



# Carl Wieman Science Education Initiative

## Achieving highly effective university science education

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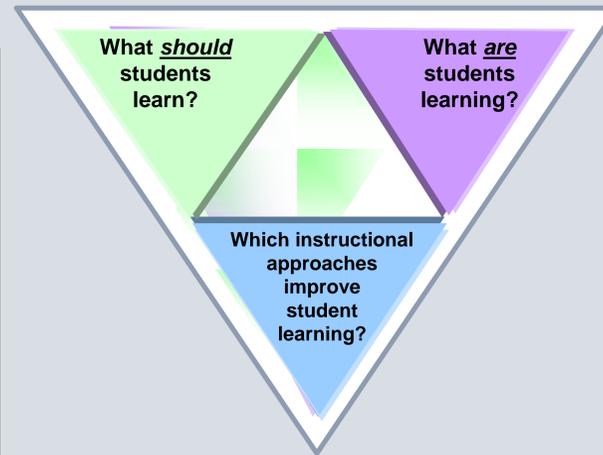


### Introduction

The Carl Wieman Science Education Initiative (CWSEI) is a six-year, \$12M program (2007–2012) at the University of British Columbia aimed at achieving sustainable institutional change towards effective, evidence-based undergraduate science education. This program funds departments to take a four-step, scientific approach to undergraduate education:

- 1) Establish what students should learn;
- 2) Scientifically measure what students are actually learning;
- 3) Use instructional approaches guided by research on learning and measures of student learning;
- 4) Disseminate and adopt what works.

In this poster, we discuss the design of the SEI model and the departmental activities.



### Departmental Activities

[www.cwsei.ubc.ca/departments](http://www.cwsei.ubc.ca/departments)

#### Earth & Ocean Sciences

- Full funding 2007, 4 **STLFs**, 37 faculty involved
- Vigorous leadership and motivated department
- Systematic approach to changing all undergrad education in dept.
- Currently "officially" transforming 12 courses & and 9 more courses "unofficially" being improved
- Over 60% of EOS faculty are involved in the SEI in some capacity (committees, working groups and/or making changes to their courses)
- Give teaching reduction for primary faculty changing course
- Developed TA training program and attitudinal survey
- In process of determining overall curriculum goals

#### Life Sciences (Depts. of Botany, Microbiology & Immunology, and Zoology – combined undergrad program 1<sup>st</sup> 2-3 years)

- Full funding 2007, 2 **STLFs**, 22 faculty involved
- Organizationally challenging (3 dept. cultures)
- Working on 6 courses & others impacted
- Developing learning outcomes for several upper level courses
- Gathering a variety of data to inform their curriculum design: 4<sup>th</sup> year Biology Satisfaction Survey, Attitudinal Survey, Ecological Attitude Survey, Concept Tests, Focus Group interviews, etc.

#### Physics & Astronomy

- Seed funding 2007, full funding 2008; 3 **STLFs**, 11 faculty involved
- Working on 12 courses
- Developed TA training program; very successful
- Administered extensive diagnostic testing of conceptual understanding
- Developed a course database system to archive course materials
- Conducted faculty survey (reflections on courses) and focus groups

#### Computer Science

- Seed funding 2007, full funding 2008; 3 **STLFs**, 14 faculty involved
- Working on 7 courses, ranging from 1<sup>st</sup> to 3<sup>rd</sup> year level
- Developed learning goals (both course-level and topic-level) for all 1<sup>st</sup> & 2<sup>nd</sup> year core courses
- In process of exploring how students' ability to communicate about code changes during their core courses

#### Statistics

- Seed funding 2007, 3 faculty involved
- Working on 4 courses
- Transformation of large intro Statistics course: conducted student interviews, developed learning goals, administered pre and post term student attitude surveys, introduced active learning and use of clickers
- 1 faculty member underwent large change in thinking about teaching

#### Chemistry

- Seed funding 2008, 1 **STLF**, 6 faculty involved, and collaboration with Skylight Research Associate
- Concentrating on evaluation and redesign of a first year lab course
- Implemented the first round of modified TA training
- Administered C-LASS CHEM (Attitudinal Survey) in multiple courses
- In process of revitalizing undergraduate laboratory for years 2-4

#### Math

- Seed funding 2008, 2 **STLFs**, 5 faculty involved
- Working on workshops and computer labs in 6 courses
- Working to assess the effectiveness of the workshops and assist in the study of how well the basic skills test predicts success in the course.

\*STLF= Science Teaching and Learning Fellow

### Underlying Reasoning

#### Logical unit of change is the Department

Department is the cultural unit. Small scale change (one or a few courses involving a few faculty) is an important research step, but does not result in widespread changes in instructional practices. Need change to involve majority of faculty in department.

**Change must be driven by department** – Faculty are experts in their science fields. The faculty and department as a whole need to decide what students should learn, adopt or develop good measures of relevant learning, and change instructional approaches.

**Evidence is key** – Most faculty will feel that change is necessary if there is good data showing students aren't getting important ideas/concepts, or evidence of students seeing subject as less interesting and/or useful after taking course.

**Additional resources are needed to support the process of change** – These changes take faculty time

#### Effective teaching can be more efficient than current practices (and more fun!)

Re-use of good materials, less repetition/overlap of material, team teaching large courses, effective use of technology, etc. can result in lower resource requirements in long-term.

### Approach

#### Significant 1-time investment of resources

Concentrated (~1-2 M\$/dept. over 5 years) to fund change activities; maintenance of change should not require extra resources.

**Departments compete for funding** – Criteria: commitment and readiness to undertake widespread sustained effort to improve undergrad education

**Science Teaching & Learning Fellows (STLF)** – Positions funded by CWSEI; work with faculty to measure learning, change courses, evaluate curriculum, ...

**Departmental culture change** – Need majority of the faculty and courses to be involved and mechanisms to sustain change

**Archive, Re-use, Improve materials** – Developing SEI course materials archival system

### STLF Model



Department-based Science Teaching & Learning Fellows as agents of change in university education

**STLF = Science Teaching and Learning Fellow**

#### An STLF:

- Is expert in particular science discipline (usually recent PhD),
- Hired by the science dept.,
- Given considerable ongoing training & guidance on science education fundamentals by CWSEI central & other STLFs,
- Works with faculty to develop learning goals, measure learning, change assessment & instruction...

### SEI Central

#### STLF Development

Frequent meetings with considerable effort and emphasis on:

- Development of STLF's understanding of how people learn, effective pedagogy, evidence supporting educational approaches
- Science education research base & how to do research
- Effective ways to work with faculty & communication of good practices

#### Faculty/Department Interactions

- Regular meetings with CWSEI departmental Directors, department Heads/Chairs, Dean, some meetings with individual faculty & whole depts.
- Lecture series, workshops (learning goals...), yearly event - SEI activities

#### Materials Archive System

Developing online course materials archive system:

- Course materials (e.g. lecture notes, clicker questions, assignments, ...)
- Instructor comments on use of materials and reflections on course
- Common student difficulties & how to address them

#### Good:

**LOTS happening** (see above list of activities) rapidly growing # faculty involved, many courses being improved, new data from multiple disciplines on what is working and not.

**STLF Model works well in many circumstances**

**Pool of excellent STLF candidates out there**

**A number of examples of spontaneous adoption/involvement**

- Individuals trying out new teaching methods with minimal assistance
- Groups tackling curriculum issues following discussions about a course

#### Help from higher up

UBC Science Dean requiring learning goals for all 1<sup>st</sup> year courses

#### Not so good:

##### Change is hard!

OK, we knew that, but it's harder than we thought; can be frustrating and discourage STLFs

**Significant minority of faculty resisting** (expected)

##### Particularly difficult when:

- Many faculty teach different sections of same course without coordination (hard to reach consensus)
- Don't have a critical mass of faculty who are open-minded about change
- Strong sense of personal "ownership" of course (rather than department ownership) & misconception of what "academic freedom" means.

**Low opinion of students by some faculty** – how to overcome?