Curriculum Mapping 2017 Summary Report
Phyllis Griffard
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In 2017 our department began a review of our undergraduate curriculum. In Spring 2017, the PULSE committee proposed that we adopt the 5 Core Concepts and 6 Core Competencies identified in Vision and Change (visionandchange.org) as those appropriate to our undergraduate biology program. The faculty voted to approve them in Spring 2017.

This report summarizes the results of two informal departmental initiatives in Fall 2017 to assess the status of our undergraduate curriculum with respect to these core concepts and competencies: curriculum mapping at our departmental retreat in December 2017, and scoring of learning objectives in our Fall 2017 syllabi by Antley. The following is a summary and recommendation based on these exercises with the caveats described below:

Summary and Recommendations:

Core Concepts: There is a perception among faculty that we are addressing most concepts as appropriate to our courses. One observation is that **100 and 200 level courses did not report having balanced treatment of all 5 Core Concepts**; Evolution, Information Flow and Pathways of Energy Transformation were lower than Structure/Function and Systems. Antley's summary of syllabi objectives is consistent with this. This is in spite of three courses (111, 203 and 233) having evolution as a major part of the course, 110 having significant metabolism and genetics modules and 233 having Genetics and Evolution in its course title. Although this could be real, the skew could alternatively be explained by a few instructors (n = 5) having more conservative estimates of coverage compared with instructors of upper level electives (n = 15). **Upper level electives** have strengths in addressing evolution and structure/function. They may wish to expand coverage of other core concepts or offer electives that are focused on genetics and energy pathways.

Core Competencies: **Courses at all levels could do more to address the core competencies of quantitative reasoning, modeling/simulation and communication/collaboration.** Although many reported that their students have direct experience with the scientific process, there may be opportunities to offer more of these authentic experiences using large datasets in the public domain or that are produced in the course, and requiring them to work in teams to formally communicate their results. Incorporating research into more courses, especially electives, would simultaneously **address the low scores we have for authentic research, team-based learning and model-based learning** among the student-centered practices. Interestingly, Antley's review of syllabi showed that most instructors include objectives about communication and collaboration, however, the worksheet summaries suggest that these same instructors may not feel their courses actually do these to a great extent.

Recommendation: Each course coordinator review and refine her/his stated learning objectives, look for opportunities to **fill any gaps** in content and competencies, and **backward design** the courses to address and assess them using recommended student-centered practices. Consult with colleagues to generate ideas for successful adoption of new practices. **Build in assessments** that would satisfy your needs. Stakeholders for the required **100-200 level core** lectures and labs can propose **common learning objectives for each course** that all sections/instructors will adopt, and that, taken together, give a balanced treatment of the core concepts and competencies. This would give coordinators of upper level electives a firm **foundation of prerequisites on which to build** their courses. The **catalog descriptions** should be changed if they do not align with these objectives.

The summary and recommendations are based on the following:

At our Faculty Retreat in Dec 2017, all faculty present participated in a curriculum mapping exercise in which we used the "Tools for Mapping Vision and Change Core Concepts and Competencies to individual courses" from http://www.pulsecommunity.org/page/assessment to:

1. List the stated Learning Objectives for a course we teach,
2. Score that course and its objectives with respect to the extent to which they address the 5 Core Concepts and 6 Core Competencies,
3. Score that course with respect to the extent to which we use student-centered practices to teach that course.

Since there was not a comprehensive orientation to establish common criteria, definitions and examples and because of ambiguity in interpretation of scores, the data and analysis should not be considered valid beyond this overview. Instead, it serves as a reflective tool for decision making by course coordinators and a baseline to which future self-assessment can be compared.

23 of the 30 active, full-time faculty were present and submitted Curriculum Mapping Worksheets for 26 courses. Most were lecture courses; if accompanying labs were mentioned, these scores were included. The means of self-reported raw scores were entered in the attached spreadsheet, and means of these were calculated for the entire set of courses (n = 26) and for various subsets of courses. No standard errors were calculated because the inherent error in the data collection (by lack of common definitions and criteria) precludes any further quantitative analysis, in my opinion.

For the Core Concepts sheet, the score for each Core Concept is the mean of the scores entered for all the Learning Objectives, except when a Learning Objective was not directly related to Concepts or Competencies (for example, a BIOL360 LO about techniques used by ecologists was omitted from the Core Concepts average). Where no choice was circled, it was assumed to be 0 and averaged as such unless other information overrode this. For the Core Competencies, the mean of the rows in Curriculum Mapping Worksheet 3 (which included examples of core competencies) was used rather than those in Worksheet 4, which in many cases did not reflect those in Worksheet 3.

Table 1: Core Concepts addressed in subsets of BIOL courses. Scores were 0-5, with 0=not addressed, 3=addressed to some extent, 5=addressed in depth.

Courses	Evolution	Structure and Function	Information, Flow, Exchange and Storage	Pathways and Transformations of Energy and Matter	Systems
All BIOL reported (n = 26)	2.70	3.55	2.28	2.47	3.04
All majors courses (n = 24)	2.70	3.55	2.28	2.47	3.04
Required Core lec + labs (n = 9)	1.82	3.21	1.64	2.07	3.01
Systematics Electives (n = 6)	3.49	3.88	2.72	2.75	3.04
Field Electives (n = 6)	3.46	3.81	3.00	2.92	2.91
Lab Electives (n = 3)	2.75	3.83	2.54	2.96	3.03

Table 2: Core Competencies addressed in subsets of BIOL courses. Scores were 0-5, with (0=not practiced, 3=practiced to some extent, 5=practiced in depth).

Courses	Ability to apply the process of science	Ability to use quantitative reasoning	Ability to use modeling and simulation	Ability to tap into the interdisciplinary nature of science	Ability to communicate and collaborate with other disciplines	Ability to understand the relationship between science and society
All courses reported (n = 26)	2.90	1.67	0.51	2.62	1.86	2.16
All majors courses (n = 24)	2.90	1.67	0.51	2.62	1.86	2.16
Required Core lec + labs (n = 9)	2.72	1.48	0.42	2.67	1.47	1.86
Systematics Electives (n = 6)	3.00	1.83	0.57	2.51	2.14	2.31
Field Electives (n = 6)	3.07	1.92	0.65	2.47	2.26	2.34
Lab Electives (n = 3)	3.17	1.75	0.42	2.94	2.07	2.12

Table 3: Extent of student-centered instructional practices. (0=not practiced, 3=practiced a few times, 5=practiced multiple times throughout semester or extensive module)

Courses	Authentic research; open-ended; student-designed; research activities	Case Studies	Immediate response (clickers, etc)	Inquiry-based/driven learning	Team-based learning	Model-based learning
All BIOL reported (n = 26)	1.53	2.55	3.12	2.85	2.27	1.81
All majors courses (n = 24)	1.53	2.55	3.12	2.85	2.27	1.81
Required Core lec + labs (n = 9)	1.04	1.46	3.62	2.85	3.00	1.77
Systematics Electives (n = 6)	1.81	3.43	2.93	2.68	1.80	1.67
Field Electives (n = 6)	2.18	3.53	2.83	2.77	1.67	2.00
Lab Electives (n = 3)	1.17	2.67	2.33	2.67	1.67	1.50

Independently, Antley and her undergraduate assistants scored the stated learning objectives with respect to Core Concepts and Competencies. She completed this as a mini-project for her Biology Education Professional Development certification. They used the entire set of Fall 2017 syllabi for all 44 BIOL courses. Any objective that did not clearly fit into one of the concept or competency bins was scored None of the Above, which is labeled Ambiguous/NA in Tables 4 and 5. Note that the tally for 200-level electives includes Human A&P, which is not required of all majors, therefore is not included in the scores for 100- and 200-level core courses in Tables 1-3 above.

It is noteworthy that the student assistants commented that they were pleased to have been part of this exercise and were impressed that the faculty actually does this kind of review.

Table 4: Number of stated learning objectives in official Fall 2017 syllabi that address Core Concepts

Courses (n)	Evolution	Structure and Function	Information, Flow, Exchange and Storage	Pathways and Transformations of Energy and Matter	Systems	Ambiguous/ NA
100 level (7)	5	4	3	1	7	11
200 level (11)	3	16	4	3	14	32
300 level (9)	3	8	1	0	8	27
400 level (17)	9	5	3	0	10	39
All BIOL syllabi (44)	20	33	11	4	39	109

Table 5: Number of stated learning objectives in official Fall 2017 syllabi that address Core Competencies

Courses	Ability to apply the process of science	Ability to use quantitative reasoning	Ability to use modeling and simulation	Ability to tap into the interdisciplinary nature of science	Ability to communicate and collaborate with other disciplines	Ability to understand the relationship between science and society	Ambiguous/ NA
100 level (7)	4	2	1	0	2	3	18
200 level (11)	3	7	3	0	0	5	40
300 level (9)	6	5	5	0	8	3	24
400 level (17)	9	5	5	1	11	4	31
All BIOL syllabi (44)	22	19	14	1	21	15	113