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Undergraduate Life Sciences Curriculum

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Abstract for DBER Group Discussion on 2013-01-24

Presenter, Department(s):
John Osterman
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School of Biological Sciences

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Professor
Department of Entomology

Title:
An Overview of the Life Sciences Curriculum

Abstract:
The Life Sciences curriculum currently consists of a two semester series of courses and associated laboratories covering the fundamentals of biology. It is intended to serve those students who intend on taking more advanced biology courses. I will review the procedure used in the development of the courses and cover the proposed syllabi for the courses.

Undergraduate Life Sciences Curriculum

John Osterman and Tiffany Heng-Moss
University of Nebraska-Lincoln

Three proposals

- Life Sciences Competencies—This proposal will identify overarching concepts and specific competencies common to undergraduate students in the life sciences at the University (introductory level).

- Life Sciences Program—This proposal will identify a framework and the initial set of courses and experiences that will help students achieve the Life Sciences Competencies.

- Life Sciences Implementation Plan—This proposed plan will encompass:
  - preparation & distribution of a report on the Life Sciences teaching facilities;
  - proposal of a strategy for coordination of the Life Sciences curriculum; and
  - engagement of the Undergraduate Life Sciences Coordinating Council to coordinate, sustain, and review the undergraduate Life Sciences program which emerges from the process.

Expected Features of the Program:

- Prepare students for a diverse array of academic and professional careers;
- Build on the ACE program;
- Responsive to the changing environment of life sciences research and practice; and
- Flexibility; provide a portal to multiple majors (e.g., lower division core that allows student movement across Life Sciences majors).

Leadership Teams

- Life Sciences Planning Team

  Audrey Atkin
  Melanie Simpson
  Martha Mamo
  Jeff Rudy
  Tiffany Heng-Moss
  Gwen Bachman
  Patrick Dussault
  Rodney Moxley
  John Osterman

- Life Sciences Advisory Council

Proposal 1: Competencies

- Progress to date:
  - Development of core themes and competencies for biology and supporting competencies in chemistry, physics, mathematics, and statistics
  - Modeled after Vision and Change report
  - Listening sessions & input from Life Sciences units
  - Approval by A&S, CASNR, CEHS (May 2012)

Proposal 2: Framework

- Progress to date:
  - Approval of proposal to develop an initial set of courses and experiences that will help students achieve the Life Sciences competencies (May 2012)
  - Course Development Committee
  - Approval of LIFE 120, 120L, 121 and 121L by colleges (September 2012)
  - Final approval by UCC and ACE certification (December 2012)

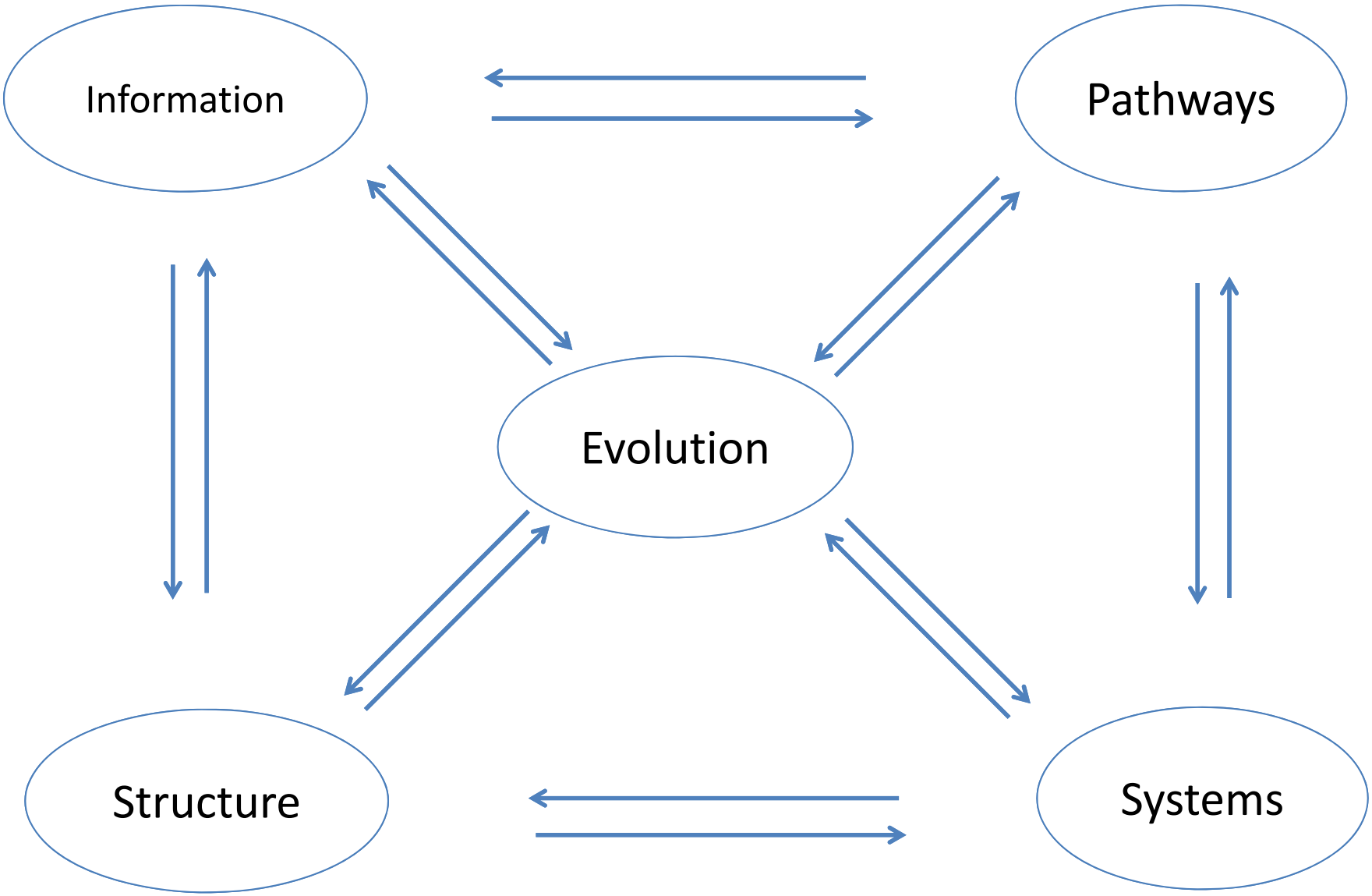
Proposal 3: Implementation Plan

- In Progress: projected to be completed by May 2013
  - Preparation & distribution of a report on teaching facilities
    - Life Sciences Education Building Task Force formed
  - Preparation & distribution of a report on resources needed (e.g., teaching support, laboratory supplies/equipment, laboratory space, etc.)
  - Team of instructors identified: October 2012
  - Proposal for coordination of the Life Sciences curriculum (discussed with Vice Chancellors)

Procedure

- Define core concepts
  - Vision and Change report
- Define competencies
  - Secondary Science Education
  - ABT reports
  - Input from colleagues
- Maintain flexibility
- Maximize coverage
- Minimum competencies

Concept map



Evolution: The scientific theory and principles of evolution underpin all of biology

- Competency 1: microevolution: students should be able to explain how selection and drift affect allele frequencies.
- Competency 2: macroevolution: students should be able to explain models of speciation.
- Competency 3: students should be able to explain how biological information is used to generate a phylogenetic tree and how to interpret the relationships displayed on a tree.
- Competency 4: students should be able to explain the origin and scope of biological diversity (including humans).

Pathways and transformations of energy and matter: life processes in living systems organize and convert matter and energy

- Competency 1: students should be able to explain the biological significance of chemical bonds and free energy changes.

- Competency 2: students should be able to explain how energy is stored chemically and released by enzymes.

- Competency 3: students should be able to explain and connect fundamental metabolic pathways.

- Competency 4: students should be able to explain conversion of light energy into chemical energy.

Information flow, exchange and storage: Inheritance and expression of genetic material

- Competency 1: students should be able to explain how cell division generates new cells.
- Competency 2: students should be able to explain basic inheritance of genetic material.
- Competency 3: students should be able to explain DNA replication and gene expression.
- Competency 4: students should be able to explain how gene expression drives development and responds to environmental conditions.

Structure and function: Structures of cells and multicellular systems are related to their function

- Competency 1: students should be able to explain how membranes form and function.

- Competency 2: students should be able to explain basic cellular structures and their corresponding functions.

- Competency 3: students should be able to explain the similarities and differences of the three domains of life (*Bacteria, Archaea and Eukarya*).

- Competency 4: students should be able to explain the basic functions of multi-cellular systems.

Systems: Understanding biological systems requires both reductionist and holistic thinking because novel properties emerge as simpler units assemble into more complex structures

- Competency 1: students should be able to give examples of structural complexity and information content at the cellular, organismal, population and ecosystem levels.

- Competency 2: students should be able to explain the flow of energy, materials and information among cells, organisms, populations and ecosystems.

- Competency 3: students should be able to give examples of homeostasis at the cellular, organismal, population and ecosystem levels.

- Competency 4: students should be able to connect specific biological systems to the Earth's ecosystem as a whole.

Integration with ACE

- ACE 4: Use scientific methods and knowledge of the natural and physical world to address problems through inquiry, interpretation, analysis, and the making of inferences from data, to determine whether conclusions or solutions are reasonable.
- Reinforcements contribute to skill set.