**Proposal for funding from CWSEI - BIOLOGY PROGRAM**

## Project Identification:

***Title of the project:*** **The New Biology Curriculum - Transforming the Core**
***Project Leader:*** Shona Ellis, Associate Head of Biology, shona@mail.ubc.ca
***Team Members:*** Greg Bole, Sunita Chowrira, Celeste Leander, Carol Pollock, Rosie Redfield, Trish Schulte, Roy Turkington, Jeannette Whitton
*Science Teaching and Learning Fellows:* Malin Hansen, Jared Taylor
*Skylight Associates:* Gulnur Birol, Andrea Han

## Project Overview:

The Biology Program has been substantially revised. In September 2011, we will launch the new curriculum with the second-year cohort of biology students. Program reform, which started in 2007, was guided by program-level learning objectives. The goal of the Biology Curriculum Working Groups is to generate an integrated curriculum where courses build on each other to ensure a logical progression through the program. We aim to provide students with a solid background in biology as well as skills that prepare them for careers, life-long learning, and global citizenship.

This proposal has been distributed to all members of the working groups (Appendix I). The participation of those listed as team members and working groups has been confirmed. Additional members may be added.

## The LS-CWSEI 2007 Proposal and Transforming the Core

The LS-CWSEI 2007 proposal from the Departments of Botany, Zoology, and Microbiology and Immunology (Improving UBC Biology Education using Evidence-Based Practice) presented objectives and activities that will be expanded with this proposal (Transforming the Core). The LS-CWSEI proposal emphasized the importance of sequencing courses across the program and connecting program learning objectives to discipline streams. A number of initiatives have been developed and implemented (program and course learning objectives, conceptual inventories, attitudinal surveys) as outlined in the progress report: Biology Curriculum Revision and Integration with CWSEI-Life Science (2009). With the reorganization of the program now complete we are ready to coordinate the integration of core concepts and competencies throughout the curriculum. We will focus on five fundamentals courses, with an emphasis on discipline streams. This will be coordinated with the continuing revisions of BIOL 112 and 121. We will also coordinate activities and enhance communication within and between discipline groups.

We have the opportunity with the development of the new fundamentals courses to modify content and activities to better meet the learning needs of students. We will also identify gaps and redundancies in the program. The Carl Wieman Science Education Initiative will provide the opportunity to take an evidence-based approach to instructional design and improved student learning.

## Transforming the Core

For the CWSEI project we propose to focus on five courses. Five discipline streams are identified and represented in five fundamentals courses that all students in the biology program are required to take (core): Cell Biology (BIOL 200) was already a program requirement; Ecology (BIOL 230) and Genetics (BIOL 234) were restructured from third year required courses; Physiology (BIOL 260) is a new course; and Evolution (BIOL 336) has become a third year core (Fig. 1). In the previous program, core courses were taught primarily at the third year level. Major concepts were introduced in first year and then many not addressed again until third year. The revision of courses from third year to second addresses this disjunction in

discipline streams and promotes continuous building of concepts throughout the curriculum. While vertical building of core content is the primary focus of these transformations, lateral connections among the discipline streams will also be enhanced.

In addition to the proposed transformations of the fundamental core courses we are also committed to developing new upper level courses or course components (tutorials and labs) that provide students with enriched experiences in experimental, field and organismal biology.

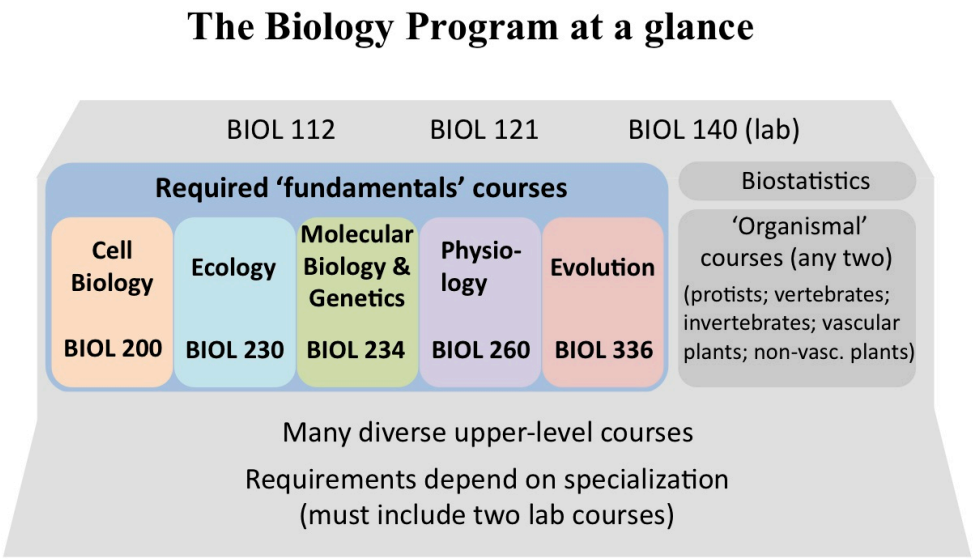


**Figure 1:** Organization Structure of the Biology Program

The fundamentals courses will be taught in September 2011/January 2012, thus the timing is optimal for transformations guided by the following goals:

1. **Support of program objectives:** Although explicit learning objectives have been developed by the instructors of each course, their relationships to the Biology Program's learning objectives have not been examined.
2. **Continuity across the years:** We do not know how well the contents of each course builds on what is taught in the first-year courses, nor how well they prepare students for upper-level courses.
3. **Connections among disciplines:** Although all parts of biology are interconnected, each fundamentals course has been developed largely without input from the others.
4. **Validation with assessment tools:** At present we have no way to assess the success of the new core courses and the curriculum they comprise.

Sound changes in course structure and teaching practices in the second year will reverberate throughout the curriculum. Linking learning objectives (and expectations) of the second year fundamentals to those of first year courses as well as those of the upper levels will consolidate our program. We will test and assess the learning of concepts at the novice, intermediate and advanced levels using concept inventories. We will use inventories already developed (various sources) as well as newly created. Assessments tools for monitoring further changes include: surveys (including attitudinal), individual student and faculty interviews and focus groups. In addition course curricula will be examined by mapping multi-section courses learning outcomes onto student assessments and reviewing student pre- and post-test results. The new curriculum will address the program learning goals by emphasizing concepts and applications in addition to building a foundation of discipline knowledge. Integration of the

curriculum across specific disciplines and throughout years of study will be integral to the new curriculum.

The scope of the project is broad, but the parallels of goals and approaches among the courses makes a multi-course Biology (or Life Sciences) CWSEI proposal efficient. Each working group (see Appendix I) includes those teaching the fundamentals course as well as faculty from first year and upper-level biology courses. To achieve integration and cooperation among discipline groups we propose that STLFs work collaboratively to ensure that courses align with program-level learning objectives, while concentrating in their area(s) of expertise. Three new STLFs will be hired with backgrounds in physiology, evolution, and genetics to complement the expertise of the current STLFs (Malin Hansen: ecology and Jared Taylor: cell biology/microbiology).

The STLFs will assist faculty in:
(i) developing and/or refining clear course specific learning goals
(ii) assessing student background knowledge of key concepts
(iii) introducing new teaching and learning practices that are aligned with learning goals for each respective course
(iv) mapping key concepts and competencies within courses and across the program
(v) developing tools that assess students' learning gains throughout courses
(vi) coordinating with first year and upper level biology courses

Under the leadership of the faculty liaisons (Shona Ellis and Trish Schulte) STLFs will ensure that relevant data are collected, analyzed, and shared with the local and global science education community. Curriculum mapping will help determine the next stages of curriculum development and implementation of evidence-based teaching strategies in 300 and 400 level courses and the program.

We recognize the challenges ahead. Collaboration and active participation of faculty members, instructors, STLFs, TAs, and undergraduate assistants are integral to the success of this project. Roles and expectations will be clearly outlined to ensure that all members of each teaching team work supportively and respectfully. Meetings and updates of the discipline groups will be scheduled (see Table 1). Updates could be in the form of short surveys developed by the STLF coordinator. The role of the newly appointed Associate Head of Biology will be to work with the CWSEI coordinator and Working Group Chairs (see Appendix) to oversee the project and ensure that goals are being accomplished in a timely fashion. The Biology Curriculum Committee will be updated regularly and provide feedback. Participating in CWSEI transformations offers professional development opportunities for instructors, and the Associate Head of Biology can recognize this work by providing support for conference attendance.

To further promote collaboration and cooperation an online repository (WebCT Vista) is under development where all participants in this project can access reference materials, documents, and feedback as well as participate on discussion boards and wikis. Posting common issues and materials will provide transparency and efficiency. It will facilitate communication and sharing within and between discipline groups as well as with other interested faculty members and graduate students. Groups will have the opportunity to showcase their work prior to larger presentations. Information on other biology teaching initiatives will also be available, such as updates of inventorying projects and the Q4B (Questions for Biology) funded through TLEF with in kind contributions from CWSEI. Links to other relevant sites will be updated regularly, such as the Biology Program Website (under construction), which will include syllabi with learning objectives for every course.

**Budget Request and Justification:**

***i) 5 STLFs*** – to provide support and guidance to faculty in assessing the effectiveness and improvement of pedagogical practices. Rehire: Malin Hansen and Jared Taylor. Hire three Postdoctoral Researchers with expertise in genetics, evolution, and physiology.
***ii) Project Coordinator*** – works with Associate Head of Biology and discipline groups to ensure that project is on track and coordinated (may be an STLF)
***iii) Course Assistants*** – support for faculty members where needed to compensate for time taken to participate in CWSEI activities
***iv) Graduate Teaching Assistants*** - to support learning activities and additional grading (getting TAs in 2011w may be challenging due to new 2nd year courses running concurrently with third year counterparts from old program – we may have to hire sessional lecturers)
***v) Undergraduate Learning Assistants*** – support learning activities and help to maintain an undergraduate focus

***Length of Time for Project:*** 3 years
***Reports submitted:*** twice a year

**Table 1: Timelines and Anticipated Deliverables:**

| | | Timeline | | |
|---|---|---|---|---|
| **Project** | **Description** | **Start** | **Estimated finish** | **Deliverables** |
| Re-establish discipline and course committees. | Each of the five core courses will have a working group. | May 2011 | May 2011 | Committees |
| Repository of teaching materials | Website (Vista) with class activities, clicker questions and exam questions aligned with learning goals for each course to facilitate collaborations and transition to new instructors. | June 2011 | April 2013 | Website |
| Current state report | Discipline working groups will submit a report on the current state of each course to the Biology Curriculum Committee. | June 2011 | June 2011 | Reports |
| Design a detailed plan for each course | The plan for each course should address the requirements listed in this proposal. | June 2011 | August 2011 | Detailed course plan |
| Learning goals | Review goals for courses where they exist and develop goals for courses with no existing goals. Align learning goals with course material and curriculum. Identify gaps and revise. | June 2011 | April 2012 | A document with learning goals aligned with exam questions, in-class activities, and assignments. |
| Hiring of new STLFs | Three new STLFs will be hired. Specific disciplines: physiology, evolution and genetics | June 2011 | June 2011 | |

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|---|---|---|---|---|
| Develop project expectations agreement | This document will outline an arrangement between the Biology Program and faculty members regarding exchange of buyout and deliverables associated with Transforming the Core | July 2011 | August 2011 | |
| Retreat (Annual Event) | Showcasing progress in teaching and learning activities: BIOL 230 and 234 (2011) Brainstorming and Sharing Session | July 2011 | April 2014 | |
| Align learning goals of core courses with those of first year biology | Align learning goals so that the goals of each course build on preceding courses to culminate in the accomplishment of program learning goals | July 2011 | April 2012 | A document with aligned learning goals. |
| Evaluate the BIOL 234 pilot | Describe how the assessment will be done here, what will you assess? | June 2011 | | |
| Identify existing conceptual inventories | Identify suitable existing conceptual inventories to assess learning gain for each course. | June 2011 | August 2011 | Conceptual inventory |
| Identify existing course material and develop new | Identify existing course material, i.e. iclicker questions, assignments, class activities and exam questions. Align with learning goals of each course and develop new material if gaps are found. | June 2011 | December 2014 | Course package on website |
| Development of new conceptual inventories | Start the process of developing new conceptual inventories if suitable inventory does not exist. Faculty member or STLF to contact the Q4B committee to initiate process. | July 2011 | December 2012 | Conceptual inventory |
| Assess student background knowledge | Assess student background knowledge of key concepts at the beginning of each semester in all core courses using conceptual inventories. | Beginning of each semester starting Sept 2011 | | Student data |
| Assess student learning gain | Assess student learning gain of key concepts at the end of each semester in all core courses using conceptual inventories. | End of each semester starting June 2011 | | Student data |
| Validate questions and activities using student interviews | Validate newly developed conceptual inventories and other assessment tools and activities using student interviews. | June 2011 | December 2014 | |

## APPENDIX I

**Current Status of Fundamentals Courses**

Learning Objectives that focus on core concepts have been developed for all courses. They are at varying degrees of implementation. Biology 230/304 for example has been transformed while Biology 260 has not yet been developed (or offered).

**Biology 200 – Cell Biology (first term)**

*Working Group:* Sunita Chowrira (chair), Jeff Richards, Lacey Samuels, Carl Douglas, Liane Chen, Tracy Kion, Geoff Wasteneys, Jim Berger, Jae-Hyeok Lee, Carol Pollock

- Learning objectives fully developed (will be reviewed and revised based on reflections from previous year's experiences), extensive online support (Vista) (will be reviewed and revised)
- Concept inventories in BIOL 200 will begin to be developed.
- The BIOL200 team will align learning outcomes with student evaluations on exams.
- Current efforts are being made to better align the learning objectives between BIOL 112 and 200
- BIOL 112 invention activities
- BIOL 200 has tutorials (1 hr/wk)

**Biology 230 (formerly Biology 304) – Ecology (both terms)**

*Working Group:* Roy Turkington (chair), Gary Bradfield, Wayne Goodey, Mary O'Connor, Kathy Nomme

- Has recently undergone transformation including the implementation of learning goals, field labs, pre-reading assignments, learning activities, and conceptual inventory
- Field Labs (3 per term)

**Biology 234 – Introductory Genetics (both terms)**

*Working Group:* Rosie Redfield (chair), Don Moerman, Craig Berezowsky, Tom Grigliatti, Pam Kalas, Jennifer Klenz, Carol Pollock

- A completely modernized replacement for Classical Genetics (BIOL 334)
- Learning objectives have been developed and partially implemented
- A pilot section ran January-April 2011; the first full offering will be in Sept. 2011.
- Uses pre-reading assignments with online quizzes, iClicker questions in every class, Peerwise, written report with Calibrated Peer Review, a 2 hr tutorial every week and open book exams

**Biology 260 – Physiology (second term)**

*Working Group:* Trish Schulte (chair), Shawn Mansfield, Angie O'Neill, Agnes Lacombe, Bill Milsom, Santokh Singh, Ljerka Kunst, Carol Pollock

- Pilot: January 2012
- Development commences when Trish Schulte returns from sabbatical (July 2011)
- Will use iClicker questions based on real world examples in every class, case studies, and weekly pre-reading assignments with online quizzes
- Tutorials may be added in the future if funding permits

**Biology 336 – Evolution (second term)**

*Working Group:* Jeannette Whitton (chair), Naomi Fast, Greg Bole

- Currently partially re-developed as a required course for all biology students, with broader topic coverage and greater emphasis on macroevolution.
- Enhanced experiential learning and considerations for ramping up (Sept. 2012)
- Tutorials (1 hr/wk)

**Biology Curriculum Working Group**

Shona Ellis/Trish Schulte (chairs), Bill Milsom, Fred Sack, Lacey Samuels, Brian Leander, Ninan Abraham, Mike Whitlock, Kathryn Zeiler, Liane Chen, Carol Pollock