From Three Courses to One: Outcomes from Redesigning the 200-level Biology Curriculum

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**Department**
- Identified need and committed to change

**Course learning objectives developed**
- Lecture/lab learning objectives developed
- Lecture/lab materials developed
- Implementation
- Department developed new or modified existing lectures to emphasize objectives

**Assessment**
- AND THEN ... how do 14 faculty take three courses and create one?

As a large committee we developed overall course objectives. We considered:
- Overall curriculum objectives
- Across curriculum efforts (Evolution and writing)
- Reinforcing BIO 105
- Creating knowledge and skills for 300 level courses

**ANIMAL, PLANT, AND ORGANISMAL BIOLOGY** had lectures, labs, exercises, exams, and instructor effort that needed recognized and utilized. In small groups with representative instructors from each course, alternative syllabi with lecture/lab content were developed. By breaking into small groups, all faculty were engaged and contributed to the discussion. A Curricular Redesign Grant provided motivation for working on lecture objectives through spring semester and funded instructors to develop and review materials over summer.

**Biodiversity Systematics and evolution**
- Draw a tree of life and map major evolutionary adaptations/events on the tree
- Explain how evolutionary adaptations arose at a molecular and evolutionary level
- Define the roles of the environment, organismal interactions in shaping evolutionary biodiversity (including human)
- When given an organizational process/chapter/chapter/section be able to compare and contrast analogues and homologues across the tree of life
- Be able to ask the right questions about a gene organization to distinguish its domain, major clade or phylum (for certain kingdoms)
- Answer questions about how different organisms solve major problems and opportunities
- Learn to think like a scientist
- Object differences among organisms via illustration
- Read and create trees
- Read and create graphs, interpret and analyze data
- Distinguish between popular and scientific literature and the different types of scientific literature
- Be able to do your own background research when presented with a biology research question
- Be able to design a sensible empirical research project

**STREAMLINED CURRICULUM: 203 full but wasteful eliminated within 2 semesters of implementation (moved bottleneck to 300 level)**. No seniors in 200 level courses.

**KNOWN STUDENT POPULATION AT 300 LEVEL**: exposure to content and skills are the same for all Biology majors as they move into 300 level.

**ADDRESSES DEPARTMENTAL LEARNING OBJECTIVES**: see Assessment section.

**DEBATE**
- **BREADTH VS. DEPTH**: the course covers a huge range of organisms (huge breadth!). Depth on any one lineage is limited. Depth exists in evolutionary history and comparative thinking but is not specific within groups of organisms.

**CONTENT AND SKILLS**: The class has a lot of content. Students also develop critical thinking, scientific process, quantitative and writing skills. Is it too much?

**ASSESSMENT**
- Students improved their understanding of target evolution concepts by the end of the semester. In pre/post assessment students showed a 15% learning gain overall.

**Evolution concepts**
- **Tree building** – Improvement on reading trees. No longer reading across the tips (27%)!
- **Molecular clock** – Understand clock is an estimate (23%) and the relative order of major group diversification (18%).
- **Evo-Devo** – Changes in gene activation are more likely than major mutations/gene gain or gene loss (13% and 16%). But we made them think all activation genes are HOX genes (>28%)!

**Quantitative concepts**
- **Experimental Design** – Pretest shows a strong understanding of dependent and independent variables (>85%) (way to go BIO 105!!). Replication still confusing.
- **Statistics/graphing** – Standard error calculation/interpretation and selection of the proper graph all showed the largest gains (45% improvement pre/post)!!
- **Interpretation and Causation vs. Correlation** – Interpretation was strong in the pretest questions (>75%) leaving little room for improvement. We may have scared students from ever saying we test causation, even in a carefully designed experiment.