

## Chemistry Department

The Chemistry CWSEI program started its first phase in 2008 and concentrated on evaluation and redesign of the CHEM 123 lab – Physical and Organic Chemistry. The First Year Assessment sub-committee of the Chemistry Lab Committee oversaw this project. The sub-committee members were: Brian Cliff (chair), Guillaume Bussiere, Ed Grant, Laurel Schafer, Vishakha Monga, Sophia Nussbaum, John Sherman, Robin Stoodley, Nancy Vered, Peter Wassell and Dana Zendrowski. In conjunction with these efforts, undergraduate laboratory revitalization for years 2 - 4 is ongoing in the department.

Jackie Stewart, former Skylight Affiliate and now the Departmental Director has been involved with the CWSEI since the start of the overall initiative in 2007 and has been doing substantial redesign of CHEM 233 Organic Chemistry for the Biological Sciences and working with the teaching teams in CHEM 121 and 202 to improve learning in those courses (independently funded by the department and TLEF).

In addition to CWSEI teaching initiatives, the department has undergone an independently funded external review of our 1st year chemistry program. Also, Mike Wolf, Derek Gates and Jackie Stewart have developed improved course support materials for CHEM 121 (tailored in-house textbook, homework sets, power point notes for instructors, etc.) independently supported by TLEF and Skylight. Additionally, seven interactive online tutorials have been developed and implemented over the past eight years to complement existing Chem 121 lab experiments as part of an ongoing co-operative between Sophia Nussbaum and the ChemCollective of Carnegie Mellon University. Funding from Skylight was used to develop yet another interactive tutorial and refine two existing tutorials with Carnegie Mellon.

In early 2013, we will begin a second phase of work, transforming 1) analytical chemistry courses (CHEM 211 and 311), 2) third-year integrated laboratories (CHEM 315/325/335/345), and 3) Global Challenges, a Chemistry Perspective (CHEM 341).

**SEI Director:** Jackie Stewart

**STLF Emeritus:** Jennifer Duis (emeritus)

**Faculty:** R. Algar, D. Bizzotto, M. Blades, G. Bussiere, G. Dake, A. Lekhi, V. Monga, C. Rogers, R. Stoodley, M. Thachuck.

**Students:** Nicholas Mah, Samantha D'Souza (2010-2011)

Ainge (Y. C.) Chang, Aalia Sachedina, James Zhou (2009-2010)

Michael Carlson and Yuri Samozvanov (2008-2009)

### Course Transformation

Course	Learning Goals	New Assessments	Improved methods
<p><b>CHEM 121: Structural Chemistry, with Application to Chemistry of the Elements (Lab component)</b> (Oct '08 start)</p> <p><u>Faculty:</u> S. Nussbaum <u>STLF:</u> Jennifer Duis</p>	<p>Course-level goals: Outline from CHEM 123, focus on transferable skill acquisition</p> <p>Experiment-level goals: process for development established</p> <p>Course-level outline and experiment-level development process appropriate for the entire lab program</p>	<p>Attitudes survey (C-LASS CHEM) given 3 Terms</p> <p>Development and implementation of end-of-term technique assessments</p> <ul style="list-style-type: none"> <li>o Year 1: TA visual assessment of technique with provided guide</li> <li>o Year 2: Visual assessment guide refined and technique questions added to the end-of-term quiz</li> </ul>	<p>Alterations made to increase alignment with 1<sup>st</sup>-year lab goals</p> <ul style="list-style-type: none"> <li>o Marks re-allocated to increase emphasis on maintaining a lab notebook</li> <li>o Directions on maintaining a lab notebook expanded in lab manual</li> <li>o Brief "taking observations" module developed and added during check-in</li> <li>o Peer marking of observations using supplied templates added to each experiment</li> <li>o Technique modules will be expanded to include choosing glassware for analytical vs. non-analytical purposes</li> <li>o A new experiment was piloted</li> <li>o "Pair-technique-ing" (ala comp. sci. pair-programming) was piloted with a small subset of students</li> </ul>
<p><b>CHEM 123: Physical and Organic Chemistry (Lab component)</b> (July '08 start)</p> <p><u>Faculty:</u> S. Nussbaum, L. Schafer, J. Stewart <u>STLF:</u> Jennifer Duis</p>	<p>Course-level goals: working version, inspired by Rice University's interdisciplinary science lab learning objectives, approved by Chemistry Lab Committee</p> <p>Experiment-level goals: (developed from existing course materials) 4 of 4 experiments complete and approved by Chemistry Lab Committee</p>	<p>Chemistry background and demographics survey developed and given 2 Terms</p> <p>Attitudes survey (C-LASS CHEM) given 2 Terms</p> <p>Pre-/Post-Lab skills survey (written) developed &amp; given 4 Terms</p> <ul style="list-style-type: none"> <li>o "LG use" questions added</li> </ul> <p>Refined hands-on lab skills assessment implemented 2 terms</p> <p>Assessments of experiment specific learning goal achievement (surveys, observations, interviews)</p> <ul style="list-style-type: none"> <li>o 3<sup>rd</sup> round of refinement based on expert &amp; student validation</li> </ul>	<p>Learning Goals incorporated into lab manual (under refinement)</p> <p>Alterations made to increase alignment with learning goals</p> <ul style="list-style-type: none"> <li>o Marks re-allocated to increase emphasis on maintaining a lab notebook</li> <li>o Directions on maintaining a lab notebook expanded in lab manual</li> <li>o Expanded quizzes will be introduced to test technical skills</li> <li>o Addition of manual dilutions to electrochemistry experiment to increase technical experience and conceptual understanding of the effect of dilution on voltage</li> <li>o Lab final modified to test students' "solo" completion of an experimental design, recording of observations and data, and evaluation of skills using a pipet and weighing by differences</li> </ul>

- **CHEM 113, 121, 415, 425, 449:** Attitudes survey (C-LASS CHEM) administered Spring '09 (CHEM 113 & 121 also participated in the written Lab Skills Survey)
- **CHEM 425/448:** Engaging students in cutting edge chemical education research, report writing, and presentations.

### Curriculum

- As CHEM 121/123 is in many ways a service course, identify interdisciplinary science lab skills that other science streams consider to be important and/or are expecting students to get from 1<sup>st</sup> year chemistry to improve "service".
- Survey Co-op employers to aid in focusing efforts of optimization and determining impact on upper level laboratory revitalization.
- Modification of course curriculum for CHEM 415/425 approved by Chemistry Department to expand research opportunities to chemistry majors.

### TA Development

The third round of modified TA training was implemented by Anka Lekhi and Sophia Nussbaum, with support from the TA Training Program through the Provost and Vice-President Academic Office and the Chemistry Department.

### Research

**Attitudinal Survey:** C-LASS CHEM given in multiple courses, statistical comparisons between UBC and CU-Boulder.

**CHEM 123 Lab Learning Goals:** Assess students' achievement of lab learning goals.

**1<sup>st</sup> Year Practical Lab Skills:** Compare students' achievement of practical lab skills as determined by written vs. hands-on assessment

**CHEM 233 Learning Objectives Alignment Study:** Investigating students' perceptions of the alignment between learning objectives and assessment, probing their ability to judge cognitive complexity of learning objectives, assessment items, and study tactics.

**Chemistry Concept Diagnostic Tests:** Propose administration and validation of an existing chemistry concept test to first year chemistry students.

### Other

Presentations at national/international meetings: 237<sup>th</sup> & 240<sup>th</sup> American Chemical Society National Meeting, 21<sup>st</sup> Biennial Conference on Chemical Education, 92<sup>nd</sup> & 93<sup>rd</sup> Canadian Chemistry Conference, Improving University Teaching 34<sup>th</sup> International Meeting.

**Computer Science Department**

Computer Science received seed funding from CWSEI in 2007 and began the efforts listed below in the Fall. The department moved to full funding starting in mid-2008.

**SEI Director:** Ian Mitchell (starting Jan 2013), Paul Carter (emeritus)

**STLFs:** Allison Elliott Tew (emeritus) – involved in CPSC 110, 210, 211, 260, 310, and 317

Ryan Golbeck (emeritus) – involved in CPSC 110 and 210

Ben Yu (emeritus) – involved in CPSC 101, 111, 121, 211, 213, 221, 304, 310, 322, 404, and APSC 160

Ray Lister (emeritus) – involved in CPSC 111, CPSC 260, and APSC 160

Beth Simon (emeritus) – involved in the early work of CPSC 101, 111, 121, 211, 213, and 221

**Faculty:** D. Acton, M. Allen, P. Belleville, G. Carenini, P. Carter, C. Conati, A. Condon, M. Dulat, K. Eiselt, M. Feeley, W. Heidrich, H. Hoos, N.

Hutchinson, G. Kiczales, E. Knorr, K. Leyton-Brown, J. Luk, J. McGrenere, G. Murphy, R. Ng, R. Pottinger, D. Poole, G. Tsiknis, K. Voll, S. Wolfman

**Post-doc:** Frank Hutter, Gabriel Murray

**Course Transformation**

Course	Learning Goals	New Assessments	Improved methods
<p><b>CPSC 101: Connecting with Computer Science</b> (Sept '07 start)</p> <p><u>Faculty:</u> M. Allen, A. Condon, S. Wolfman, H. Hoos <u>STLF:</u> Ben Yu</p>	<p>Course-level goals: complete Topic-level goals: complete</p>	<p>Performed study of instructor &amp; student perception and use of learning goals.</p> <p>Developing assessment to probe student understanding of JavaScript code.</p> <p>Piloted a new Computing Attitude Survey (CAS) in Fall of 2011 (part of the survey validation process).</p>	<p>Used clicker questions in class.</p> <p>Developed broad set of clicker questions.</p> <p>In the process of adjusting delivery of course to use Just-in-Time teaching methods with pre-class readings and in-class learning activities.</p>
<p><b>CPSC 110: Computation, Programs and Programming</b> (Sept '09 start)</p> <p><u>Faculty:</u> G. Kiczales, P. Carter, K. Eiselt <u>STLF:</u> Allison Tew, Ryan Golbeck</p>	<p>Course-level and topic-level goals: solid draft in place</p>	<p>Have per-question analysis of midterm and final exam data.</p> <p>Developed weekly problem sets that provide students with timely feedback on their learning.</p> <p>Piloted a new Computing Attitude Survey (CAS) in Fall of 2011 (part of the survey validation process).</p>	<p>Developed a series of relevant and engaging labs.</p> <p>A plug-in was developed for Dr. Racket IDE so that students can submit assignments electronically from the development environment. This reduces the number of tools that students have to master and allows the course to focus on concepts.</p>
<p><b>CPSC 111: Introduction to Computation</b> (Sept '07 start)</p> <p><u>Faculty:</u> K. Eiselt, C. Conati, W. Heidrich, J. Luk <u>STLF:</u> Ben Yu, Ray Lister</p> <p>This course is no longer offered. It has been replaced by CPSC 110.</p>	<p>Course-level goals: complete Topic-level goals: complete</p>	<p>Attitudinal survey revised and administered at start and end of term in all sections of summer and fall terms.</p> <p>Cognitive pre-test developed and administered at start of course. The same test was administered to students in APSC 160.</p> <p>Questions targeting specific learning goals have been included on exams.</p> <p>A lab checklist has been developed to track the kinds of problems that students run in to during labs.</p>	
<p><b>CPSC 121: Models of Computation</b> (Sept '07 start)</p> <p><u>Faculty:</u> S. Wolfman, P. Belleville, K. Voll, M. Allen <u>STLF:</u> Ben Yu</p> <p><a href="#">Poster (CWSEI EOY 2012): Effective Closed Labs in CPSC 121: Lessons from Eight Terms of Action Research</a></p>	<p>Learning goals have been further categorized to identify pre-class learning goals. Students are expected to achieve pre-class learning goals on their own in advance of the corresponding class.</p>	<p>Attitudinal surveys developed and administered in summer and fall terms.</p> <p>Student interviews conducted in summer and fall terms.</p> <p>Pre and post-tests developed and administered.</p> <p>MCQs developed for final exam that target specific learning goals.</p> <p>A scenario based think-aloud survey tool has been developed to study how students approach solving mathematical induction</p>	<p>Two-stage exam conducted in summer term. Results published in ICERI 2009 and further analysis appeared at SIGCSE 2010.</p> <p>Refined online quizzes used to assess pre-class learning goals on the basis of previous term's quiz results.</p> <p>Re-structured in-class problem solving activities to be based on progressive clicker questions with solo- and group-response format. Approximately 160 clicker questions developed and used in class.</p> <p>Continued work on labs to make them "open-ended" and driven by student exploration rather</p>

<p><a href="#">Posters (CWSEI EOY 2010): Adaptation of JiTT in CPSC 121</a> and <a href="#">Changes in CPSC 121: Towards a coherent picture of computation</a></p>		<p>problems. The tool is being used to examine the effectiveness of a decomposition technique that teaches students to approach such problems by breaking them down into more manageable pieces.</p>	<p>than closed-ended. Continued to re-design labs so that they are more closely aligned with core learning goals, avoiding extraneous detail. Established a protocol for preparing TAs to a consistent level and for developing a community of support among the teaching staff.</p>
<p><b>CPSC 210: Software Construction</b> (Jan '10 start)  Faculty: G. Murphy, M. Allen STLF: Allison Tew, Ryan Golbeck  <a href="#">Poster (CWSEI EOY 2011): Measuring Student Confidence and Lab Material Balance in a Computer Science Course</a></p>	<p>Topic-level goals: solid draft in place</p>	<p>Parallel assessment in progress with CPSC 211 (the course that CPSC 210 will eventually replace).</p>	<p>Examining the use of cell phones in some labs to increase relevance and student engagement.</p>
<p><b>CPSC 211: Introduction to Software Development</b> (Sept '07 start)  Faculty: D. Poole, M. Dulat STLF: Allison Tew, Ben Yu</p>	<p>Course-level goals: complete Topic-level goals: complete</p>	<p>Attitudinal survey developed and administered at start and end of both sections of fall term.  Parallel assessment in progress with CPSC 210 (the course that will eventually replace CPSC 211)</p>	<p>Subversion repository has been developed that will facilitate distribution of code to students for labs and lectures. A subversion plug-in for the Eclipse IDE will be used to minimize the number of different tools that students have to master.</p>
<p><b>CPSC 213: Introduction to Computer Systems</b> (Sept '07 start)  Faculty: G. Tsiknis STLF: Ben Yu</p>	<p>Course-level goals: complete Topic-level goals: complete</p>	<p>Pre and post-tests developed and administered during summer term.</p>	<p>Two-stage exam conducted in summer term. Results published in ICERI 2009 and further analysis appeared at SIGCSE 2010.</p>
<p><b>CPSC 221: Basic Algorithms and Data Structures</b> (Sept '07 start)  Faculty: K. Voll, E. Knorr STLF: Ben Yu  <a href="#">Poster (CWSEI EOY 2012): Planning Assessment for a Game-Like, Highly Reusable Data Structures Assignment</a></p>	<p>Course-level goals: complete Topic-level goals: complete</p>	<p>Post-test developed and administered at the end of summer term.  Attitudinal survey revised and administered at the end of 2009 fall term.</p>	<p>Use JITT, in-class group problem solving and peer instruction, clickers or non-electronic clicker equivalents, and web-based quizzes to shift focus of courses to higher-level analysis and problem solving.</p>
<p><b>CPSC 259: Data Structures &amp; Algorithms for Electrical Engineers</b> (Fall 2012 start)  Faculty: E. Knorr</p>	<p>Course and topic-level learning goals: complete</p>	<p>Apply pre-test as diagnostic of retention of learning from prerequisite course (APSC 160)</p>	<p>Identify pre-class readings. Develop online quizzes to examine pre-class material. Develop in-class materials that build on pre-class readings. Revise labs.</p>
<p><b>CPSC 260: Object-Oriented Program Design</b> (Sept '09 start)  Faculty: D. Acton STLF: Allison Tew, Ray Lister</p>	<p>Topic-level learning goals: complete</p>	<p>Pre-test developed and administered in 2009/2010 that measure retention of learning from APSC 160.</p>	<p>A series of clicker questions has been developed.</p>

<p><b>CPSC 304: Introduction to Relational Databases</b> (Sept '09 start)</p> <p><u>Faculty:</u> E. Knorr, R. Pottinger, R. Ng <u>STLF:</u> Ben Yu</p> <p><a href="#">Poster (CWSEI EOY 2010): CPSC 304: Course Transformation</a></p>	<p>Topic-level goals: draft</p>	<p>Attitudinal survey developed and administered at start and end of term.</p> <p>Pre and post-tests developed to assess change in learning.</p> <p>Student interviews conducted during fall term.</p>	<p>Clicker questions developed and used in fall offering of course.</p> <p>Two-stage exams conducted in both midterms of fall 2009 term.</p> <p>A set of new tutorials has been developed and tested in spring 2010 in response to poor attendance in previous terms. The new tutorials are designed to incorporate active learning and have resulted in higher attendance.</p> <p>Tutorials were improved upon for summer 2010 offering of course to include reflection exercises such as the development of a concept map.</p>
<p><b>CPSC 310: Introduction to Software Engineering</b> (May '10 start)</p> <p><u>Faculty:</u> M. Allen <u>STLF:</u> Allison Tew, Ben Yu</p>	<p>Course-level and topic-level learning goals: in progress</p>	<p>Diagnostic test developed to assess student preparation in learning.</p>	<p>New lecture material under development on topics that are more relevant (e.g., distributed version control systems).</p>
<p><b>CPSC 317: Internet Computing</b> (Sept '09 start)</p> <p><u>Faculty:</u> D. Acton, N. Hutchinson <u>STLF:</u> Allison Tew</p> <p><a href="#">Poster (CWSEI EOY 2012): An Evidence-Based Transformation of a Computer Networking Course</a></p>	<p>Course-level goals: complete Topic-level goals: complete</p>	<p>Conducted initial survey to gather baseline data on student experience in course.</p> <p>Baseline data collected in the form of per-question analysis of exam data and attitudinal survey.</p>	<p>Developed group based, in-class learning activities and associated discussion questions focused on specific learning goals. These methods will be administered for the first time in Spring 2012.</p>
<p><b>CPSC 320: Intermediate Algorithms and Data Structures</b> (Sept '09 start)</p> <p><u>Faculty:</u> K. Voll</p>		<p>A test of expected prerequisite knowledge was developed and administered at the start of the term.</p>	
<p><b>CPSC 322: Artificial Intelligence</b> (Summer '08 start)</p> <p><u>Faculty:</u> G. Carenini, K. Leyton-Brown <u>Post-doc:</u> Frank Hutter <u>Graduate student:</u> Byron Knoll <u>STLF:</u> Ben Yu</p>	<p>Course-level goals: complete Topic-level goals: complete</p>	<p>A large body of questions has been developed to be used as the core of future exams.</p> <p>Conducted survey on student use of practice problems and perceived usefulness for their learning.</p>	<p>A set of 19 practice problems complete with solutions have been developed and made available at <a href="http://www.aispace.org/exercises.shtml">www.aispace.org/exercises.shtml</a></p> <p>12 of these 19 exercises are integrated with AI Space applets. Background reading for each exercise was also identified in the course textbook.</p> <p>These exercises were also integrated into webCT and two quizzes for each problem were created.</p> <p>An additional set of 19 quizzes covering 7 of the practice problems were made available towards the end of the term.</p> <p>Two new AI Space applets have been developed.</p>
<p><b>CPSC 404: Advanced Database Systems</b> (Sept '09 start)</p> <p><u>Faculty:</u> E. Knorr <u>STLF:</u> Ben Yu</p>	<p>Topic-level learning goals: draft</p>	<p>Attitudinal survey developed and administered at start and end of term.</p> <p>Pre and post-tests developed to assess change in learning.</p>	
<p><b>CPSC 406: Computational Optimization</b> (Fall 2012 start)</p> <p><u>Faculty:</u> M. Friedlander</p>	<p>Course-level learning goals: complete</p>	<p>Conduct per-question analysis of exam data before and after introduction of case studies to measure change in student learning.</p>	<p>Developing a case study for each major module in the course that will give students practical, hands-on practice at solving a problem in the field. Each case study will be accompanied by related in-class activities and a homework assignment.</p>

<p><b>CPSC 410: Advanced Software Engineering</b> (Sept '11 start) Faculty: E. Wohlstadter</p>	<p>Learning goals revised to provide a stronger connection between CPSC 410 and its major prerequisite CPSC 310.</p>		
<p><b>CPSC 422: Intelligent Systems</b> (Sept '09 start) Faculty: C. Conati, K. Leyton-Brown Post-doc: Frank Hutter</p>	<p>Learning goals under development.</p>		<p>All assignments have been revised with respect to learning goals and two new assignments have been developed.</p>
<p><b>CPSC 425: Computer Vision</b> (Spring 2012 start) Faculty: R. Woodham, J. Little, D. Lowe Graduate Student: T. Southey</p>	<p>Course-level learning goals: complete</p>	<p>Conduct per-question analysis of exam data before and after introducing revised materials to measure change in student learning.</p>	<p>Development of simulations for use in class. Development of framework that allows students to apply concepts learned in course to real-world computer-vision tasks.</p>
<p><b>CPSC 430: Computers and Society</b> (Spring 2012 start) Faculty: K. Leyton-Brown</p>	<p>Course-level learning goals: complete</p>		<p>Identify weekly pre-class reading assignments. Develop related quizzes and mini-essays that students must complete prior to class. Essays are peer-reviewed. Class time can then focus on discussion, group exercises and analysis of arguments.</p>
<p><b>CPSC 444: Advanced Methods for Human-Computer Interaction</b> (Sept '10 start) Faculty: J. McGrenere</p>	<p>Learning goals drafted and under revision</p>		<p>Added practical component to each tutorial in response to feedback from students.  Reworked project and labs to streamline descriptions and milestones.  Improved tutorial instructions for TAs  Created a new lab to teach Android phone development skills.</p>
<p><b>APSC 160: Introduction to Computation in Engineering Design</b> (Sept '09 start) Faculty: P. Carter, E. Knorr STLF: Ray Lister, Ben Yu  <a href="#">Poster (CWSEI EOY 2010): Student perceptions of online multimedia instruction with JITT</a></p>	<p>Topic-level goals: complete</p>	<p>Attitudinal survey developed and administered at start and end of term. Analysis pending.  Surveys assessing impact of Peer Instruction conducted in week 4 and week 8 of term.  Increased number of midterms from 1 to 2 in an effort to provide students with more regular and more accurate feedback on their progress.  Piloted a new Computing Attitudes Survey (CAS) in the Fall of 2011 as part of the survey validation process.</p>	<p>A series of approximately 30 screencasts have been developed that introduce students to basic concepts. Students are asked to study the screencasts before coming to class.  Clicker questions have been developed to assess students' comprehension of the concepts presented in the screencasts.  A series of in-class problem sets have been developed that allow students to further develop their understanding of the concepts learned in the screencasts.  The new format was incorporated into all four sections of the course offered in 2009/2010. Over 800 students were enrolled. Feedback from students on surveys has been overwhelmingly positive. Analysis of learning gains is in progress.</p>
<p><b>Learning goals for core courses (CPSC 110, 111, 121, 210, 211, 213, 221, 310, 313, 320):</b> A comprehensive set of learning goals (both course-level and topic-level) has been developed for most 1<sup>st</sup> and 2<sup>nd</sup> year core courses. Most of these courses use LGs regularly to some extent in class (e.g., many 111 instructors now show the LGs associated with each unit as they lecture on the unit). CPSC 313 also has rough draft LGs. Draft course-level learning goals for the new CPSC 110 and CPSC 210 have been completed. <b>CPSC 260: Object-Oriented Program Design:</b> Don Acton and Ben Yu are investigating the correlation of student performance with different components of this course. <b>Attitudinal Surveys:</b> Survey instruments have been developed for CPSC 101, 111, 221, 317, 320, 404, and APSC 160. These instruments will facilitate the tracking of students' attitudes about the curriculum, their interest in Computer Science, and their expectations throughout their undergraduate years.</p>			
<p><b>Curriculum</b></p>			
<p><b>Code communication in APSC 160, CPSC 111, and CPSC 260:</b> Exploring how students' ability to communicate about code changes during our core courses. A style of question that involves explaining the purpose of code is used across several exams to see how and whether students progress in their ability to succinctly and abstractly describe the purpose of code fragments.</p>			

## Research

**Computing Attitudes Survey (CAS):** Allison Tew is in the process of developing and validating the Computing Attitudes Survey (CAS), a new assessment instrument to gauge student attitudes and perceptions about learning computer science. The CAS is based on the Colorado Learning Attitudes about Science Survey (CLASS) and extends that work to include specific computing issues such as debugging and data representation. The CAS will be applicable to a broad range of students and was piloted in three introductory courses in Fall of 2011: CPSC 101, CPSC 110 and APSC 160. We plan to run the survey as a pre and post test in each of these courses in Spring 2012.

**Longitudinal Study of Student Learning:** Allison Elliott Tew is designing a research study into assessment of student learning across a sequence of software design courses running from 1st to 4th year. Implementation details are currently under development. Initial meetings have been held with faculty who teach the courses. The first step is to move from learning goals that focus on particular courses to learning goals that capture the progression from novice to expert over a sequence of courses.

**PeerWise:** Conducted study of the use of PeerWise (an online collaborative multiple-choice question repository) by students in 2nd and 4th year courses in 2007/08. Surveyed students about how they use PeerWise and whether they feel submitting or answering questions helps them learn.

**Self-theories:** Conducted a study in 2007/08 of impact of students' self-theories relating to learning and ability on their success and persistence in beginning programming courses.

**Learning Goals:** Explicit use of learning goals in the classroom to aid student learning has been explored and is the subject of an article has been published in the Journal of College Science Teaching. Explicit use of learning goals has also spread to the Computer Science and Engineering department at UC San Diego, home institution of our first STLF.

**Just-in-time-teaching in APSC 160:** Instructor has developed screencasts to introduce basic content to students. Students are expected to watch one or more screencasts before coming to class and are assessed on their grasp of this introductory material using clicker questions at the start of class. A collection of in-class problem sets has also been developed that will allow students to explore their understanding of more advanced content. We plan to conduct an assessment of retention of learning at the start of the follow-on course (CPSC 260) in the Fall and compare with results from last year where students had taken APSC 160 with more traditional instruction.

**Just-in-time teaching in CPSC 121:** Instructor has identified a subset of learning goals called `pre-class` learning goals. These are goals that students are expected to meet before coming to class. On-line tests have been developed to assess student learning for those goals. A set of in-class problems have been developed that address more advanced learning goals. Comparative survey work indicates dramatic increases in percentages of students that use the textbook and find it useful to their learning.

**Just-in-time-teaching in CPSC 221:** One instructor taught both sections in 2008/09 Winter term 2. Students in one section are seeing a JITT approach and the use of in-class activities involving peer instruction and discussion. Students in the other section are receiving more traditional instruction. Students in both sections are writing the same exams and completing the same homework assignments.

**Parson's puzzles:** Conducted a study in 2007/08 of a new type of exam question for assessing similar skills to code writing questions. Results have been published in the proceedings of the Fourth International Computing Education Research Workshop.

**Decomposition techniques in teaching proof by induction:** Kim Voll applied a decomposition technique when teaching proof by induction in CPSC 121 in spring 2010. Ben Yu is currently interviewing students from both sections of the course taught last term using a think-aloud protocol developed in conjunction with Wendy Adams (UC). The results will be analyzed to determine if students taught with the decomposition technique demonstrate a stronger ability to perform proof by induction.

**Earth, Ocean and Atmospheric Sciences Department**

Earth, Ocean and Atmospheric Sciences received full funding from CWSEI in 2007 and began the efforts listed below in Summer 2007. The EOS-SEI program is making excellent progress with 23 courses finished with the official transformation process and more than 10 additional courses “unofficially” improved using the principles of research-based effective pedagogy. Many of the instructors of these courses are continuing to iterate on improvements either on their own or with consulting help from STLFs. Over 77% of EOS faculty and over half of our sessional instructors have received direct support to adjust their courses and teaching from SEI. The overarching goal of the EOS-SEI is to promote cultural change in our approach to teaching and learning and establish sustainable processes to continue and improve the work accomplished during the CWSEI project.

**SEI Director:** Sara Harris

**STLFs:** Francis Jones, Brett Gilley, Erin Lane (emeritus), Joshua Caulkins (emeritus), Ben Kennedy (emeritus)

**Faculty (instructors teaching targeted courses):** S. Allen, G. Andrews, R. Beckie, M.L. Bevier, M. Bostock, G. Dipple, E. Eberhardt, J. Finnis, R. Francois, M. Grey, S. Harris, F. Herrmann, K. Hickey, W. Hsieh, M. Jellinek, C. Johnson, M. Kopylova, M. Maldonado, U. Mayer, S. Mills, R. Mindell, J. Mortensen, K. Orians, E. Pakhomov, R. Pawlowicz, J. Scoates, P. Smith, R. Stull, S. Sutherland

**Faculty and Post Docs or Sessionals involved in working groups, committees, or ad-hoc support:** P. Austin, A. Bain, E. Barns, M. Bustin, A. Caruthers, K. Chan, Freed, K. Grimm, B. Gilley, L. Groat, P. Hammer, E. Hearn, S. Hollingshead, O. Hungr, T. Ivanochko, F. Jones, L. Kennedy, M. Lipsen, L. Longridge, M. McKinnon, J. Monteux, D. Oldenburg, V. Radic, K. Russell, D. Steyn, C. Suttle, P. Tortell, L. Ver, B. VanStraaten, D. Weis, D. Winget, H. Zerriffi, D. Turner, T. Dzikowski

**Students:** L. Bailey, L. Beranek, J-F. Blanchette-Guertin, A. Caruthers, D. Cassis, R. Cockett, J. Dohaney, R. Eso, L. Gurney, M. Halverson, S. Henderson, T. Hirsche, K. Hodge, A. Jolley, K. Ko, P. Lelievre, C. Leslie, C. Livingstone, K. Lucas, J. Mcalister, K. Rasmussen, J. Rhajiak, E. Schaeffer, B. Smithyman, K. Smet, R. Taylor, D. Tomkins, D. Tommasi, C. Wong, G. Baldon, J. Shiller

**Completed Course Transformations**

Course	Learning Goals	New Assessments	Improved methods
<p><b>EOSC 111: Laboratory Exploration of Planet Earth</b> (Sept '07 start)</p> <p><u>Faculty:</u> S. Harris <u>STLF:</u> Brett Gilley</p> <p>Ongoing updates to pre-post assessment, lab activities, and quizzes. Course transferred to new instructor (R. Mindel)</p> <p><a href="#">Poster (CWSEI EOY 2012): Invention Activities in an Introductory Lab: Minerals, Rocks, Biodiversity, &amp; Earthquakes</a></p>	<p>Course-level goals: complete Lab-level goals: complete</p>	<p>Individual and group quizzes 3rd draft of Pre/Post assessment complete for all topics Post-lab surveys for each lab End-of-term survey</p>	<p>Invention activities (Introduction, Plankton &amp; Marine Ecosystems) Student-derived methods (Earthquakes, Groundwater, Dinosaurs, Waves, Estuaries) Contrasting cases (Sediments &amp; Sedimentary Rocks)</p>
<p><b>EOSC 112: The Fluid Earth: Atmosphere and Ocean</b> (Jan '08 start)</p> <p><u>Faculty:</u> R. Francois, S. Harris, W. Hsieh <u>STLF:</u> Erin Lane</p> <p>Course transferred to various new instructors (V. Radic, E. Pakhomov, D. Steyn)</p>	<p>Course-level goals: complete Lecture-level goals: complete</p>	<p>Midterm &amp; end-of-term surveys Online quizzes Validated pre-post survey Student engagement observations Student workloads questions</p>	<p>Widespread use of thought-provoking clicker questions Relevance slide added to each lecture, relevance added throughout class.</p>
<p><b>EOSC 114: The Catastrophic Earth: Natural Disasters</b> (Sept '07 start)</p> <p><u>Faculty:</u> R. Stull, E. Eberhardt, M.L. Bevier, S. Sutherland, J. Finnis, G. Andrews <u>STLF:</u> Francis Jones (~1000 students per yr)</p> <p><b>New in 2010:</b> Introduction of group exams, overseen by Brett Gilley and Roland Stull. Course transferred to various new instructors.</p>	<p>Course-level goals: complete Lecture-level goals for all lectures: complete</p>	<p>Midterm &amp; end-of-term surveys Pre-course diagnostic on basic skills Online homework based on text readings introduced Fall 2008 Attitudes survey  Dec 2012: A video record of two classroom activities is being developed to support professional development of instructors</p>	<p>Vista Course Management System and a custom website used extensively for content delivery, quizzing, surveying, logistics. Use of thought-provoking clicker questions in all lectures Pre-post question “wrappers” around video clips to focus and assess student learning Custom text introduced. Off-schedule pre-exam review/question sessions Fall '09: Preliminary experiment with PeerWise in one section. Not continued beyond Fall '09. Multiple sequential instructors with one lead instructor and administrative support.</p>

<p><b>EOSC 210: Earth Science for Engineers</b> (Jan '08 start)</p> <p>Faculty: E. Eberhardt, U. Mayer, S. Sutherland STLF: Brett Gilley</p> <p>Course transferred to various new instructors</p> <p><a href="#">Poster (CWSEI EOY 2010): EOSC 210: Introduction to Earth Science for Engineers</a></p>	<p>Course-level goals: complete</p> <p>Lecture-level goals: complete</p> <p>Goals for all labs: complete</p>	<p>End-of-term survey</p> <p>Mineral exam</p> <p>Peerwise</p>	<p>Use of PeerWise for student generation of questions (<a href="http://peerwise.cs.auckland.ac.nz/">http://peerwise.cs.auckland.ac.nz/</a>)</p> <p>Widespread use of clicker questions (4-8 in each 1.5 hour lecture), focus attention, test understanding, and drive discussion</p> <p>Small group or pair discussions in most classes</p> <p>Many case studies relevant to lectures</p> <p>Labs redesigned with new activities linked to learning goals</p> <p>Labs streamlined and reworked over Summer/Fall 2012</p>
<p><b>EOSC 211: Computer Methods in Earth, Ocean &amp; Atmosph. Sciences</b> (Jan '09 start)</p> <p>Faculty: R. Pawlowicz, C. Johnson STLF: Joshua Caulkins</p> <p><a href="#">Poster (CWSEI EOY 2010): EOSC 211: Transformations and results</a></p>	<p>Course-level goals: complete</p> <p>Lecture-level goals: complete</p> <p>Learning goals for Labs/Assignments: draft</p>	<p>Pre-post assessment: Administered in Teach 1 and edited for Teach 2, can be used "as is" for all future terms</p> <p>Midterm and end-of-term surveys</p> <p>New types of exam questions based on computer science concepts</p>	<p>In-class worksheets for every lecture</p> <p>Pair-programming used in all labs and assignments.</p> <p>Name-sticks used to call on students during lectures and in-class discussions</p> <p>Post-lecture Interviews</p> <p>Lab interviews</p>
<p><b>EOSC 212: Topics in the Earth &amp; Planetary Sciences</b> (Jan '08 start)</p> <p>Faculty: M. Jellinek, M. Bostock STLF: Francis Jones (~30 students per yr)</p> <p>Further refinements of generic science thinking activities and assessments were carried out in Fall '10, primarily by the instructor (M. Jellinek), with minor input and support from F. Jones.</p> <p><a href="#">Poster (CWSEI EOY 2011): Promoting and Measuring General Scientific Reasoning Expertise of 2nd Year Students</a></p>	<p>Course-level goals: complete</p> <p>Focus is on science thinking skills rather than content</p>	<p>End-of-term survey for project evaluation</p> <p>Quizzes on readings for both individual and teams, using Team Based Learning strategies</p> <p>Two projects (presentation and poster), including feedback at multiple stages of delivery</p> <p>Pre-post test related to model-based reasoning</p> <p>Peer assessment of some homework and both projects</p> <p>Regular graded abstract writing and question-posing assignments</p> <p>Student participation in rubric design for reading, writing and questioning</p>	<p>Vista Course Management System used extensively for content delivery, quizzing, surveying, logistics</p> <p>Team Based Learning elements: permanent teams, individual/team quiz protocols &amp; in-class team activities</p> <p>Content from Scientific American and other articles and lectures</p> <p>Three modules chosen to highlight departmental research strengths</p> <p>Guest speakers for each module</p> <p>Instruction and practice at developing science article reading, questioning &amp; discussing skills</p> <p>Project topics are student-determined</p> <p>Question posing, abstract writing and model based reasoning rubrics are used</p> <p>In Fall 2010, question posing aspect was more closely guided so students know whether to ask content or discussion oriented questions</p> <p>Capstone week introduced to revisit core skills and learning goals</p> <p>Two instructors with roughly half the classes attended by both</p>
<p><b>EOSC 220: Introductory Mineralogy</b> (Jan '08 start)</p> <p>Faculty: S. Mills, M.L. Bevier, J. Scoates STLF: Ben Kennedy, Joshua Caulkins, Erin Lane, Brett Gilley</p> <p>Additional work by R. Mindel, J. Dohaney; course Transferred to various instructors.</p> <p><a href="#">Poster (CWSEI EOY 2011): Tracking Student Progress with a Mineralogy/Petrology Concept Inventory</a></p>	<p>Course-level goals: complete</p> <p>Lecture-level goals: complete</p>	<p>Midterm and end-of-term surveys</p> <p>Lab quizzes</p>	<p>In-class activities and discussions are part of each lecture.</p> <p>3x5 cards used for student responses and feedback.</p> <p>Labs reworked and provided more structure to students and TAs</p> <p>Students create their own reference "mineral book" that can be used later for studying.</p>

<p><b>EOSC 221: Introductory Petrology</b> (Sept '07 start)</p> <p><u>Faculty:</u> M. Kopylova <u>STLF:</u> Brett Gilley</p> <p>Course transferred early on to M. Kopylova</p>	<p>Course-level goals: complete Lecture-level goals: complete Lab goals: complete</p>	<p>Pre/post assessment</p>	<p>Labs rewritten - more structure activities linked to goals Small group lecture activities in each lecture 3x5 cards for ongoing assessment of students and the course Many smaller quizzes after each module Improved course framework (spaced lectures that do more to highlight differences rather than massed lectures, covering all of one rock type).</p>
<p><b>EOSC 222: Geological Time</b> (Sept '11 start)</p> <p><u>Faculty:</u> P. Smith <u>STLF:</u> Francis Jones (~50 students per yr)</p>	<p>Course-level goals: completed Module and lab-level goals completed</p>	<p>Weekly lab exercises Midterm End of term lab exam Final exam In-class activities (next column) serve as formative assessment opportunities.</p>	<p>Roughly half the content was re-worked by P. Smith and R. Mindel. Four of ten labs were re worked with the assistance from an experienced teaching assistant. Complete lecture observations (student engagement plus in-class observations) were conducted during Spring 2011. Roughly 10 in-class group activities for use during class were developed during Spring 2012 teaching term.</p>
<p><b>EOSC 252: Introduction to Experimental Geophysics</b> (Sept '09 start)</p> <p><u>Faculty:</u> F. Herrmann <u>STLF:</u> Francis Jones (~15 students per yr)</p> <p>Transformation project adjourned prior to January 2011 teaching term because the class is no longer offered.</p>	<p>Course-level goals: agreed upon Lecture-level goals: first versions</p>	<p>Weekly lab or homework exercises supported by TAs One midterm One final exam In-class demonstrations assessed for "participation". The beginnings of regular on-line self-test quizzing based on assigned readings. More to come the time the course is taught. Extensive end of term survey about initiatives and preferences.</p>	<p>Enhanced context for all material by:</p> <ol style="list-style-type: none"> <li>1. Reworking four Lab exercises</li> <li>2. Re-compiling all lab exercises into a consistent format, which recognizes progression of learning from one exercise to the next.</li> <li>3. Dropping two in favor of a new "capstone exercise" (a context rich exercise using new forms of data (borehole well logs) and lab results from earlier work).</li> <li>4. Projects involving student-chosen topics, and 3-stage deliverables with TA and peer feedback.</li> <li>5. Guided demonstrations introduced to four class lectures, including pre-demonstration "prediction" worksheets.</li> </ol>
<p><b>EOSC 321: Introduction to Igneous Petrology</b> (Jan '10 start)</p> <p><u>Faculty:</u> M. Kopylova <u>STLF:</u> Brett Gilley</p>	<p>Course-level goals: complete Lecture-level goals: complete</p>	<p>End-of-term survey '09 &amp; '10 Focus groups Mineral quizzes, exams, group project</p>	<p>Student focus group Development of several new labs "Wake up" activities in each lecture Distributed mineral quizzes (as opposed to one quiz in week 1) Improved exam creation and marking/grading scheme Exams questions tied to learning goals Tectonic setting group project with group contract, in presentations of project students required to incorporate the data presented by the other students and come to their own conclusions.</p>
<p><b>EOSC 322: Metamorphic Petrology</b> (Sept '08 start)</p> <p><u>Faculty:</u> G. Dipple <u>STLF:</u> Erin Lane</p>	<p>Course-level goals: complete Topic-level goals: complete</p>	<p>Midterm survey Pre-reading quizzes</p>	<p>Rock sample and relevance in lectures Just-in-Time-Teaching (pre-readings and online quizzes given prior to module)</p>

<p><b>EOSC 326: Earth and Life Through Time</b> (Jan '10 start)</p> <p><u>Faculty:</u> S. Sutherland <u>STLF:</u> Francis Jones (~160 students per yr)</p> <p>Dec 2012: A video record of one lab and its follow up Friday activity is being developed to support professional development of instructors</p>	<p>Course-level goals: complete</p> <p>Module-level goals: complete (14 modules) with minor revisions in progress</p>	<p>Pre-requisite self-test, plus corresponding catch up material</p> <p>Weekly online exercises based on assigned readings from text and elsewhere.</p> <p>Regular use of clickers in class</p> <p>Weekly “active Friday” worksheets (see “Improved Methods”)</p> <p>Midterm and final exams plus a comprehensive end-of-term survey</p>	<p>New text to help remove low level content from class.</p> <p>Clicker questions are improving as experience is gained.</p> <p>Weekly homework based on assigned readings helps keep students on task. Students do these once for grades, then they are re-opened for practice before exams.</p> <p>Weekly “Active Fridays” allows 1/3 of all classes to be 100% peer instruction, active learning. Work is guided, and instructor plus 2 teaching assistants circulate during work.</p> <p>Two hands-on lab exercises substitute for 2 weeks of lectures. Deliverables are completed during class in groups.</p>
<p><b>EOSC 329: Groundwater Hydrology</b> (Jan '10 start)</p> <p><u>Faculty:</u> R. Beckie <u>STLF:</u> Francis Jones, Joshua Caulkins (~160 students per yr)</p>	<p>Course-level goals: complete</p> <p>Module-level goals: draft – need distributing among modules.</p> <p>Learning goals for Labs: complete</p>	<p>Pre-post assessment</p> <p>Clicker questions introduced into nearly all lectures –Weekly labs are taught &amp; marked by TAs. Some lab materials were moved to Vista to improve efficiency and feedback. Weekly TA meetings with the instructor help ensure consistency in all four lab sections.</p> <p>Midterm and final exams plus a comprehensive end-of-term survey during the transformation process.</p>	<p>Classroom observations and post-lecture interviews were carried out early in the transformation process</p> <p>Lab exercises were substantially refined and aligned with learning goals, and expectations have been made more explicit.</p> <p>TAs have well developed guidance for instructing and running labs.</p> <p>Introduced three case studies to correspond with lab work.</p> <p>Some small group work during lectures.</p> <p>Clickers added to all lectures to help leverage Socratic teaching to advantage all students.</p>
<p><b>EOSC 331: Introduction to Mineral Deposits</b> (Jan '10 start)</p> <p><u>Faculty:</u> J. Scoates, K. Hickey <u>STLF:</u> Brett Gilley</p> <p><a href="#">Poster (CWSEI EOY 2012): 3 years of Improving Student Impressions of EOSC 331</a></p>	<p>Course-level goals: complete</p> <p>Lecture level goals: complete</p> <p>Lab-level goals: complete</p>	<p>End-of-term survey</p> <p>Sketches in first and last labs</p> <p>Smaller quizzes replace midterms</p>	<p>New course frameworks developed.</p> <p>Reduced length of midterms, inserted framework activity after each quiz.</p> <p>Activities in many lectures</p> <p>Rewrote all labs, labs now have “checkpoints” and are handed in at the end of lab.</p> <p>How does a geologist sketch activity</p> <p>Poster session activity –successful model</p> <p>Poster Rubric</p> <p>Summative “deposits in space and time” activity</p> <p>Improved final exam format</p> <p>Work has continued past “official” transformation. Many more activities</p>
<p><b>EOSC 332: Tectonic Evolution of North America</b> (Sept '08 start)</p> <p><u>Faculty:</u> J. Mortensen <u>STLF:</u> Brett Gilley</p> <p>Course Transferred to E. Barnes for one semester</p>	<p>Course-level goals: draft</p> <p>Module-level goals: draft</p>	<p>Pre/Post Assessment rewritten for Jan 2010 (validated with former students)</p> <p>Midterm survey</p> <p>Peer Review Essay assignment</p> <p>End-of-term survey</p>	<p>Activities and discussions planned for some lectures.</p> <p>Just-in-Time-Teaching (pre-readings and online quizzes given prior to each module)</p>

<p><b>EOSC 355: The Planets</b> (Sept '08 start)</p> <p>Faculty: C. Johnson STLF: Francis Jones</p> <p>New course, taught 1<sup>st</sup> time in Spring 2009. (~70 students/yr)</p> <p><b>Fall 2010:</b> incorporation of a second instructor supported and observed by STLF as a "transfer" and sustainability experiment.</p> <p><a href="#">Poster (CWSEI EOY 2010): Continuing development of in-class activities in an upper level science elective</a></p>	<p>Course-level goals: complete</p> <p>Module-level goals: finalized for Spring 2010 term.</p>	<p>Pre-course skills diagnostic and "attitudes toward planetary sciences"</p> <p>Midterm survey for improving course delivery and focus</p> <p>Frequent in-class quizzes</p> <p>Clickers, major capstone homework exercises for each of 3 modules, in-class team-based worksheets used to set up or practices lecture content and skills.</p> <p>Major project, including 3-stage deliverables, and peer assessment.</p>	<p>Vista Course Management System used for content delivery, quizzing, surveying, logistics.</p> <p>Use of permanent teams for quizzes and in-class worksheet-based activities</p> <p>Clickers used for pre-lecture prediction and mid-lecture discussions.</p> <p>Online and in-class quizzes, especially to ensure accountability and assess comprehension of basic content, thus permitting higher level in-class activities &amp; lectures.</p> <p>No final exam</p> <p>Major poster presentation projects are a primary source of grades.</p>
<p><b>EOSC 372: Introductory Oceanography: Circulation and Plankton</b> (Jan '09 start)</p> <p>Faculty: S. Allen, K. Orians, M. Maldonado, E. Lane STLF: Erin Lane</p>	<p>Course-level goals: complete</p> <p>Lecture-level goals: complete</p> <p>Assignment learning goals: complete</p>	<p>Mid-term survey</p> <p>End-of-term survey</p> <p>Daily online quizzes</p> <p>Pre-requisite knowledge diagnostic quiz</p> <p>Draft post test</p> <p>Student workloads questions</p>	<p>Widespread use of thought-provoking clicker questions</p> <p>Daily assignments with online quizzes</p> <p>In class demonstrations and analogies developed</p>
<p><b>EOSC 373: Introductory Oceanography: Climate and Ecosystems</b> (Sept '09 start)</p> <p>Faculty: M. Maldonado, S. Allen, R. Francois, E. Lane STLF: Erin Lane</p>	<p>Course-level goals: complete</p> <p>Lecture-level goals: complete</p>	<p>Mid-term survey</p> <p>Draft diagnostic test</p> <p>Daily online quizzes</p>	<p>Widespread use of thought-provoking clicker questions</p> <p>Daily assignments with online quizzes</p>
<p><b>EOSC 472: Introduction to Marine Chemistry and Geochemistry</b> (Sep '09 start)</p> <p>Faculty: K. Orians STLF: Joshua Caulkins</p>	<p>Course-level goals: complete, editing for new content</p> <p>Lecture-level goals: draft, editing for new content</p>	<p>Midterm and end-of-term surveys</p> <p>Reading quizzes introduced.</p> <p>Reworked homework sets.</p> <p>Term papers enhanced to be a "critical review paper" which includes greater depth of comprehension</p>	<p>Weekly worksheet activities</p> <p>Anonymous peer-reviewed writing assignment with instructor feedback</p> <p>Post-lecture student interviews</p> <p>Investigating new textbook options, perhaps introducing a packet of articles</p> <p>Name sticks used during lectures.</p>

**The following courses have undergone improvement without specific STLF help, or with ad-hoc support**

- EOSC 110:** Using the Geoscience Concept Inventory to measure student learning - Faculty: M. Bevier
- EOSC 116:** Faculty: S. Sutherland
- EOSC 118:** Activities in the online setting Faculty: D. Turner, T. Dzikowski, STLF: B. Gilley
- ATSC 201:** Just-in-Time Teaching and clickers - Faculty: R. Stull
- EOSC 223:** Pre-post assessments and in-field assessments - Faculty: M. Bevier, STLF: J. Caulkins. [Poster \(CWSEI EOY 2010\): EOSC 223: Development and Implementation of an in-field assessment protocol for an introductory geologic field course](#)
- EOSC 270:** Homework exercises that use UBC's Beaty Museum of biodiversity for synthesis of principle concepts, early and late in the course. M. Maldonado, E. Pakhomov, F. Jones and a grad student.
- EOSC 315:** Clickers - Faculty: M. Lipsen
- EOSC 324:** No longer offered - Faculty M. Bevier
- EOSC 328:** GPS tracking of students, in-field assessments - Faculty: K. Hickey, STLF: J. Caulkins. [Poster \(CWSEI EOY 2011\): Measuring Novices' Field Mapping Abilities Using an In-Class Exercise Based on Expert Task Analysis](#) and [Geologic Expertise and Field Mapping: Lessons from a 3rd Year Undergraduate Field School](#)
- EOSC 333:** Learning goals, in class activities, field trips, labs summative activities STLF: B. Gilley
- EOSC 340:** Just-in-Time Teaching and clickers - Faculty: S. Harris & P. Austin
- EOSC 350:** Team Based Learning - Faculty: D. Oldenburg
- ENVR 200 & 300:** Team projects, studying metacognition - Faculty: K. Chan, S. Harris, T. Ivanochko, M. Johnson, D. Steyn

**EOSC 420:** Developing lab activities and student conference on projects. Faculty: K Russell STLF B. Gilley

**EOSC 421:** Lab projects, lecture activities, and field trip Faculty: A. Caruthers STLF B. Gilley

**EOSC 424:** Learning goals, activities, labs, and projects Faculty: J. Scoates and K. Hickey STLF B. Gilley

**EOSC433:** Scaffolding exercises for design and reporting on design projects, and a peer assessment of intermediate work. E. Eberhardt, F. Jones, and a grad student.

**EOSC 478:** Eposter project and online poster session. Faculty: E. Pakhomov STLF B. Gilley

### Curriculum

**Service Courses Curriculum Committee** evaluated precedents, conducted surveys, and analyzed student data to articulate a list of learning goals for all service courses under the subheadings “Knowledge and Major Concepts”, “Skills”, and “Habits and Attitudes”. The list was revised based on faculty input, was presented at the department’s retreat in April 2009, and adopted by the department. Goals are posted on the departmental website.

**Atmospheric Science Curriculum Committee** defined program goals. (S. Allen, chair)

**Environmental Science Curriculum Committee** conducted student focus groups and extensive data analysis on student enrollment data and developed a set of recommendations and a revised curriculum (D. Steyn, chair)

**Geophysics Curriculum Committee** reinstated the Geophysics Majors program (E. Hearn, chair)

**Geology Curriculum Committee** reinstated the Geology Majors program. A matrix correlating courses and program objectives is under development (J. Scoates and S. Sutherland).

**Oceanography Curriculum Committee** is actively working to define program goals & build links among courses. They have also created two new combined majors in Oceanography programs (with biology and with physics), and a new oceanography minor. (S. Allen, chair)

**Geological Engineering Curriculum** has started a course/objectives matrix in anticipation of an upcoming program review.

**Exit Survey:** An online survey has been developed for graduating 4<sup>th</sup> year EOAS students from all streams. Data will provide us with student perspectives on the EOAS academic programs, career goals and curriculum recommendations. This information will help us improve our program structure, content, and courses. The survey was initiated in April 2009 and administered annually since then. Results of the 2010, 2011 and 2012 have been processed.

### TA Development

Established a **TA training course** for graduate students (EOSC 516: Teaching and Learning in Earth & Ocean Sciences)

Course is run primarily by graduate students who have facilitator training. Enrolment is about 15/year. [Poster \(CWSEI EOY 2010\): Teaching and Learning in the Earth and Ocean Sciences: Adding Geoscience Education to the Graduate Student Curriculum at UBC](#)

Learning goals: Course level goals, Learning goals for each session

Assessments: Using Physics' Teaching Attitudes Survey as Pre/Post, Formative Evaluation after each session, Summative Evaluation

Methods and materials: Mini-lesson practice, Group discussions, Lab redesign project

### Research

See <http://eos.ubc.ca/research/cwsei/research.html> for a list of previous and continuing projects.

See <http://www.eos.ubc.ca/research/cwsei/resources/research/eossei-ResearchList.pdf> for a complete list of research results from EOS-SEI since 2007

### Other

**EOS-SEI Times:** A monthly newsletter containing results from courses, tips and information for instructors (42 editions so far)

**Teaching and Learning Workshops:** One-two per year are facilitated by STLFs for participants within and outside EOAS.

**Visitors:** Cathy Manduca, director of the Science Education Resource Center at Carleton College; Eric Riggs, co-director of the Center for Research and Engagement in Science and Mathematics Education, Purdue University; Leslie Reid, Tamaratt Teaching Professor, University of Calgary; Frank Granshaw, Portland Community College; Anne Marie Ryan, Dalhousie University; Jane Schoonmaker, University of Hawaii-Manoa; Steve Taylor, Kauai Community College; Julie Libarkin, Michigan State University

### Life Sciences Program

The Life Sciences Program (Depts. of Zoology, Botany, and Microbiology & Immunology) received its first funding from CWSEI in 2007. The funding was renewed and extended in 2011 with four new STLFs starting in late 2011 and early 2012. The new funding will allow STLFs to work with all second year core courses in the newly designed and implemented Biology Program at UBC. We are currently implementing interactive activities and peer discussion in second year core courses as well as some first and third year courses. Some examples of these are: iClicker questions with peer discussion, worksheets, case studies, learning activities, and invention activities. We have also implemented learning goals and pre-reading assignments in most courses we are working on. In addition, conceptual inventories in information transfer and community and population ecology have been developed and are used to evaluate the effectiveness of various class activities.

**SEI Director:** P. Schulte

**STLFs:** J. Taylor, M. Hansen, M. Banet, B. Clarkston, L. McDonnell, L. Weir, H. Yurk (emeritus), T. Kelly (emeritus)

**Faculty (instructors teaching targeted courses):** K. Smith, G. Spiegelman, G. Bradfield, W. Goodey, R. Turkington, M. O'Connor, E. Hammill, P. Kalas, S. Chowrira, P. Schulte, P. Kalas, J-H Lee, J. Klenz, G. Haughn, D. Altshuler, D. Moerman, C. Berezowsky, A. O'Neill, W. Tetzlaff, S. Ellis, S. Graham, M. Berbee, G. Bole, J. Whitton, D. Srivastava

**Faculty (others involved in working groups, committees, or ad-hoc support):** G. Bole, C. Pollack, A. O'Neal, K. Nomme, B. Couch

**Skylight Affiliate:** G. Birol; **Students and Post-Doctoral Fellows:** T. Deane, E. Jeffrey, R. Oh, M. Tseng, N. Wang, P. van Stolk

### Course Transformation

Course	Learning Goals	New Assessments	Improved methods
<b>BIOL 111: Cell and Organismal Biology</b> (Sept '07 - Sept '08)  <b>Faculty:</b> K. Nomme, J. Klenz <b>Skylight Liaison:</b> G. Birol	Course-level goals: complete Topic-level goals: complete	Midterm student evaluations Focus groups Biology attitudinal survey Clicker questions	Case studies Group activities Vista reading quizzes Peer tutor support Intentional alignment of topics with student work and assessment Clicker questions
<b>BIOL 112: Cell Biology</b> (Sept '07 start)  <b>Faculty:</b> E. Gaynor, T. Kion, G. Spiegelman, <b>STLF:</b> Jared Taylor  <a href="#">Poster (CWSEI EOY 2010): Invention Activities in First Year Biology</a>	Course-level goals: complete Topic-level goals: complete	End-of-term surveys Student interviews to assess problem solving abilities End-of-term assessment of learning and invention groups to assess transfer abilities Biology attitudinal survey	Developed and refined a series of invention/investigation activities for in class once per week. Just-in-Time Teaching incorporated with pre-class readings. In-class writing assignments Clicker questions with peer discussion End of week problems PeerWise used in all sections PeerWise workshops were implemented in an attempt to give the students some guidance in writing better multiple choice questions.
<b>BIOL 121: Ecology, Genetics and Evolution</b> (Sept '07)  <b>Faculty:</b> C. Pollock, G. Bole, P. Kalas, B. Couch, A. O'Neill <b>Skylight Liaison:</b> G. Birol	Course-level goals: complete Topic-level goals: complete (revised and extended for the ecology unit in '11)	Mapping of multi-section course outcomes onto assessments Biology attitudinal survey Meiosis concept inventory (in preparation)	Peer tutors Learning centre PeerWise used in some sections. Writing project with Rosie Redfield, 2008/09 iClickers implemented in most sections Testing of conceptual inventory in community and population ecology ('10). The conceptual inventory in community and population ecology was used to evaluate the effectiveness of in-class activities (Kalas '11).
<b>BIOL 201: Cell Biology II: Introduction to Biochemistry</b> (Jan '08 – Sept '08)  <b>Faculty:</b> W. Bingle, S. Chowrira, J. Richards <b>STLF:</b> Jared Taylor	Lecture -level goals: complete	Chemistry concept pre-test Focus group interviews Focus group follow-up survey (entire class) Biology attitudinal survey	Recommendations provided to faculty.

<p><b>BIOL 204: Vertebrate Structure and Function</b> (Jan '08- start)</p> <p><u>Faculty:</u> B. Milsom, A. O'Neill W. Tetzlaff <u>STLF:</u> Laura Weir</p>	<p>Course-level goals: complete Topic-level goals: complete</p>	<p>Clicker questions Post test: Vista Reading/Content quizzes In-class exam-style questions with posted rubrics and feedback</p>	<p>New study questions Midterm teaching evaluations Improvement of group activities and discussions in class Revised course content and lecture materials incorporating real life examples. Enhanced problem solving approach including comparisons. Introduced exam-style question practice into lecture time Collected data regarding approaches to teaching phylogenetics</p>
<p><b>BIOL 205: Comparative Invertebrate Zoology</b> (Jan '13 start)</p> <p><u>Faculty:</u> A. O'Neill <u>STLF:</u> Laura Weir</p>	<p>Course-level goals: In process Topic level goals: In process</p>	<p>Clicker questions Pre-reading assignments for lecture and laboratory</p>	<p>Clicker questions with peer discussion Pre-reading assignments that cover both lecture and laboratory material Midterm teaching evaluations Collecting data regarding approaches to teaching phylogenetics</p>
<p><b>BIOL 209: Non-vascular Plants</b> (Sept '12 start)</p> <p><u>Faculty:</u> M. Berbee, M. Hawkes <u>STLF:</u> Laura Weir</p>	<p>Course-level goals: completed Topic level goals: completed</p>	<p>Clicker questions Independent research projects</p>	<p>Clicker questions with peer discussion Alignment of exam questions and learning objectives Collecting data regarding approaches to teaching phylogenetics</p>
<p><b>BIOL 210: Vascular Plants</b> (Jan '13 start)</p> <p><u>Faculty:</u> S. Ellis, S. Graham <u>STLF:</u> Laura Weir</p>	<p>Course-level goals: completed Topic level goals: completed</p>	<p>Clicker questions In-class worksheets</p>	<p>Clicker questions with peer discussion Alignment of exam questions and learning objectives Collecting data regarding approaches to teaching phylogenetics</p>
<p><b>BIOL 230/304: Fundamentals of Ecology</b> (Sept '09 start)</p> <p><u>Faculty:</u> D. Srivastava, R. Turkington, W. Goodey, E. Hammill <u>STLF:</u> Malin Hansen</p> <p><a href="#">Poster (CWSEI EOY 2011): Measuring Learning Gain in a Transformed Introductory Ecology Course</a></p> <p><a href="#">Poster (CWSEI EOY 2012): Evaluating Interactive Activities by Measuring Student Learning Gain</a></p>	<p>Topic-level/ class specific goals: completed and provided to students Learning goals have been linked to exam question, iclicker questions and pre-reading questions.</p>	<p>The CLASS pre and post biology attitude surveys have been used in all sections each term (2009-2011). A pre/post conceptual survey for community and population ecology has been developed and is used. Student interviews have been conducted to assess class activities and methods and to validate conceptual survey. Midterm survey has been developed and is used to assess class activities and methods.</p>	<p>Clicker questions with peer discussion Pre-reading assignments with multiple choice and open ended question (with feedback) are issued each week. Small group in-class discussions have been incorporated. Twenty-three on-line article based practice problems/case studies have been developed. Some of them have been implemented as in-class learning activities. Three mandatory field labs have been implemented. Two tutorials have been designed and implemented (for summer courses only). The conceptual inventory in community and population ecology has been used to evaluate the effectiveness of in-class activities (Instructor: Roy Turkington and Wayne Goodey '11). Conceptual questions on population dynamics are used to compare the effectiveness of in-person tutorials and on-line tutorials ('12). The effectiveness of using analogies when teaching ecology was evaluated using optional tutorials ('11).</p>
<p><b>BIOL 234: Fundamentals of Genetics</b> (Jan '12 start)</p>	<p>Topic level learning goals - complete, used to structure lectures, tutorials, and provided to students.</p>	<p>Genetics Concept Inventory Test Student think-aloud interviews to assess problem solving in</p>	<p>Clicker questions with peer discussion used (by most instructors) Targeted pre-reading assignments with quiz</p>

<p>Faculty: J. Klenz, P. Kalas, D. Moerman, G. Haughn, C. Berezowsky STLF: Lisa McDonnell</p>		<p>genetics</p> <p>Interviews conducted to assess course satisfaction</p> <p>Problem solving and conceptual understanding assessed with some handed-in homeworks</p> <p>Mid-term and end-of-term satisfaction surveys deployed to assess class activities.</p> <p>Regularly collecting feedback from TAs about their experience and the challenges they observe students experiencing</p>	<p>are used weekly.</p> <p>Tutorials with an emphasis on group work and facilitation by TAs deployed weekly</p> <p>Improved support for TAs to provide students with a consistent experience across multiple tutorial sections</p> <p>Peer-discussion used in-class regularly</p> <p>Improved approach to teaching problem solving</p>
<p><b>BIOL 260: Fundamentals of Physiology</b> (Jan '12 start)</p> <p>Faculty: P. Schulte, J-H Lee STLF: Mandy Banet</p>	<p>Lecture-level learning goals: Goals were provided to students and are currently in revision.</p> <p>Goals have been linked to exams and iclicker questions</p>	<p>End-of-term survey was conducted to get specific detail on active learning aspects of the course. Focus groups are used to provide feedback on class activities and methods.</p>	<p>Biology 260 was a new course, so these can be thought of as "used methods" rather than "new methods"</p> <p>Clicker questions with peer discussion</p> <p>Pre-reading assignments with an online quiz (including one open-ended JITT questions) are issued each week.</p> <p>Practice exam questions are provided as in-class activities to give students practice and feedback on what is expected from them when answering a short essay question.</p>
<p><b>BIOL 306: Advanced Ecology</b> (Jan '10 start)</p> <p>Faculty: G. Bradfield, W. Goodey, M. O'Connor STLF: Malin Hansen</p>	<p>Topic-level/class specific goals: completed and provided to students</p>	<p>The CLASS pre and post biology attitude surveys have been used in all sections each term ('10, '11 and '12).</p> <p>A pre/post conceptual survey for advanced ecology has been developed and is used.</p> <p>A pre/post conceptual survey on competition models have been developed. Student interviews have been conducted to assess class activities and methods and to validate conceptual survey.</p> <p>Mid-term survey has been developed and is used to assess class activities and methods.</p>	<p>Clicker questions with peer discussion</p> <p>Pre-reading assignments with multiple choice and open ended questions (with feedback) are issued each week.</p> <p>Small group in-class discussions have been incorporated.</p> <p>Twenty-three on-line article based practice problems have been developed. Some of them were implemented as in-class learning activities in '11 and '12 (approximately one learning activity per week).</p> <p>The conceptual inventory on competition models is being used to evaluate an in-class learning activity.</p> <p>Three mandatory field labs have been implemented.</p> <p>Two tutorials have been designed and implemented (for summer courses only).</p>
<p><b>BIOL 310: Introduction to Animal Behaviour</b> (Jan '11 start)</p> <p>Faculty: W. Goodey STLF: Malin Hansen</p>	<p>Topic-level/class specific goals: completed and provided to students</p> <p>Learning goals have been linked to exam question, iclicker questions and pre-reading questions</p>	<p>The CLASS pre and post biology attitude surveys have been used in all sections each term ('11-'12).</p> <p>A pre/post conceptual/attitudinal survey has been developed by the instructor and is used.</p> <p>Mid-term survey will be developed and used.</p>	<p>Clicker questions with peer discussion</p> <p>Pre-reading assignments with multiple choice questions (with feedback) are issued each week.</p> <p>Small group in-class discussions have been incorporated.</p> <p>An entire 50 min lecture per week is devoted to an in-class group discussion activity.</p> <p>Mandatory field labs have been part of the course for some years.</p> <p>Student project and associated poster presentation have been part of the course for some years.</p>
<p><b>MICB 302: Immunology</b> (Sept '11 start)</p> <p>Faculty: P. Johnson STLF: Jared Taylor</p>	<p>Learning goals: in the process</p>		

<p><b>MICB 325: Microbial Genetics</b> (Jan '11 start)</p> <p>Faculty: T. Beatty STLF: Jared Taylor</p> <p><a href="#">Poster (CWSEI EOY 2012): Restructuring Microbiology 325: Microbial Genetics</a></p>	<p>Learning Goals: complete</p>	<p>A newly developed Bacterial Gene Regulation Concept Inventory is being used in a trial run.</p>	<p>Currently tutorial/homework questions are being converted into clicker questions that will be used during a weekly 50-minute tutorial lecture.</p> <p>Currently undergoing transformation to use a full active learning with JITT format.</p>
<p><b>Biol 336: Fundamentals of Evolution</b> (Jan. '12 start)</p> <p>Faculty: J. Whitton, G. Bole STLF: Bridgette Clarkston</p>	<p>Course-level: in progress Topic-level: complete</p>	<p>Mid-course and end-course student attitudinal surveys</p> <p>Clicker questions</p> <p>Speciation Concept Inventory (in validation stage)</p>	<p>Weekly targeted textbook pre-reading assignments and quizzes</p> <p>Assessment questions drawn from learning goals.</p> <p>Tutorials more connected to lecture section and converted from informal discussion to more structured group work with worksheets and discussion.</p> <p>Clicker questions with peer discussion; broader use of clicker questions (e.g., assess prior knowledge, make predictions, probe misconceptions)</p>
<p><b>BIOL 361: Introduction to Physiology</b> (Sep '12 start)</p> <p>Faculty: D. Altshuler STLF: Mandy Banet</p>	<p>Lecture-level learning goals: Goals were provided to students.</p> <p>Goals have been linked to exams, iclicker questions, practice problems, and homeworks.</p>	<p>Pre-term assessment on topics covered in the course was given first day of class.</p> <p>End-of-term survey was conducted to get specific detail on active learning aspects of the course. Focus groups are used to provide feedback on class activities and methods.</p>	<p>Clicker questions with peer discussion</p> <p>Pre-reading assignments with an online quiz (including one open-ended JITT questions) are issued each week.</p> <p>Practice exam questions are provided as in-class activities to give students practice and feedback on what is expected from them when answering a short essay question.</p>

Transformations in the following courses have been undertaken by individual faculty members (with advice provided by CWSEI-LS)

**Microbiology 300: Microbial Ecology** (Faculty: W. Mohn) – Course-level and topic-level learning goals completed, survey, in-class group problems, poster made by learning group, in-class and out-of-class student learning group problems, clickers.

**Microbiology 409: Advanced Microbial Genetics** (Faculty: S Hallam) – Course-level and topic-level learning goals completed, student survey, in-class workshops using groups of students, clickers.

## Curriculum

### Organizational Planning:

- Biology Program curriculum working group has proposed extensive changes to the program. G. Birol is on the committee with faculty from Botany and Zoology.
- Established a methodology for developing learning objectives (e.g. Angie O'Neill's work within the scope of BIOL 204 resulted in development of 3rd year physiology courses' learning outcomes with Trish Schulte and Agnes Lacombe)
- Developed a comprehensive project plan for the new upper level ecology courses led by Diana Srivastava with the help of Harald Yurk 2007/2008.
- **Curriculum Mapping Project:** Life Sciences STLFs B. Clarkson, M. Banet, L. Weir, and L. McDonnell have undertaken curriculum mapping project of the biology program. Information about nearly all biology courses have been collected and the information is being used to map the overlap (and gaps) in the coverage of course-level and program-level learning goals and skills.

### Evidence Based Approach to Curriculum Design:

- **Concept Inventories:** Jared Taylor and Liz Imrie with help from George Spiegelman developed gene regulation concept inventory in BIOL 112 which has now been validated and is being deployed in some large classroom settings. A smaller version of the inventory has been used in Biology 112 as a pre-test, and they plan on running the full inventory as a post-test. Additionally, the inventory is being deployed in MICB 325 as both a pre and post-test. Malin Hansen developed a concept inventory in population and community ecology which has been validated and is used to evaluate the effectiveness of in-class activities in both BIOL 121 and BIOL 230/304.
- **4th year Biology Satisfaction Survey:** Evaluation of Student Satisfaction and Skills by Harald Yurk and Gülnur Birol provided evidence about student satisfaction and areas for improvement in the program.
- **Attitudinal Survey:** The CLASS pre and post biology attitude surveys have been used in several first, second, third and fourth year courses between 2009-2011. This is part of a longitudinal study where we investigate shifts in students' attitudes towards biology from first to fourth year.
- **Ecological Attitude Surveys:** Harald Yurk conducted surveys on ecological attitudes of students before and after ecology instruction and at different program levels 1st, 3rd, and 4th year, and grad students. The survey use was based on the learning goal that ecology education should build an informed citizenry which can be measured as an attitude change towards environmental issues.
- **Chemistry Concepts:** Jared Taylor conducted a review of UBC biology courses to determine the required chemistry knowledge. As a starting point, the required courses for the Cell Biology and Genetics program were analyzed to determine the relevant chemistry content. This was followed by a general survey of other UBC biology courses. The report provided important insight into decisions regarding the chemistry content.

- **Concept Tests:** Investigating Conceptual Understanding of Natural Selection: Harald Yurk has been assessing conceptual understanding of natural selection in 1st and 3rd year students before and after instruction, using a multiple choice survey (Conceptual Inventory of Natural Selection, CINS, developed at San Diego State University). The CINS measures the presence and absence of the seven key principles of natural selection plus three other concepts that are related to natural selection but are not considered key concepts, such as speciation. Harald also used another short answer instrument in BIOL 336 to test for common misconceptions about natural selection.
- **Focus Group Interviews:** e.g. BIOL 111, BIOL 121, BIOL 201, 4th year students 2007-2009
- **Learning Objectives:** At present 16 out of 51 biology courses (200 level and up) have topic level learning objectives, some of which were developed by faculty members only and some with the help of STLFs. In addition, all first year biology lecture courses have topic level learning objectives. These objectives are helpful to guide the work of discipline specific committees in identifying the depth and breadth of concepts.
- **UBC PAIR data**

## Research

### CWSEI funded:

- **Learning Objectives:** Jared Taylor in collaboration with Beth Simon, STLF in Computer Science, conducted a study of student and faculty perceptions of the usefulness of learning goals. Their paper on this work is accepted for publication in the Journal of College Science Teaching.
- **Invention Activities:** Jared Taylor, George Spiegelman and Karen Smith are conducting a study of the effectiveness of invention activities and learning group activities in developing students' reasoning/problem solving skills and ability to transfer knowledge to novel situations.
- **Biology Attitudinal Survey:** Gülnur Birol and Malin Hansen are working on a study that compares student attitudes in first and third year courses. The CLASS pre and post biology attitude surveys have been used in several first, second, third and fourth year courses between 2009-2011. This is part of a longitudinal study where we investigate shifts in students' attitudes towards biology from first to fourth year.
- **Learning Activities/Case Studies:** The concept inventory in population and community ecology has been used to evaluate the effectiveness of in-class activities in both BIOL 121 and BIOL 230/304.
- **Use of analogies to teach ecology:** The effectiveness of using analogies when teaching ecology was evaluated using optional tutorials in BIOL 230/304 in the fall of 2011.
- **Student Satisfaction Survey:** Harald Yurk and Gülnur Birol investigated student satisfaction within the biology program. In April 09, 2009, student responses were collected in fourteen fourth year biology courses. The analysis of the data is completed. As part of the project, we are planning to conduct surveys with potential employers of life science graduates to assess needs of employers with regard to the biology curriculum and general scientific skill sets. A special assistant has been hired for this latter project.
- **Writing Assignment Study:** Rosie Redfield and Tamara Kelly conducted a study on the effect of different types of assignments on student's writing and clarity of thought January – April 2008.
- **Pre-reading Study:** Mandy Banet collaborated with Cynthia Heiner (former STLF in Physics) to study the implementation of directed pre-readings in across disciplines. A manuscript is in prep for the American Journal of Physics.
- **Problem Solving in Genetics:** Lisa McDonnell conducted a study to investigate how students solve problems in genetics, and how to modify course activities to improve student ability at problem solving in genetics. Student interviews and tests continue to be collected to assess the effectiveness of changes to the way we teach problem solving. The study is ongoing, and more data will be collected over the next two terms.
- **Retention of conceptual and procedural knowledge in genetics:** Lisa McDonnell is measuring the degree of retention of conceptual understanding and procedural knowledge (how to solve problems) in genetics. Students from both summer, fall, and spring terms are recruited approximately 2.5 months after course completion to write a previously-written conceptual inventory and exam questions. Data collection has begun, and will be ongoing through 2013.
- **Two-stage Collaborative Test Study:** Bridgette Clarkston collaborated with Brett Gilley (STLF in EOAS) to study the effects of testing students in groups vs. individually on student learning. A manuscript is in prep. for the Journal of College Science Teaching.
- **Constructing logical arguments:** Laura Weir is currently examining the effectiveness of repeated practice with feedback on the construction of logical arguments on open-ended essay type examinations.

### Spin-off projects with funding from other resources (e.g. TLEF, Skylight, Faculty/Graduate Student Teaching Certificate Program) in addition to CWSEI funding:

- **Course Curriculum Mapping in a Multi Section Course:** Angie O'Neill, Gülnur Birol and Carol Pollock have submitted a paper on the teaching and assessment of learning outcomes in a multi-section first year biology course.
- **Non-majors Biology Course Development:** Kathy Nomme and Gülnur Birol are conducting a study on student attitudes and beliefs towards biological sciences in a non-majors first year biology course using focus group interviews, midterm evaluations and attitudinal survey data.
- **Study Habits of Students in a 2nd year Biology Course:** Gülnur Birol, Lacey Samuels, Ellen Rosenberg and Joanne Nakonechny are conducting a study on students' study habits in BIOL 200 using both quantitative and qualitative data collected over a period of three years.
- **Questions for Biology:** Funded by Two Skylight grants, developing concept questions for first year Biology courses using material collected in BIOL 112 and BIOL 121. People involved are Jared Taylor, Gülnur Birol, Leah MacFadyen, George Spiegelman, Karen Smith, Tracy Kion, Carol Pollock, Angie O'Neill, Pam Kalas, Carol Pollock and Jennifer Klencz. [Poster \(CWSEI EOY 2012\): Developing Concept Inventories for Biology](#) and [EOY 2011: The Operon Concept Inventory: Measuring Targeted Learning Gains in Microbiology](#)

## Other

- **BIOL 310: September - December 2008** Leticia Aviles and Harald Yurk conducted a study on the usefulness of group discussions in class through in-class observations and focus groups.
- **MICB 202: January - April 2008:** Yiannis Himaras did a MICB 448 project under the supervision of Tracy Kion and Gülnur Birol to conduct an exploratory project to investigate student learning in MICB 202.
- **BIOL 352: January - April 2013:** Mandy Banet is collaborating with Santokh Singh to measure the impact of short oral presentations on student's comfort and ability to communicate about scientific research.
- **BIOL 340: Sept-Dec 2012:** Lisa McDonnell consulted with a 448 student to conduct a study about the effectiveness of a predict-and-reflect exercise on student learning in experimental cell biology.

## Mathematics Department

Starting in 2008, the UBC Mathematics Department is participating in the Carl Wieman Science Education Initiative (CWSEI) to improve undergraduate science education. In 2010 the Math-CWSEI program underwent a major expansion thanks to the generous donation by Prof. David Cheriton, UBC alumnus, now Professor of Computer Science at Stanford University.

An important first step for the Math CWSEI in all the courses involved in the project is to write down a set of learning goals. Learning goals (also called "learning outcomes" or "learning objectives") make explicit what the students are expected to be able to do at each stage of the course. They are useful to instructors in preparing tests, and assessing the success of a course. In lower level courses, where the students and instructors may start out thinking about the material in radically different ways, learning goals can help to focus the instruction at the appropriate level. They provide a communication channel for successive instructors in a given course, so that effort in improving pedagogy is transmitted. Made available to students, they help students assess their understanding and to prepare for exams.

An important last step for all the projects in the Math CWSEI is the archiving of materials in the [SEI Course Materials Archive](#). This archive contains material developed by departments participating in the CWSEI at UBC, and is intended to be an open resource for educators.

In 2008-2009 our projects were concentrated in two areas.

The first area was computing and computer labs in Math 152, Math 256 (Mech 221), Math 257/316, Math 253 (Mech 222), and Math 307. These courses had all recently introduced computing as an intrinsic part of the syllabus. The Math CWSEI helped in the creation of tutorials and lab materials, assisted in integrating the computational component into the course material and developing testing methods, and assessed the effectiveness of the computational component.

The second area was support for the Math 180/184 workshops and the Basic Skills Test. The introduction of problem-solving workshops in all sections of Math 180 and Math 184 in 2008 brought new challenges in the course management and coordination. The Math CWSEI helped to assess the effectiveness of the program in such large, multi-section courses, and contributed to the development of effective program management strategies. The Math CWSEI also contributed to the revision of the Basic Skills Test, providing support for a statistical analysis of the test and developing a computer-based version of the test. [Poster \(CWSEI EOY 2011\): Basic Skills in Mathematics](#)

In 2009-2010 our focus was mainly in-depth assessment of student activities and engagement, improvements to course materials based on data collected in the previous year, and better coordination of workshops and labs with course lectures. The Math CWSEI also provided support for the development of a new computing module in Math 318.

In 2010, the Math CWSEI expanded to incorporate new, longer term projects, mostly involving tracking and improving key skills throughout the curriculum and supporting the implementation of effective teaching methods and use of classroom technologies (clickers, online homework, etc.).

**SEI Director:** Costanza Piccolo (current), Stephanie van Willigenburg (2009-10), Richard Froese (2008-09)

**STLF:** Warren Code, Sandra Merchant, Joseph Lo, Katya Yurasovskaya (emeritus, July '11-Aug '12), Paul Ottaway (emeritus, Sept-Dec '09)

**Faculty:** Currently involved: J. Bryan, A. Chau, E. Cytrynbaum, J. Gordon, R. Gupta, F-S. Leung, P. Loewen, B. Marcus, S. Ramdorai, A. Rechnitzer, Z.Reichstein, D. Schoetzau. Involved in past projects: R. Anstee, M. Doebeli, R. Froese, B. Homsy, L. Keshet, M. MacLean, A. Peirce, G. Slade, S. van Willigenburg, M. Ward, B. Wetton, O. Yilmaz.

**TA's and Postdocs:** Involved in the past: P. Bell, M. Berube, J. Gou, A. Herrera, V. Kapoor, I. Karimfazli, D. Karslidis, R. Liang, A. Lindsay, T. Milnor, A. Nguyen, M. Raggi, L. Robson, S. Rose, R. Schwarz, A. Raghoonundun (with Skylight support), G. de Oliveira, W. Thompson, M. Willoughby, A. Zaman.

### Course Transformation

Course	Learning Goals	New Assessments	Improved methods
<b>MATH 101: Integral Calculus with Applications to Physical Science and Engineering</b> (Jan '12 start) Faculty: R. Gupta STLF: Costanza Piccolo	No revision	In-class short diagnostic Test on basic differential calculus skills  Weekly common homework assignments	Online homework using WeBWork
<b>MATH 102: Differential Calculus with applications to Life Sciences</b> (Sept '12 start) Faculty: E. Cytrynbaum STLF: S. Merchant, C. Piccolo	Topic-level goals: first draft is under development	Online basics math skills diagnostic  Pre-lecture quizzes  Weekly common homework assignments  End-of-term survey  Classroom observations	Adopted interactive teaching methods using clickers

<p><b>MATH 104/184: Differential Calculus with applications to Social Sciences and Commerce</b> (Jan 10 start)</p> <p><u>Faculty:</u> M. MacLean ('10-'11), S. Ramdorai ('12)  <u>STLF:</u> Warren Code  <u>TA:</u> M. Raggi ('10), L. Robson ('11)</p> <p><a href="#">Poster (CWSEI EOY 2012): MAPS: Math Attitude and Perceptions Survey</a>          (developed by STLFs Warren Code, Joseph Lo, Sandra Merchant)</p> <p><a href="#">Poster (CWSEI EOY 2012): Teaching Methods Comparison in a Large Introductory Calculus Class</a></p>	<p>Course-level goals: second draft complete</p> <p>Topic-level goals: second draft complete and incorporated into weekly "learning guides" for instructors with specific textbook examples for each goal.</p>	<p><i>All sections:</i></p> <ul style="list-style-type: none"> <li>-Attitude survey with short diagnostic test</li> <li>-Instructor interviews</li> <li>-Class observations</li> </ul> <p><i>MacLean's sections:</i></p> <ul style="list-style-type: none"> <li>-Midterm and end-of-term surveys</li> <li>-Clicker session data</li> <li>-In-class activity audio + written</li> </ul> <p><i>Methods Comparison ('11):</i></p> <ul style="list-style-type: none"> <li>-Math 104 Calculus Diagnostic to measure student calculus background from high school.</li> <li>-Topic quizzes for Related Rates and Linear Approximation.</li> </ul> <p><i>Ramdorai's section ('12):</i></p> <ul style="list-style-type: none"> <li>-Student work from in-class worksheets</li> <li>-Clicker and diagnostic data (as previous years)</li> </ul>	<p><i>All sections:</i></p> <ul style="list-style-type: none"> <li>-Developed weekly "learning guides" for instructors to enhance coordination; guides incorporate learning goals, practice problems and pedagogical approaches and issues.</li> <li>-Developed common online and paper homework assignments.</li> <li>-Facilitated weekly instructor meetings</li> </ul> <p><i>MacLean's sections:</i></p> <ul style="list-style-type: none"> <li>-Developed in-class activities and clicker questions.</li> </ul> <p><i>Methods Comparison (11):</i></p> <ul style="list-style-type: none"> <li>-Structured class notes, lesson plans, clicker questions and pre-reading assignments for the Related Rates and Linear Approximation weeks, with evidence of better conceptual learning over more traditional instruction.</li> </ul> <p>Ramdorai's section ('12):</p> <ul style="list-style-type: none"> <li>-Worksheets for almost all current course topics, some clicker questions to support, used in final 20 minutes of each 80-minute class period.</li> </ul>
<p><b>MATH 180/184: Differential Calculus (Workshop component)</b> (Sept 08 start)</p> <p><u>Faculty:</u> R. Gupta, A. Chau, R. Anstee  <u>STLF:</u> Costanza Piccolo ('08-'10), Warren Code (11)  <u>TA:</u> V. Kapoor, R. Schwarz, A. Zaman</p> <p>Completed Fall '11</p> <p><a href="#">Poster (CWSEI EOY 2010): First Year Calculus Workshops</a></p>	<p>Course-level goals: complete</p> <p>Workshop goals: complete</p>	<p>Midterm and end-of-term surveys on workshop activities and student attitudes.</p> <p>Weekly quizzes</p> <p>Class observations</p>	<p>Workshops 1-12 complete: added workshop-level learning goals and list of required basic skills; created new problems with course-specific applications; developed problem solving strategies.</p> <p>Program Structure and Management: Expanded the administrative structure and TA training; developed problem database (with Skylight support) to ease weekly production of workshop material.</p>
<p><b>MATH 110: Differential Calculus</b> (Sept 10 start)</p> <p><u>Faculty:</u> F. S. Leung  <u>STLF:</u> Joseph Lo ('10-'12), Warren Code ('12)</p> <p><a href="#">Poster (CWSEI EOY 2012): Precalculus Skills</a></p> <p><a href="#">Poster (CWSEI EOY 2012): What might affect student performance in a Math Course?</a></p>	<p>Course-level goals: complete</p> <p>Workshop goals: complete</p>	<p>Diagnostic Test on Basic Skills</p> <p>Attitude and study habit survey</p> <p>Midterm class and workshop surveys</p> <p>Class observations of workshops and lectures</p> <p>Focus group and survey on use of textbooks ('12)</p>	<p>New workshop format developed to address low student engagement in workshop activities.</p> <p>Online homework assignments used in all sections.</p> <p>Archiving of course material for future use</p> <p>Weekly remedial work on basic skills.</p> <p>Use of existing free online text, with collection of supporting web materials ('12-'13)</p>
<p><b>MATH 152: Linear Systems (Computer Labs component)</b> (Sept '08 start)</p> <p><u>Faculty:</u> B. Wetton  <u>STLF:</u> Warren Code ('09-'10), Costanza Piccolo ('08-'09)  <u>TA:</u> A. Lindsay</p> <p>Completed in 2010</p> <p><a href="#">Poster (CWSEI EOY 2011): Redesign of Computer Labs for Engineering Students in a Linear Algebra Course</a></p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>End-of-term lab surveys</p> <p>Pre/post-tests on Matlab syntax and basic programming structures.</p> <p>Pre/post-tests on translation of word problems into linear systems.</p> <p>Lab observations and TA interviews to determine student difficulties and completion rates.</p>	<p>Labs rewritten to tie in more closely with the course material, and revised after a full term of use.</p> <p>Paper-based homework, midterm exam and final exam questions developed to test/practice Matlab syntax and basic programming structures.</p> <p>Lecture notes revised to include Matlab material.</p>

<p><b>MATH 200: Calculus III</b> (Sept '12 start)</p> <p><u>Faculty:</u> J. Gordon <u>STLF:</u> J. Lo</p>	No revision	<p>Diagnostic test on first-year calculus materials</p> <p>Midterm and end-of-term surveys on online homework, in-class activities and supplementary materials</p>	<p>In-class activities were developed.</p> <p>3D graphics were produced for use in class and interactive supplementary materials on UBC Blog</p>
<p><b>MATH 210: Introduction to Mathematical Computing</b> (Sept '11 start)</p> <p><u>Faculty:</u> D. Schoetzau <u>STLF:</u> Joseph Lo</p>	Topic-level goals: complete and revised	<p>Diagnostic test on series and first year calculus</p> <p>Computer-based exams</p> <p>Student survey</p> <p>Class and lab observations</p>	<p>Course curriculum has been substantially changed. All standard course materials (course outline, lecture notes, assignments and exams) have been redeveloped.</p> <p>In-class computer-based activities developed.</p>
<p><b>MATH 220: Mathematical Proof</b> (March '10 start)</p> <p><u>Faculty:</u> A. Rechnitzer <u>STLF:</u> Katya Yurasovskaya (July '11- Aug'12), Sandra Merchant ('10-'11, May '12)</p> <p><a href="#">Poster (CWSEI EOY 2011): Assessing Basic Skills for Mathematical Proof</a></p> <p><a href="#">Poster (CWSEI EOY 2012): Workshops and the First Course in Mathematical Proof</a></p>	<p>Course-level goals: first draft complete.</p> <p>Topic-level goals: second draft complete</p>	<p>Proof diagnostic pre/post test</p> <p>Midterm and end-of-term surveys</p> <p>Student interviews after lectures to monitor difficulties and effectiveness of class activities.</p> <p>Student problem-solving interviews to assess learning and retention of proof skills</p> <p>Short in-class individual and group quizzes</p> <p>Proof concept test (first draft) on specific proof skills</p>	<p>Additional practice problems and solutions were prepared for midterm 2 and the final exam.</p> <p>In-class proof activities were run. More activities will be developed.</p> <p>Small group problem-solving sessions ("workshops") were created and comprise approximately 25% of lecture time.</p>
<p><b>MATH 221: Matrix Algebra</b> (Sept '12 start)</p> <p><u>Faculty:</u> Z. Reichstein <u>STLF:</u> Joseph Lo</p>	No revision	<p>Weekly common online homework assignments and practice tests</p> <p>Midterm and end-of-term surveys on online homework</p>	Online homework using WeBWork
<p><b>Math 230/335: Mathematics for Elementary Teachers</b> (June '11 start)</p> <p><u>Faculty:</u> S. van Willigenburg, J. MacDonald <u>STLF:</u> Katya Yurasovskaya</p> <p>Completed April '12</p> <p><a href="#">Poster (CWSEI EOY 2012): Math course for future elementary teachers at UBC</a></p>	<p>Course-level goals – complete</p> <p>Topic-level goals- complete</p> <p>Comments by instructor added as a teaching aid for future instructors.</p>	<p>Diagnostic pre/post test, which also includes survey-type questions on student career plans and attitudes/beliefs regarding mathematics.</p>	<p>A list of study tips for students specific to the course and the audience.</p> <p>A set of study skills and tips relevant to future teachers of elementary education students.</p> <p>A website with resources and useful links has been put together for future departmental use.</p>
<p><b>Math 253 (Mech 222): Multivariable Calculus (Computer Labs component)</b> (Sept '08 start)</p> <p><u>Faculty:</u> P. Loewen <u>STLF:</u> Warren Code <u>TA:</u> M. Willoughby, W. Thompson</p> <p>Completed April '12</p> <p><a href="#">Poster (CWSEI EOY 2011): How do novices spend time programming in MATLAB?</a></p>	Goals incorporated into weekly learning guides and lab documents. Substantial detail added in the second year.	<p>Weekly surveys of student completion rates and attitudes.</p> <p>Lab observations and TA interviews to determine most significant student difficulties.</p> <p>Automated student session logging to measure time spent on various tasks and frequency of common syntax errors (improved from trial run in Math 256).</p> <p>Pre-lab quiz late in the term to track basic skills and measure interpretation of MATLAB code.</p>	<p>Labs have been updated to tie in more closely with the course material, and have been further revised based on data from the first implementation with evidence of more collaboration, higher completion rates and more positive student attitudes due to the revisions.</p> <p>MATLAB resource web page developed for student reference, especially for those with weaker backgrounds.</p>

<p><b>Math 253: Multivariable calculus</b> (Sept '12 start)</p> <p><u>Faculty:</u> J. Bryan <u>SLTF:</u> Costanza Piccolo</p>	No revision	Weekly common homework assignments	Online homework using WeBWork
<p><b>Math 256 (Mech 221): Differential Equations (Computer Labs component)</b> (Sept '08 start)</p> <p><u>Faculty:</u> B. Wetton <u>SLTF:</u> Warren Code ('10-'12), Paul Ottaway (Sept-Dec '09), Costanza Piccolo ('08-'09) <u>TA:</u> W. Thompson</p> <p>Completed in 2010</p> <p><a href="#">Poster (CWSEI EOY 2011): How do novices spend time programming in MATLAB?</a></p>	Learning goals: complete	<p>Lab observations and TA interviews to determine most significant student difficulties.</p> <p>End of term student attitude surveys.</p> <p>Trial run of automated student session logging to measure time spent on various tasks and frequency of common syntax errors.</p>	<p>New labs have been developed and revised based on feedback from the first two offerings.</p> <p>Matlab demonstrations have been used in lectures.</p> <p>Targeted questions have been designed for the final exams and used to assess learning in the lab sessions.</p> <p>MATLAB resource web page developed for student reference, especially for those with weaker backgrounds.</p>
<p><b>Math 257/316: Partial Differential Equations (Computer Labs component)</b> (Sept '08 start)</p> <p><u>Faculty:</u> A. Peirce <u>SLTF:</u> Costanza Piccolo <u>TA:</u> G. de Oliveira</p> <p>Completed Fall '11</p>	Topic-level goals: complete	Student survey about attitudes towards the use of spreadsheets and the learning of numerical methods in the course.	Course-specific, online Excel tutorials are completed; sets of homework assignments, in-class demos using spreadsheets, and a Powerpoint presentation on numerical methods have been developed.
<p><b>MATH 264: Vector Calculus for Electrical Engineering</b> (Jan '12 start)</p> <p><u>Faculty:</u> O. Yilmaz <u>SLTF:</u> Costanza Piccolo</p>	Topic-level goals: first draft is under development	Classroom observation Midterm student survey	This is a new course, all materials were developed from scratch.
<p><b>Math 305: Applied Complex Analysis</b> (Sept '10 start)</p> <p><u>Faculty:</u> M. Ward <u>SLTF:</u> Joseph Lo <u>TA:</u> P. Bell</p> <p>Completed April '12</p>	Topic-level goals: complete	<p>Diagnostic assignment on series</p> <p>End-of-term survey</p> <p>Analysis of grades and comparison between students in Math 300 and 305 based on their enrollment programs</p>	This is a newly-developed course. All standard course material (course outline, lecture notes, assignments, and exams) has been developed from scratch.
<p><b>Math 307: Applied Linear Algebra (Computer Labs component)</b> (Sept '08 start)</p> <p><u>Faculty:</u> R. Froese <u>SLTF:</u> Costanza Piccolo <u>TA:</u> A. Raghonundun</p> <p>Completed Fall '11</p>	<p>Course-level goals: revision is completed</p> <p>Topic-level goals: revision is completed</p>	<p>Student surveys</p> <p>Pre-reading/diagnostic quizzes</p> <p>Special homework assignments with extensive use of Matlab</p>	<p>Lecture Notes have been updated extensively.</p> <p>Matlab/Octave resource page has been developed.</p> <p>Basic Matlab/Octave tutorials have been developed, including a set of practice problems on basic syntax and programming.</p>
<p><b>MATH 318: Probability with Physical Applications (Computer-based component)</b> (Jan '10 start)</p> <p><u>Faculty:</u> G. Slade <u>Postdoc:</u> Richard Liang</p> <p>Completed Fall '11</p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Tracked scores on computer-based homework exercises and exam questions.</p> <p>Mid-semester and end-of-semester attitude surveys</p>	<p>Octave/Matlab-based questions drafted for each of the homework assignments, as well as to each of the two midterms and the final exam.</p> <p>Octave resource webpage constructed (based on the Math 307 resource page) to assist the students in getting started with using Octave.</p>

<p><b>MATH 358: Engineering Analysis</b> (January '12 start)  <u>Faculty:</u> B. Homsy  <u>STLF:</u> Warren Code  <u>TA:</u> I. Karimfazli</p>	<p>New course; topics only finalized during term.</p>	<p>Computer lab observations                      Pair of student surveys: after second and after final computer lab</p>	<p>Matlab activities for biweekly labs (5 total for the term) which build on paper-based assignments, all produced for this new course</p>
<p><b>MATH 360: Mathematical Modeling in Science</b> (January '10 start)  <u>Faculty:</u> M. Doebeli  <u>STLF:</u> Costanza Piccolo ('11-'12), Sandi Merchant ('10-'11)                      Completed April '12</p>	<p>Course-level goals: complete</p>	<p>Computer-based exams                      Midterm student survey                      Class observations                      Student focus group</p>	<p>Matlab-based in-class activities were developed for weekly labs.</p>

## Physics and Astronomy Department

Physics & Astronomy received seed funding in 2007 and began the efforts listed below in the Fall of that year. The department moved to full funding starting in 2008. The Department SEI effort is in 2 areas: Transforming courses and preparing graduate student Teaching Assistants.

**SEI Director:** Georg Rieger, Mona Berciu (emeritus), Doug Bonn (emeritus)

**STLFs:** Jim Carolan, James Day, Louis Deslauriers, Ido Roll, Peter Newbury (emeritus), Cynthia Heiner (emeritus)

**Faculty:** D. Bonn, J. Folk, B. Gladman, J. Iqbal, D. Jones, A. Kotlicki, K. Madison, J. Matthews, H. Richer, I. Stairs, M. Van Raamsdonk, S. Reinsberg, G. Rieger, L. Van Waerbeke, C. Waltham, C. Wieman, J. Zibin, S. Burke, D. Witt, V. Sossi, J. Roettler, J. Charbonneau, S. Bates, J. Young, D. Bryman, I. Affleck, V. Hinkov

**Students:** C. Veenstra, R. Wong, N. Holmes, E. Schelew, T. Vernstrom, M. Sitwell. Involved in the past: S. Martinuk, D. Mazur, B. Ramshaw, M. Warren, S. Vafaei

### Course Transformation

Course	Learning Goals	New Assessments	Improved methods
<p><b>ASTR 310: Exploring the Universe I: The Solar System</b> (Summer '08 start)</p> <p><u>Faculty:</u> B. Gladman, H. Richer  <u>STLF:</u> Peter Newbury  <u>Grad Students:</u> M. Milkeraitis, S. Lawler, M. Gendre, S. Vafaei</p> <p><u>Poster (CWSEI EOY 2011):</u>  <a href="#">Shifting to a Copernican Model of the Solar System by Shifting Away from a Copernican Model of Teaching</a></p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Improved midterm and final exam questions based on assessing learning goals</p>	<p>Created 6 activities for tutorials including guidelines for TAs for facilitating the activities.</p> <p>Using MasteringAstronomy for Just-in-time teaching (Gladman)</p> <p>Aligning lecture material with learning goals</p> <p>Peer instruction using clickers (Richer)</p> <p>Using Lecture-Tutorial workbooks (Richer)</p>
<p><b>ASTR 311: Exploring the Universe II: Stars and Galaxies</b> (Summer '09 start)</p> <p><u>Faculty:</u> I. Stairs, J. Heyl, L. Van Waerbeke, J. Zibin  <u>STLF:</u> Peter Newbury  <u>Grad Student:</u> M. Gendre, T. Vernstrom</p> <p><u>Poster (CWSEI EOY 2010):</u>  <a href="#">Transforming Introductory Astronomy: from Learning Goals to Instruction and Assessment</a></p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Developed pre/post concept test for tutorial activities</p> <p>Improved final exam based on learning goals.</p> <p>Light and Spectroscopy Concept Inventory (LSCI) pre- and post-test (Stairs)</p> <p>Pre-, Post-testing with the Test of Astronomy Standards (TOAST)</p>	<p>Developed 7 50-minute activities for tutorial sessions including guidelines for TAs for facilitating the activities</p> <p>Intense focus on learner-centered instruction: peer-instruction with clickers, lecture-tutorial workbook, in-class worksheets (Stairs)</p>
<p><b>PHYS 100: Introductory Physics</b> (Sept '07 start)</p> <p><u>Faculty:</u> G. Rieger, A. Kotlicki  <u>STLF:</u> Ido Roll (current), Jim Carolan, Louis Deslauriers  <u>Grad Student:</u> M. Sitwell</p> <p><u>Poster (CWSEI EOY 2012):</u>  <a href="#">Transforming and Evaluating the Physics 100 Labs</a></p> <p><u>Poster (CWSEI EOY 2011):</u>  <a href="#">Epistemological Framing and External Knowledge in Physics Problem Solving</a></p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p> <p>Lab goals revised towards skills development: complete.</p>	<p>Conducted study on impact of learning goals on student self assessment of understanding</p> <p>Lab diagnostic developed &amp; interviews conducted.</p> <p>Improved the lab skills assessment - given to students on the first and last weeks of the term.</p> <p>Conducted study comparing different forms of invention activities and support for group work.</p> <p>Used two-stage midterm exams</p>	<p>Provided feedback for clicker question improvement and more student engagement in lectures.</p> <p>Lab write-ups revised for '09 &amp; again for '10</p> <p>Revised the labs – they now include a homework component in which students do the actual experiments prior to coming to the lab for data analysis. The labs and homework build on top of each other so that each component is required for the subsequent task. Together with the homework, the labs and homework now build on each other so they create a sequence in which students use new tools to analyze old data, or collect more data to improve conclusions from data collected earlier, etc.</p> <p>Added clicker questions to the lab – a couple of clickers at the beginning of class are used to recap previous labs. Several questions at the end of the lab are used to summarize the lab and frame the discussion about what was done during that specific lab.</p>

<p><b>PHYS 101: Energy and Waves</b> (Sept '07 start)</p> <p><u>Faculty:</u> F. Bates, G. Rieger, C. Heiner, J. Iqbal, A. Mackay <u>STLF:</u> Cynthia Heiner, Peter Newbury</p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Conducted survey targeting students approach to and learning from pre-readings, clickers, and in-class worksheets.</p> <p>Used 2-stage exams (summer)</p> <p>Conducted survey targeting attitudes towards 2-stage exams</p>	<p>Developed new lab experiments on measurement/uncertainty and interference.</p> <p>Complete set of in-class activities and worksheets developed.</p> <p>Complete set of pre-reading assignments developed.</p>
<p><b>PHYS 102: Electricity, Light and Radiation</b> (Sept '09 start)</p> <p><u>Faculty:</u> F. Bates, V. Sossi, J. Roettler, J. Charbonneau <u>STLF:</u> Peter Newbury, Louis Deslaurier</p>		<p>Creating pre-lab exercises using PhET simulations</p> <p>Used two-stage exams (summer)</p> <p>Used the BEMA diagnostic</p>	<p>Complete set of reading assignments, clicker questions, and worksheets. Revising lab experiments</p>
<p><b>PHYS 107 &amp; 109: Enriched Physics 1 lab and Intro to Experimental Physics</b> (Sept '07 start)</p> <p><u>Faculty:</u> D. Bonn <u>STLF:</u> James Day, Ido Roll <u>Grad Student:</u> N. Holmes</p> <p><a href="#">Poster (CWSEI EOY 2011): On Guided Invention Activities that Support Scientific Reasoning and Domain Learning</a></p> <p><a href="#">Posters (CWSEI EOY 2010): Preparing students for learning through invention activities</a> and <a href="#">Using Invention Tasks to Help Students Become Better Scientists</a></p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Developed &amp; validated physics lab pre-post diagnostic.</p> <p>Conducted study on the impact of invention activities completed preceding versus following a lesson.</p> <p>End-of-term survey</p> <p>Conducting study on the impact of structure in invention activities</p> <p>Conducting study on how students practice their scientific reasoning skills during invention activities and whether these skills improve over the term</p> <p>Statistics diagnostics added to gauge cumulative effect of state-focused invention activities. In addition, several additional surveys were used to measure student attitudes and motivation across the term including the E-CLASS (C-LASS for Experimental Physics) and Achievement Goal Questionnaire</p> <p>Conducting study on gender biases of mix-gender groups</p> <p>Conducting study on the effect of the overall lab course, as well as specific activities within the labs, on students' motivation towards physics in general and experimental physics in particular</p>	<p>Developed 15 invention activities on data interpretation and analysis</p> <p>Developed marking rubrics for all labs and for formal reports</p> <p>Incorporated classroom discussion of pros and cons of novel student solutions to invention activity problems</p> <p>Invention activities and associated instruction and practice activities now delivered by computer (the Invention Support Environment)</p>
<p><b>PHYS 107: Enriched Physics I</b> (Sept '10 start)</p> <p><u>Faculty:</u> I. Affleck <u>STLF:</u> Jim Carolan</p>	<p>Course-level goals: complete</p> <p>Topic-level goals: under development</p>	<p>Pre and post concept surveys completed ('10 and '11)</p> <p>Lecture observations</p> <p>Student post course interviews completed for '10 and in progress for '11</p> <p>Pre and post problem solving skills surveys completed '11.</p> <p>Used the Mechanics Baseline Test and the CLASS survey.</p>	<p>Clicker use – developed</p> <p>Online pre reading quizzes – developed</p> <p>In-class activities – worksheets developed</p>
<p><b>PHYS 153: Elements of Physics</b> (Sept '10 start)</p> <p><u>Faculty:</u> S. Burke, D. Witt, A. Kotlicki <u>STLF:</u> Cynthia Heiner, Louis Deslauriers</p> <p><a href="#">Poster (CWSEI EOY 2012): Transforming traditional large lectures into active learning environments</a></p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Compared student performance on exams in transformed course vs. earlier traditional version.</p> <p>Conducted BEMA survey</p> <p>Conducted student survey rating course elements</p>	<p>Bank of clicker questions</p> <p>In-class activities for entire term</p> <p>Peer instruction</p> <p>Learning goals were referred to throughout the course for aligning material and for creating exams</p>

<p><b>PHYS 153: Elements of Physics (LAB)</b> (Nov '11 start)</p> <p><u>Faculty:</u> J. Young, M. Hasinoff, B. McCutcheon, D. Witt, E. Koster  <u>STLF:</u> James Day</p>	<p>Course-level learning goals: complete</p>	<p>Two final lab exams created, closely aligned with course-level learning goals.</p> <p>Peer assessment between TAs, to promote and support deliberate practice</p>	<p>Three "tutorial weeks" modified (based on last year's feedback TA and student feedback)d to provide students with basic skills needed for the rest of course (i.e. use of basic stats, uncertainty analysis, and experimental design)</p> <p>Rubrics created for individual labs.</p> <p>Brief pre-lab readings created.</p> <p>2-day TA and instructor training sessions added</p>
<p><b>PHYS 200: Relativity and Quanta</b> (Sept '08 start)</p> <p><u>Faculty:</u> M. Van Raamsdonk, J. Karczmarek  <u>STLF:</u> Louis Deslauriers</p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Lecture observations</p> <p>Analyze Mid-term</p> <p>Midterm &amp; end-of-term survey</p> <p>Observe HW sessions</p>	<p>Weekly interactive tutorials developed</p> <p>Improved clicker questions</p> <p>Use of pencasts (J. Karczmarek)</p>
<p><b>PHYS 250: Introduction to Modern Physics</b> (Jan '09 start)</p> <p><u>Faculty:</u> L. Deslauriers, C. Wieman  <u>STLF:</u> Louis Deslauriers</p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Development of an extended Quantum Mechanical Conceptual Survey</p> <p>Lecture observations</p> <p>Dual individual/group exam (we filmed them in Sum 2010)</p> <p>Analyze Mid-term</p> <p>Midterm &amp; end-of-term survey</p> <p>Observe HW sessions</p> <p>Measuring long term retention of quantum concepts</p> <p>Conducting study on learning from two-stage exams</p>	<p>Weekly tutorials developed</p> <p>Bank of clicker questions</p> <p>In-class activities for entire term</p> <p>Measurement of long term retention for the quantum part of course</p> <p>Demonstrated a successful intervention with lower performing students</p>
<p><b>PHYS 304: Quantum Mechanics</b> (Jan '10 start)</p> <p><u>Faculty:</u> K. Madison  <u>STLF:</u> Louis Deslauriers</p>	<p>Course and topic-level goals: 80% complete</p>	<p>Lecture observations</p> <p>Observe HW sessions</p> <p>Measured effect of BONUS clicker questions on student engagement during voting period.</p> <p>Compared student performance to previous terms – transformed course scores are consistently higher</p> <p>Measured student engagement in general. Compared it to other course the eng phys cohorts were taking at the same time.</p>	<p>Creating a bank of clicker questions</p> <p>Designing in- class activities for every lecture</p> <p>Improved engagement during clicker questions by adding BONUS questions</p>
<p><b>PHYS 315: Physics of Materials</b> (Sept '11 start)</p> <p><u>Faculty:</u> V. Hinkov  <u>STLF:</u> James Day</p> <p><a href="#">Poster (CWSEI EOY 2012): The transformation of Physics 315</a></p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Homework assignments closely aligned to learning goals</p>	<p>New clicker questions drafted &amp; older clicker questions improved</p> <p>Training on delivery of clicker questions and subsequent results</p> <p>In-class group activities</p> <p>Implementation of pre-reading</p> <p>One lecture video recorded so that instructor can associate objective feedback on style with actual footage</p> <p>Formative midterm and year-end feedback form created</p>
<p><b>PHYS 401: Electromagnetic Theory</b> (Sept '11 start)</p> <p><u>Faculty:</u> D. Bryman  <u>STLF:</u> Peter Newbury</p>	<p>Course-level goals: draft</p> <p>Topic-level goals: complete set</p>		<p>Creating in-class worksheets and clicker questions aligned with learning goals</p> <p>Focus on moving from instructor-centred to student-centred instruction</p> <p>Development of pre-reading assignments</p>

<p><b>PHYS 408: Optics</b> (Sept '09 start)</p> <p>Faculty: D. Jones STLF: Louis Deslauriers</p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Development of a Optics Conceptual Survey</p> <p>Lecture observations</p> <p>Analyze Mid-term</p> <p>Observe HW sessions</p> <p>Transformed course scores are consistently higher than previous terms</p> <p>Measured student engagement in general. Compared it to other course the eng phys cohorts were taking at the same time</p> <p>Conducting spacing effect study</p>	<p>Created a bank of clicker questions</p> <p>In-class activities for entire term</p> <p>Developed a remedial tutorial for students lacking pre-requisite in signal processing (Fourier Transforms)</p> <p>Development of active learning materials for two new topics: Quantum optics and non-linear optics</p>
<p><b>PHYS 450: Quantum Mechanics</b> (Jan '09 start)</p> <p>Faculty: J. Folk STLF: Louis Deslauriers</p>	<p>Course and topic -level learning goals: 95% complete</p>	<p>Lecture observations</p> <p>Analyze Mid-term</p> <p>Observe HW sessions</p> <p>Conducting study on impact of student peer discussions vs. classic instruction on students' knowledge retention</p>	<p>Created a bank of clicker questions (including isomorphic questions to test longer-term retention)</p>

**PHYS 170 & 270** – Mechanics diagnostic surveys are being administered annually to monitor conceptual learning gains and aid future course development. Clicker usage is being encouraged in the large multi-section engineering course, PHYS 170, with lecture observation and advice from STLF Jim Carolan

**PHYS 101 & 108** - clicker usage is being developed and improved in these large freshman courses with extensive observation and advice from STLF Jim Carolan

### Curriculum

Extensive diagnostic testing by Jim Carolan and Louis Deslauriers is starting to uncover information that will inform upcoming curriculum decisions. These will likely include a new 'terminal' physics stream that starts with PHYS 100, but does not then go into the usual 101/102 sequence for which the students' mechanics preparation is insufficient. Extensive testing of first and upper year students using an electricity and magnetism concept survey (BEMA) is providing information on learning gains and retention. The results from the survey are being used in decisions about merging the Eng. Phys and Honours Phys. streams of E&M. These results will also feed into upcoming decisions about the freshman treatment of E&M concepts. Efforts are also getting underway to optimize the way in which various E & M topics are covered in various courses, at all levels, to formulate a set of coherent learning goals for all such courses and to insure that all faculty will strive to achieve these learning goals in the future. [Poster \(CWSEI EOY 2011\): Tracking Students' Knowledge of Electricity and Magnetism from 1st to 3rd Year](#)

The large first-year physics courses (PHYS 101 & PHYS 102) include 6 3-hour lab experiments. Because it is so difficult to sync the concepts presented in multiple lecture sections with the experiments, we are trying to convert the lab experiments to self-contained "learning units." These would include pre-lab exercises and lab activities that contain all the necessary information. Wherever they are in the sequence of lectures, instructors could use these experiments to preview what's coming next, to reinforce what they're currently covering, or to wrap up already-covered topics. The development and testing of several activities and pre-lab exercises started in the small, Summer PHYS 102 section, in preparation of the full PHYS 102 course in January 2011.

### TA Development

A coordinating team of graduate students in the department developed and regularly run a very successful, one-day interactive workshop, which started in the beginning of the 2007 fall term by former graduate students Mya Warren, Joss Ives, and Sandy Martinuk. The workshop is required for incoming graduate students and available to veterans as well. A system of mentor TAs provides a structure in which senior graduate TAs oversee other graduate students in the first year undergraduate courses and help to develop their teaching skills through a peer-mentorship framework. 'Head TAs' are also deployed in each of the large multi-section courses to develop and deliver course-specific training as follow-up throughout the term.

This program is enhanced by a graduate course in pedagogy in Physics & Astronomy: PHYS 520, Teaching Techniques in Physics and Astronomy. This course exposes students to current Physics education research literature and allows them to apply the research to their own teaching by developing sample clicker questions or invention activities. In addition, many students complement this course with a directed studies project that allows them to get involved in physics education research in the department.

Many excellent resources from the training program can be found at [http://www.phas.ubc.ca/~phas\\_ta/](http://www.phas.ubc.ca/~phas_ta/), including a TA Handbook developed by Liam Huber, Jonathan Massey-Allard, and Sandra Meyers.

[Poster \(CWSEI EOY 2012\): Physics & Astronomy TA Professional Development Program](#)

### Research

James Day, Idol Roll & Doug Bonn, with further assistance from students Natasha Holmes, Hiroko Nakahara, and Brad Ramshaw, have been studying the effectiveness of invention activities to improve students' data interpretation and analysis skills and understanding. This has included classroom observation, pre/post testing with a lab diagnostic, and data-mining of student work on an online system used to deliver invention activities. The latter is being used to understand how invention activities can help students develop high level scientific reasoning skills. A paper on invention activities has been published in a special issue of Instructional Science in 2012 about productive failure activities.

[Poster \(CWSEI EOY 2012\): The Invention Support Environment: Where Do We Go From Here?](#)

Peter Newbury has completed pre- and post-testing of ASTR 310 and ASTR 311 tutorial exercises, such as the Human Orrery (The Physics Teacher, **48**, 9, 573-577 (2010)). The results were presented at AAS 216, May 23-27, 2010 in Miami, FLA. In Stair's ASTR 311 (Fall 2010) students wrote the Light and Spectroscopy Concept Inventory pre- and post-test. The results are used to compare the impact of interactive, learner-centered instruction to similar introductory astronomy courses across the U.S.

Louis Deslauriers, Georg Rieger, and Bing Dai are studying the impact of pre-reading on the sophistication of student questions during lectures. The study is taking place in Physics 101, 102 and 250. So far, results consistently show that pre-reading along with proper incentive leads to a doubling in the sophistication of student questions.

Louis Deslauriers, Joshua Folk, and Georg Rieger are studying the impact of learning goals on student self assessment of their understanding in Physics 100 and Physics 101.

Louis Deslauriers and Joshua Folk are conducting a study in PHYS 450 aimed at comparing the effect of peer discussions and classic instruction on students' knowledge retention.

Cynthia Heiner and Georg Rieger are writing a paper on two-stage exams.

Cynthia Heiner and Mandy Banet (Biology) are writing a paper on pre-reading assignments

### Other

Widespread deployment of conceptual inventories to assess student understanding of mechanics and electricity & magnetism concepts. These include an extensive vertical survey from first to fourth year using the new lab diagnostic, a similar vertical survey using the BEMA diagnostic, and use of the FCI in freshman classes and sophomore mechanics.

Widespread deployment of CLASS student attitudes about science surveys in all first year courses, with testing done in Sept., at the end of the first term, and again at the end of the second term.

Jim Carolan is looking at survey data with a special focus on gender differences. He also looks at FCI, MBT, CLASS, and BEMA results in several courses as a function of time.

Participating in CWSEI-wide study on why some students do poorly (particularly focusing on high-failure-rate courses)

Louis Deslauriers has developed a math diagnostic to assess upper-level physics students' grasp of the math skills needed to succeed in the senior courses. This tool will be used to make judgments about curriculum and will feed discussions with the math department about their curriculum. This complements the math department's own efforts on entrance-level testing of math skills. A math diagnostic for first-year math has also been automated. The two diagnostics are available online at:

First Year Diagnostic: <http://cwsei-diagnostics.sites.olt.ubc.ca/first-year-math-diagnostic/>

Upper Year Diagnostic: <http://cwsei-diagnostics.sites.olt.ubc.ca/upper-level-math-diagnostic-exam/>

An archive system has now been developed and extensively tested as a tool to store course information.

Since March 2010, we have published a monthly newsletter focusing on various teaching activities taking place in conjunction with the CWSEI STLFs. Every month either an instructor involved in a transformation, or TAs involved with or students taking such transformed courses express their views about what works and what doesn't, and how things can be further improved. These 1-to-2 pages newsletters are distributed to the entire faculty in order to keep them informed about these various efforts and give them a contact person to talk to if they become interested in any particular aspect.

A very fruitful exchange of ideas and information has taken place with professor Marjan Zadnik from Perth, Australia, who has visited our department for 6 weeks during his sabbatical leave. We hope this will lead to strong ties for research and exchanges with his university in the future.

Peter Newbury and Cynthia Heiner have developed and successfully ran workshops on peer instruction and creating clicker questions. Cynthia Heiner has developed a workshop on pre-reading assignments.

We had another visitor in 2012, Tony Signal from Massey University, New Zealand, who stayed in our department for the entire fall term. Tony contributed to the improvements of labs in Phys 100 and is very interested in transforming the introductory quantum mechanics at Massey. He had long and fruitful discussions with Jim Carolan, Louis Deslauriers, Georg Rieger, and Ido Roll.

## Statistics Department

The Statistics CWSEI program started in 2007 and initially concentrated on the transformation of STAT 200, Elementary Statistics for Applications, an introductory course presently taken by around one thousand undergraduate students per year. In recent years our focus has expanded to enhance the teaching and assessment on STAT 241/251, Elementary Statistics (a calculus-based introduction for Applied Science and Computer Science students), STAT 300, Intermediate Statistics for Applications (a second course accessible to any student with a generic first course in Statistics), STAT 302, Introduction to Probability, and STAT 305, Introduction to Statistical Inference. Our aim is to enhance the teaching and learning experience within our undergraduate courses through methods of proven effectiveness. There are currently five faculty members and one STLF involved in the Statistics department's CWSEI project.

**SEI Director:** Bruce Dunham

**STLF Emeritus:** Gaitri Yapa

**Faculty:** B. Dunham, P. Gustafson, Y. Lim, W. Welch, E. Yu

## Course Transformation

Course	Learning Goals	New Assessments	Improved methods
<p><b>STAT 200: Elementary Statistics for Applications</b> (2007 start)</p> <p><u>Faculty:</u> E. Yu, Y. Lim</p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Compared the effectiveness of two different lab activities in helping students understand sampling distributions.</p> <p>Comparison of student performances on exam and midterm questions following targeted interventions.</p> <p>On-line mid-course survey, for small amount of credit, elicits sizeable response and useful data.</p>	<p>Developed and trialed worksheets/in-class activities for use in each class.</p> <p>Clicker questions used in every class.</p> <p>Lab activities improved to focus on key concepts that learners typically find difficult.</p> <p>Students work together in pre-assigned groups within each lab.</p> <p>Pre-reading quizzes trialed to begin each lab session.</p> <p>TAs completed a feedback survey on their opinions about each lab session.</p> <p>Weekly on-line assignments in WeBWork, eleven in total.</p> <p>Two-stage midterm and final examination trialed, in which students collaborated in their lab groups for part of the tests.</p> <p>Adopted more efficient method for grading written assignments to reduce turnaround time.</p>
<p><b>STAT 241/251: Elementary Statistics</b> (Sept '11 start)</p> <p><u>Faculty:</u> Y. Lim <u>STLF:</u> Gaitri Yapa</p> <p><a href="#">Poster (CWSEI EOY 2012): Recent Developments in the Transformation of Statistics Courses with Highlights on Revisions to STAT 241/251 Labs</a></p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Intervention used to address misconception identified on midterm exam question.</p> <p>On-line mid-course survey, for small amount of credit, elicits sizeable response and useful data.</p> <p>Post-course interviews, also used to validate a new concept inventory, explore student retention.</p>	<p>Context rich problems included in assignments, midterm tests and examination.</p> <p>On-line homework assignments in WeBWork, six sets of questions in total with a further four in development.</p> <p>Additional interventions introduced for students performing poorly on the midterm tests.</p> <p>New material incorporated to expand the number of labs.</p> <p>Students work together in pre-assigned groups within each lab.</p> <p>De-briefing by TAs at the end of lab sessions.</p> <p>TAs completed a feedback survey on their opinions about each lab session.</p>
<p><b>STAT 300: Intermediate Statistics for Applications</b> (Sept '12 start)</p> <p><u>Faculty:</u> B. Dunham, P. Gustafson</p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>On-line mid-course survey, for small amount of credit, elicits sizeable response and useful data.</p> <p>Planning to investigate how students taking this course</p>	<p>All lecture sessions used in-class activities on which students work in preselected groups. Class activities are supported by clickers questions.</p> <p>Detailed course notes created, available via course website.</p>

<p><u>STLF</u>: Gaitri Yapa</p>		<p>perform on STAT 305 and STAT 306 compared to peers who did not take STAT 300.</p>	<p>Students work together in pre-assigned groups within each lab session.</p> <p>New labs in Earth Science Building provide better environment for group-based activities.</p> <p>Two-stage midterm test trialed, in which students collaborated in their lab groups for part of the test.</p> <p>Planning creation of short "pencast" mini-lectures, to be made available on-line.</p>
<p><b>STAT 302: Introduction to Probability</b> (Sept '11 start)</p> <p><u>Faculty</u>: E. Yu <u>STLF</u>: Gaitri Yapa</p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Post-course knowledge retention interviews conducted, with eight student participants so far.</p> <p>On-line mid-course survey, for small amount of credit, elicits sizeable response and useful data.</p> <p>Effectiveness of an intervention – teaching on topic via in-class activity compared to traditional lecture – compared via student performance on final examination question.</p>	<p>Clicker questions developed and used for each lecture.</p> <p>Created and trialed two in-class activities to target concepts where student misconceptions have been observed.</p> <p>Ongoing work developing in-class activities for each class.</p> <p>Students to work on activities in pre-selected groups each class.</p> <p>Development of weekly WeBWork on-line homework assignments.</p>
<p><b>STAT 305: Introduction to Statistical Inference</b> (Sept '12 start)</p> <p><u>Faculty</u>: W. Welch <u>STLF</u>: Gaitri Yapa</p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Post-course knowledge retention interviews on-going.</p> <p>Planning to give mid-course survey.</p>	<p>Ongoing work developing in-class activities, supported by clickers questions, for each class.</p> <p>Students to work on lecture and lab activities in pre-selected groups each class.</p> <p>New labs in Earth Science Building provide better environment for group-based activities.</p>
<p><b>STAT 100 – Statistical Thinking:</b> A rather novel introductory course in the discipline, STAT 100 involves six "modules", each on a different theme in statistical science accessible to learners who have not had previous exposure to the discipline. The course was offered for the second time in 2009, and after the first run it was decided by the teaching team (of five instructors) that clickers would be used in future to help improve student engagement. This idea was implemented, and in-house training and support was offered by Eugenia Yu. In total about half of the faculty in the department now have used clickers in their teaching.</p> <p><b>STAT 335 – Statistics in Quality Assurance:</b> This course was revived in 2008, having not been offered for some years. The new incarnation of the course was enhanced using CWSEI methodology. In particular:</p> <ul style="list-style-type: none"> <li>(a) Learning outcomes were devised.</li> <li>(b) Detailed books of notes covering the material were created and posted online.</li> <li>(c) In-class activities were used in the lectures, during which the students would work in groups on an activity, aided by the support of the instructor.</li> <li>(d) Laboratory activities involving group work were used to illustrate concepts using computer applications.</li> </ul> <p><b>STAT 447 – Time Series and Forecasting:</b> Having been twice previously offered as a "topics" course, this "new" addition to the department's upper-level offerings was improved this year by instruction that placed less emphasis on the traditional lecture. In a similar fashion to STAT 335, students worked in groups on activities within the classes, with instructor support. Often concepts were introduced informally in an activity before a more formal presentation of the idea was provided in a short lecture. Solutions to an in-class activity were posted shortly after the class for timely feedback. As measured by student performance and satisfaction, this change in instruction style has been successful.</p>			
<p><b>Assessment Tools</b></p>			
<p><b>Student Attitude Surveys:</b> We have developed a <a href="#">Learning Attitudes Survey</a> for Statistics. Near the start and end of STAT 200, students are expected to complete this on-line attitude survey. The survey attempts to gauge how students perceive the relevance of the discipline, their enthusiasm for studying it and how they go about learning in Statistics. A robust method of analyzing the resulting data has been devised and encoded in R (a freely available package for statistical computing), and a user guide has been created. Anyone wishing to implement our method on their own data should contact Dr. Bruce Dunham at <a href="mailto:b.dunham@stat.ubc.ca">b.dunham@stat.ubc.ca</a>. A description of the method, and our findings from the analysis of our data, are being written up for future publication.</p> <p><b>Concept Inventory for STAT 241/251:</b> Work is on-going with the validation of a proposed concept inventory for STAT 241/251. This course is a calculus-based introduction to probability and statistics, and although such courses are widely offered there is no other existing concept inventory. Any instructor wishing to trial this concept inventory should contact Dr. Bruce Dunham at <a href="mailto:b.dunham@stat.ubc.ca">b.dunham@stat.ubc.ca</a>.</p> <p><b>WeBWork Online Homework Tool:</b> We are developing and implementing online homework problems for the large enrolment courses.</p>			