Building open education ecosystems to facilitate the adoption and adaptation of computational and data-centric tools across undergraduate biology education

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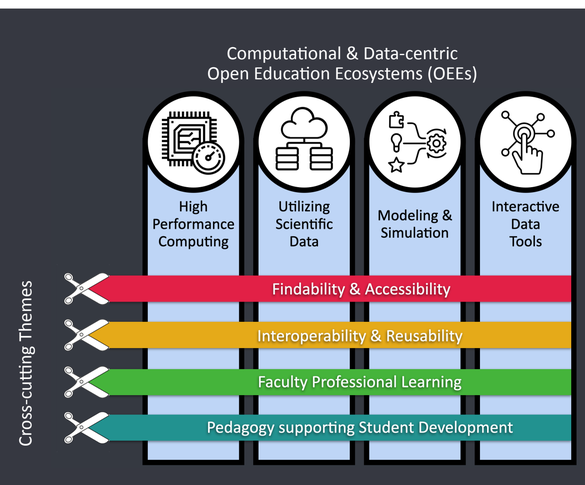

Abstract: The OEE-RCN is an NSF-funded Research Coordination Network working at the intersection of Open Science and Open Education Resources (OER) with the goal of lowering barriers to adopting computational and data-centric tools in biology undergraduate education. Four ***open education ecosystems (OEEs)*** will be designed as stewardship communities that establish, support, and incubate diverse collections of resources addressing the complex ecosystem of support required to meet this goal. While distinct in their computational contexts, the OEEs share ***cross-cutting themes*** that address well documented barriers to classroom implementation.

Cross-cutting Themes (Implementation Challenges)

Findability & Accessibility

- Multidimensional nature of scientific data, computational tools, and open educational resources (OER)
- Integration of computational and data-centric tools in OER are often not accessible
- Many computational tools are not scalable from research to educational contexts

Interoperability & Reusability

- Lack of integration between OER repositories, computational service providers, and data storage centers
- List of alternate service providers, tools, and data sets would allow for more flexible implementations
- Difficult to adapt computational and data-integrated OER to new classroom contexts

Faculty Professional Learning

- Teaching unfamiliar content from adjacent STEM disciplines is challenging with modern scientific tools
- Finding computational and data-centric professional training can be difficult for educators
- Applying content from short courses designed for researchers to teaching contexts can be challenging

Pedagogy supporting Student Development

- Pedagogical content knowledge from adjacent STEM disciplines has limited uptake in biology education
- Identifying and addressing learning outcomes associated with computational approaches requires support
- Lack of cross-disciplinary communities to collaborate on implementation of pedagogical techniques

Computational & Data-centric Open Education Ecosystems

(P) Partner (E) Education Project (T) Tool (S) Service Provider

High Performance Computing

Genomics Education Partnership (E, P) · HHMI · HITS (E, P) · TACC (S) · Galaxy PROJECT (S, P) · SGX3 | SGCI (S, P) · hubzero (S, P) · CYVERSE (S, P) · ACCESS (S)

Utilizing Scientific Data

BEDE Network (E, P) · neon National Ecological Observatory Network (E, P) · jupyter (T) · (T) · R (T) · julia (T) · Google colab (T)

Modeling & Simulation

COCALC (S) · Math Modeling Hub (E, P) · sage (T) · SAGEMODELER (T) · SIMIODE (E, P) · The PROSE Consortium (E, P)

Interactive Data Tools

Observable (T) · gala (E, P) · hhmi BioInteractive Data Explorer (T, P) · Shiny shinylive for R webR (T) · CODAP (T) · QGIS (T) · OCELOTS (E, P) · plotly | Dash (T)

Objectives

- Support **FAIR principles across STEM education and research**, particularly in support of computational and data-centric curricula.
- Host protocols and access points for faculty and students to computational resources that **scale to large numbers of learners** and facilitate interoperability with data and lessons.
- Provide a diverse array of **Faculty Professional Learning opportunities** that cover both pedagogical best practices for incorporating computations and data into the curriculum and on-ramps to existing cyber-training and data skill development programs.
- Ensure that the educational benefits associated with this work will **empower traditionally marginalized learner communities**.

Goals

- Develop **metadata schemas** linking OER with cyber-training, data, tools, and service providers.
- Annotate a **diverse and integrated repository** spanning scientific and educational resources including OER, service providers, computational techniques, organizations and communities, data, and training/professional learning resources.
- Provide a diverse array of Faculty Professional Learning opportunities, including **Faculty Mentoring Networks**, and link to existing cyber-training and faculty development events occurring through partner organizations.
- Assess and disseminate results and activities of the network through a multifaceted approach, including performing **landscape analyses, white papers, collaborative knowledge base articles, blogs, newsletters, and case studies**.

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