Interdisciplinary biology education: a holistic approach to an intractable problem

Kristin Jenkins
BioQUEST
GLBIO 2019

BioQUEST
CURRICULUM CONSORTIUM

BioQUEST Curriculum Consortium

BioQUEST is a transformative, collaborative community empowering Life Science educators to drive innovation in STEM education.

BioQUEST

QUBES
Biology × Math × Community
qubeshub.org

Quantitative Undergraduate Biology Education and Synthesis (QUBES)

QUBES

The Power of Biology × Math × Community

- Offers virtual faculty professional development
- Provides open educational resources for teaching quantitative skills

Professional Development

TIEE
TEACHING ISSUES AND EXPERIMENTS IN ECOLOGY

BOTANICAL SOCIETY OF AMERICA
leading scientists and educators since 1893

Math Bench
Biology Modules

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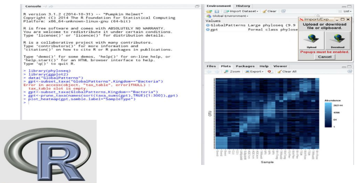
InTeGrate
Interdisciplinary Teaching about Earth for a Sustainable Future

Software Tools



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Educational Materials

Society for Mathematical Biology

SUMS4Bio
Strengthening Undergraduate Mathematics and Statistics for Biologists

ECOLOGICAL SOCIETY OF AMERICA
esa

BioInteractive
hhmi

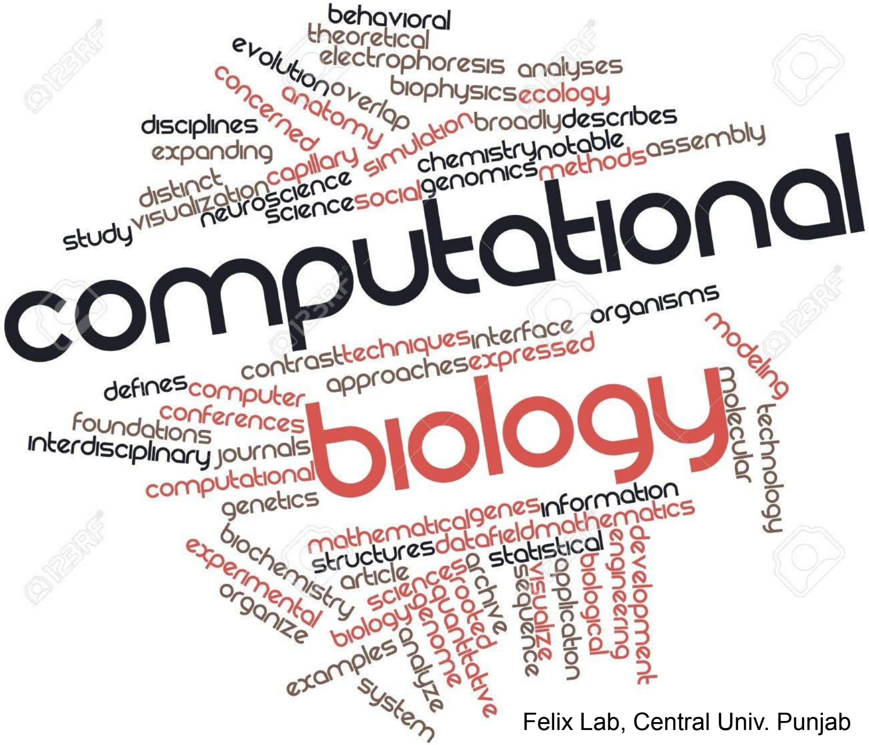
NIMBioS
National Institute for Mathematical and Biological Synthesis

neon
National Ecological Observatory Network

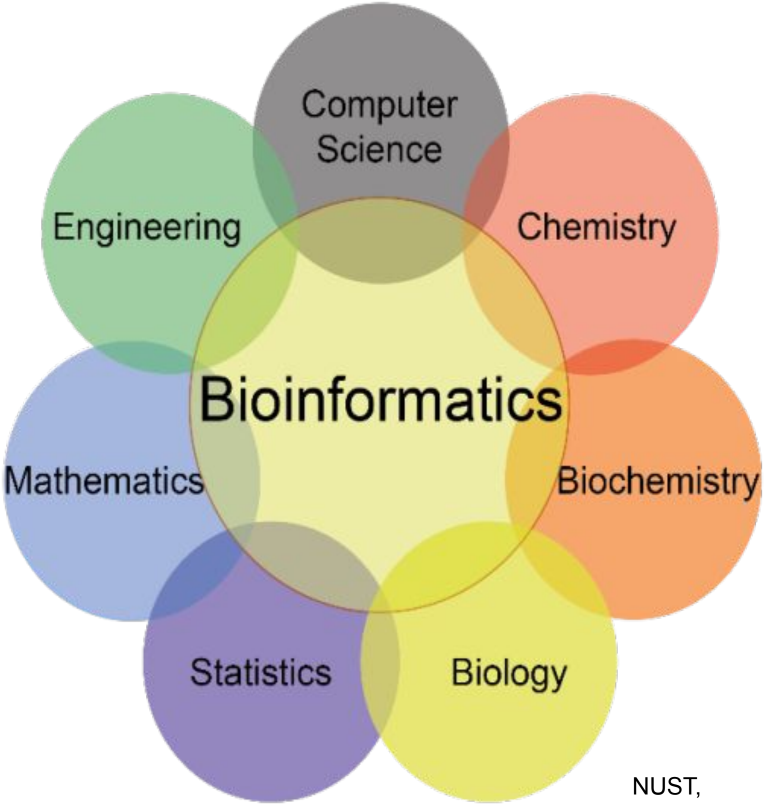
NABT
National Association of Biology Teachers

SSE

AAAS



Felix Lab, Central Univ. Punjab

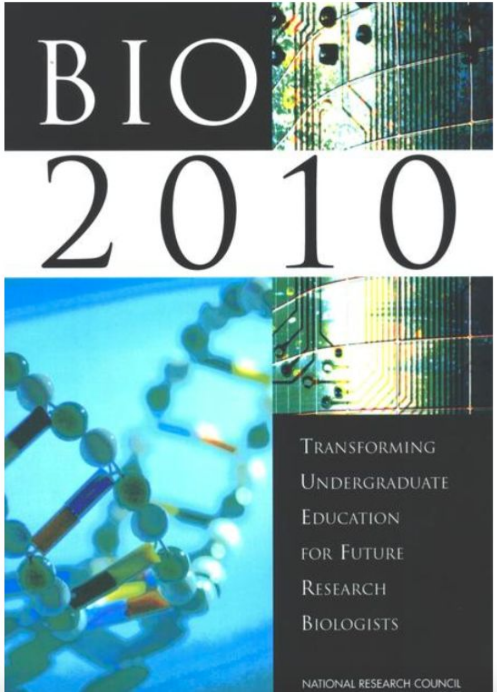


NUST,
Pakistan

Interdisciplinary Biology Education

Identifying commonalities between disciplines that can be taught and reinforced in different contexts.

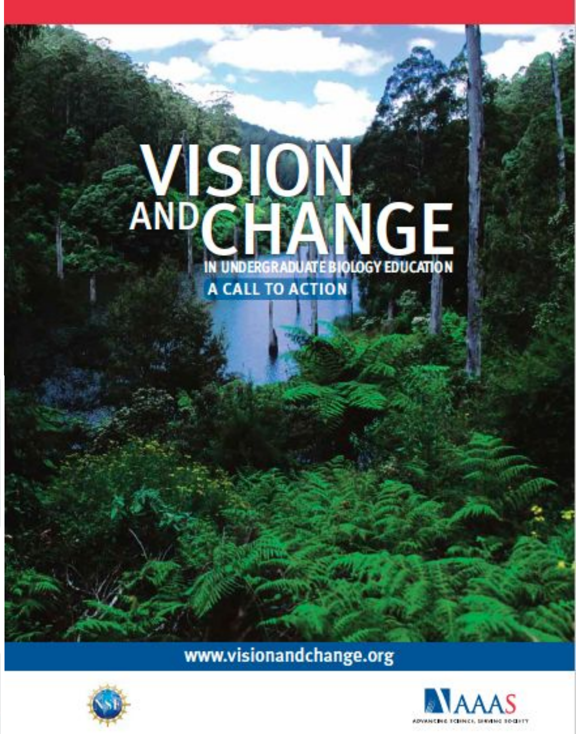
Using bioinformatics and computational biology contexts to teach and reinforce more general learning outcomes.



BIO
2010

Transforming
Undergraduate
Education
for Future
Research
Biologists

National Research Council



VISION
AND CHANGE
IN UNDERGRADUATE BIOLOGY EDUCATION
A CALL TO ACTION

www.visionandchange.org

AAAS

Five core biological concepts

- **Evolution**: The diversity of life evolved over time by processes of mutation, selection, and genetic change.
- **Structure and Function**: Basic units of structure define the function of all living things.
- **Information flow, exchange, and storage**: The growth and behavior of organisms are activated through the expression of genetic information in context.
- **Pathways and transformations of energy and matter**: Biological systems grow and change by processes based upon chemical transformation pathways and are governed by the laws of thermodynamics.
- **Systems**: Living systems are interconnected and interacting.

Core Competencies

BioGrad Liverpool Science Park

- Ability to …
    - apply the process of science
    - use quantitative reasoning
    - use modeling and simulation
    - tap into the interdisciplinary nature of science
    - communicate and collaborate with other disciplines
    - understand the relationship between science and society

NIBLSE Bioinformatics Learning Outcomes

C1. Explain the role of computation and data mining in addressing ***hypothesis-driven and hypothesis-generating questions*** within the life sciences.

C2. Summarize key ***computational concepts***, such as algorithms and relational databases, and their applications in the life sciences.

C3. Apply ***statistical concepts*** used in bioinformatics.

C4. Use bioinformatics tools to examine complex biological problems in ***evolution, information flow, and other important areas of biology***.

C5. Find, retrieve, and organize various types of biological ***data***.

C6. Explore and/or ***model*** biological interactions, networks and data integration using bioinformatics.

C7. Students should be able to manipulate their own data and to create and modify complex ***data processing and analysis workflows***.

C8. Describe and manage biological ***data*** types, structure, and reproducibility.

C9. Interpret the ***ethical, legal, medical, and social implications of biological data***.

Using Learning Outcomes to Incorporate Bioinformatics Across Levels & Courses

- Identify one or two key learning objectives or core competencies in a module you currently use.
- How might this module be adapted to introduce or reinforce these objectives/competencies in a higher or lower level course?

Teaching bioinformatics and computational biology

- What resources and support do faculty need to teach bioinformatics & computational biology across the biology curriculum?
- What resources and support can this community provide to promote the teaching of bioinformatics & computational biology across the biology curriculum?

NIBLSE
Bioinformatics in Life Sciences Education

NIBLSE (Networks for Integrating Bioinformatics into Life Sciences Education)
https://qubeshub.org/community/groups/niblse

GLBIO 2019 Special Session on Bioinformatics Education
https://qubeshub.org/community/groups/glbioedu

QUBES qubeshub.org

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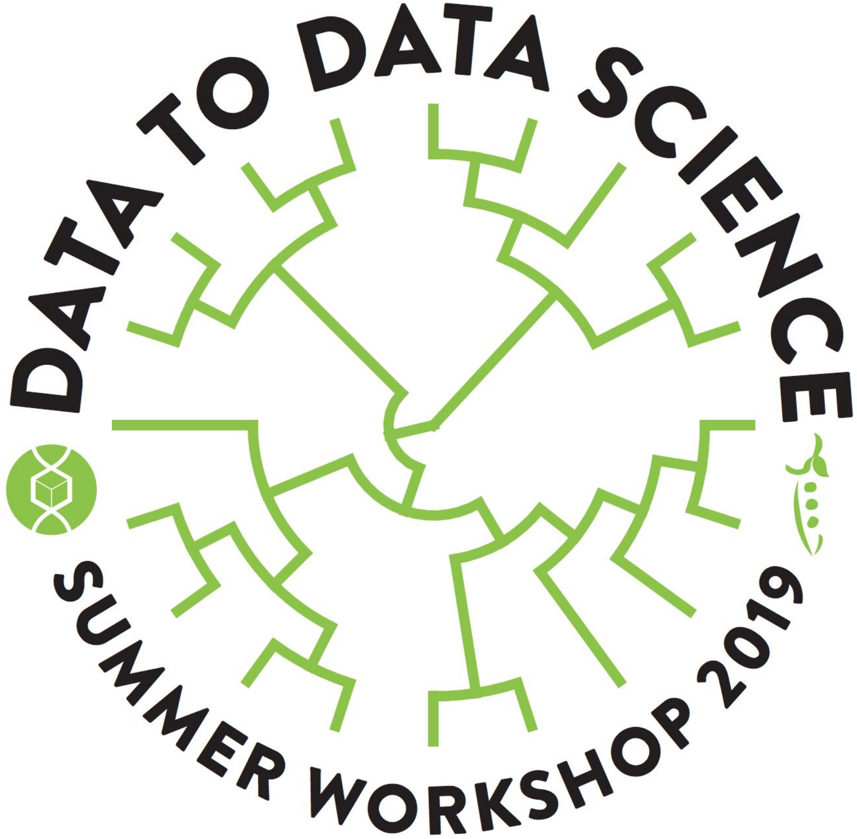

Dates: July 14-19, 2019

Location: William and Mary

Website:
https://qubeshub.org/groups/summer2019