological organization – from the full-organism level to the micro or macro level – moving back and forth between the levels to make explicit connections between concepts and phenomena at different levels.