EOS-SEI Year 1 Progress
Earth and Ocean Sciences – Science Education Initiative.
April 28, 2008

EOS Teaching Initiatives Committee – Sara Harris (Chair & Liaison), Mary Lou Bevier, Jim Mortensen, Douw Steyn, Francis Jones (STLF), Brett Gilley (STLF), Ben Kennedy (STLF), Tom-Pierre Frappe, Peter Lelievre, Melissa Grey, Jamil Rhajiak (Phil Hammer, Greg Dipple, Stuart Sutherland)

EOS faculty perspective – Roland Stull
Many others involved, including graduate and undergraduate students
Overview

• The EOS department

• EOS’ approach to the CWSEI project
  – Mostly course-based, with...
  – Curriculum considerations and...
  – Overarching components

• Two examples
  – Student Attitudes about Earth Sciences Survey (Ben Kennedy)
  – Perspectives on EOSC 114 Course Transformation (Roland Stull & Francis Jones)
The EOS department – many “streams”

INTRO COURSES

Environmental Science

300-level service

Geology, geological engineering

Geophysics

Oceanography

Atmospheric Science
Our approach: Course Transformations

• Course working groups
  – Primary instructors & STLF
  – Faculty members who teach “related” courses (pre-, post-, co-requisites)
  – Graduate and undergraduate students

• Faculty buyouts (for primary instructor)
  – For 3 terms, choice of:
    • ~0.5 course release (NOT the targeted course)
    • 6-hr TA or undergraduate help

• Aiming for high faculty involvement – important for sustainability
Involves ~60% of EOS faculty as primary instructors, with opportunity for 100% of faculty to be involved in working groups.

## EOS-SEI Long-Term Plan

**Updated Draft, Still Flexible**

<table>
<thead>
<tr>
<th>Targeted Courses</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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<td>Fall</td>
<td>Spr</td>
<td>Sum</td>
<td>Fall</td>
<td>Spr</td>
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<tr>
<td><strong>EOSC 114</strong></td>
<td>P2&amp;T1</td>
<td>P3&amp;T2</td>
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<td>T3</td>
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<td>T3</td>
<td>T4</td>
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<td>P2</td>
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<td>T1</td>
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<td>ENVR 200</td>
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<td>ENVR 449</td>
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<td>T1</td>
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<tr>
<td><strong>EOSC 116</strong></td>
<td>SS</td>
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<tr>
<td><strong>ENVR 300</strong></td>
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</tbody>
</table>

Below this line, course sequence is under discussion. Are you involved in the courses on this list?

<table>
<thead>
<tr>
<th>Courses</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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<tbody>
<tr>
<td>EOSC 211 (RP)</td>
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<td>P1</td>
<td>T1</td>
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<td>P2</td>
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<td>ATSC 201?</td>
<td>P1</td>
<td>P1</td>
<td>T1</td>
<td>P2</td>
<td>P2</td>
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<td>EOSC 370 (SA)</td>
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<td>T1</td>
<td>P2</td>
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<td>EOSC 371 (KO)</td>
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<td>T1</td>
<td>P2</td>
<td>P2</td>
<td>T2</td>
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<tr>
<td>EOSC 250? 252? (FH)</td>
<td>P1</td>
<td>T1</td>
<td>P2</td>
<td>P2</td>
<td>T2</td>
</tr>
<tr>
<td>EOSC 222 (PS&amp;SS)</td>
<td>P1</td>
<td>T1</td>
<td>P2</td>
<td>P2</td>
<td>T2</td>
</tr>
<tr>
<td>EOSC 320?</td>
<td>P1</td>
<td>T1</td>
<td>P2</td>
<td>P2</td>
<td>T2</td>
</tr>
<tr>
<td>EOSC 321 (MK)</td>
<td>P1</td>
<td>P1</td>
<td>T1</td>
<td>P2</td>
<td>P2</td>
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<tr>
<td>EOSC 323? 327?</td>
<td>P1</td>
<td>P1</td>
<td>T1</td>
<td>P2</td>
<td>P2</td>
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<tr>
<td>EOSC 329</td>
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<td>P1</td>
<td>T1</td>
<td>P2</td>
<td>P2</td>
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<tr>
<td>EOSC 3117???</td>
<td>P1</td>
<td>P1</td>
<td>T1</td>
<td>P2</td>
<td>P2</td>
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<tr>
<td>EOSC 270? (MM)</td>
<td>P1</td>
<td>P1</td>
<td>T1</td>
<td>P2</td>
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</table>

Courses undergoing transformation w/o specific STLF help.
What we’ve done so far: Courses

• Draft learning goals for at least 13 courses:
  – EOSC 111, EOSC 114, EOSC 221, EOSC 112, EOSC 210, EOSC 212, EOSC 220, EOSC 223, EOSC 310, EOSC 449, EOSC 324, ENVR 200, ENVR 300

• Data collection:
  – Quantitative: pre-post tests of student abilities
  – Qualitative: surveys, focus groups, interviews

• New pedagogy (and plans for new pedagogy)

• Plans for thorough assessment (the key to approaching teaching science based on science)
Plans: Curriculum considerations

- Course-transformation requires defining a course’s role in a program/curriculum
  - Departmental structure to define program-level goals
  - Identify links, gaps, overlaps among courses
  - Make recommendations for curriculum changes
  - Make structure sustainable

- CWSEI is an ideal opportunity to examine curricula (human resources to collect and analyze data)

- Starting with service courses:
  110, 111, 112, 114, 116, 310, 311, 312, 314, 315
  (maybe: 210, 211, 222, 250, 252, 270, 324, atsc201)
Our approach: Overarching components

• Student Attitudes about Earth Science Survey
• TA training
  – Improved professional development for grad students
  – Improved education for undergrads
• Dissemination & discussion of ideas:
  – Seminars, brown bags, tips
• Archiving/Sharing resources
Attitude Surveys in Earth and Ocean Science

Tom- Pierre Frappe and Ben Kennedy

How do you feel towards this statement

“Learning about attitude surveys is useful in my life”

Novice attitude

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Expert attitude

Your opinion is different to actually how useful the attitude surveys really are,

However, your opinion about it will affect how much you will learn about it!
Student Attitudes in Earth and Ocean Science

WHY? Students beliefs and attitudes are a better predictor of performance in science than the amount of previous science classes.

WHAT? An online survey for assessing the impact our classes have on students beliefs and attitudes relative to an expert.

HOW? By comparison of answers on identical surveys at the beginning and end of the semester.

WHERE? Originally developed at Colorado University for Physics and Chemistry. The negative shifts in student attitudes were hugely influential for driving educational reform at Colorado.

NOW- Earth and Ocean Sciences and other departments at UBC fall 07 and spring 08
Survey Development Process, 18 months in

1. Finding out what student scientific beliefs were important to Earth and Ocean Scientists.
2. Adapting the existing physics survey to address these beliefs.
3. Validation- student interviews to assess whether these statements were clear.
4. Running the survey, collecting, and analyzing the results.
5. Validating expert opinion.
6. Reworking and improving questions with Colorado who are also working on an Earth Science survey.
Results- Spring 08 Response comparisons

Eg From category “Connection to real world”

Things that I see around me in nature often lead me to think about how the Earth works.

- Initially high belief in the real world connection of geology
- Plotted as “Agreement with expert opinion”

800 students
11 classes
37 questions
6 question categories

- 0% disagree
- 10% neutral
- 20% agree
Results - Spring 08 Response comparisons

Memorization and thinking

Understanding science basically means being able to recall something you've read or been shown.

After a semester of Earth Science classes, how is this opinion affected?

Survey timing:
- 1st week
- Last week

- Disagree with expert
- Neutral
- Agree with expert

- 0%
- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%
Categories- representing 5-8 questions

SAESS pre/post: All Students
PRE and POST

Overall a slight positive increase

Definitely plenty of room for improvement
However, better starting point than Physics and Chemistry at Colorado
Course comparison- Any course stand out?

What is this course doing that we are not?

Understanding science basically means being able to recall something you've read or been shown.
Agreement with expert opinion for each question: PRE and POST scores side by side spring 08

Year to year comparison in a class
Consistent student responses
Year to year comparison EOSC 114

Fall 2007

Things that I see around me in nature often lead me to think about how the Earth works.

<table>
<thead>
<tr>
<th>Survey Timing</th>
<th>1st Week</th>
<th>Last Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disagree</td>
<td>14%</td>
<td>25%</td>
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<tr>
<td>Neutral</td>
<td>73%</td>
<td>72%</td>
</tr>
<tr>
<td>Agree</td>
<td>13%</td>
<td>10%</td>
</tr>
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</table>

Spring 2008

<table>
<thead>
<tr>
<th>Survey Timing</th>
<th>1st Week</th>
<th>Last Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disagree</td>
<td>7%</td>
<td>12%</td>
</tr>
<tr>
<td>Neutral</td>
<td>73%</td>
<td>68%</td>
</tr>
<tr>
<td>Agree</td>
<td>20%</td>
<td>18%</td>
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</table>
Attitude Survey Summary

• Student attitudes and beliefs towards EOS showed a 0-2 % positive shift which differs from initial published results from Physics and Chemistry at Colorado that showed a 5-10 % negative shift.

• We should be aiming for large positive shifts in student attitudes in all categories

• The survey highlighted particular attitudes that can be concentrated upon for course improvement.

• The survey highlights courses that are positively effective and negatively effective in changing student attitudes.

• The survey highlights positive and negative changes in courses over time.
How do you feel towards this statement now?

“Learning about Attitude surveys is useful in my life”

Strongly disagree, Disagree, Neutral, Agree, Strongly agree.
Faculty – STLF interactions

**Handout:** General model for STLF-Faculty member interactions (C. Wieman)

- Who
- Learning goals
- Assessments
- Resources
- Sustainability
- General timing

Interaction between Faculty, Department, Students, TAs, C. Wieman, other STLFs …

These are highly case-specific.

But guidelines are an excellent starting point.
Faculty – STLF interactions

At EOS:

• Teaching faculty
  – Buyouts ... provides (some of the) necessary time.
  – Actions: initial goals, assessments, activities, content ...

• STLFs:
  – Advice, edits, recommendations based upon ...
    data acquisition (observations, interviews, etc. etc.) & analysis
  – Implement, collection, analysis of evaluation of efforts.
  – Contribute (growing) knowledge about learning & pedagogy.
EOS-SEI  Year 1
Progress in EOSC114

Earth and Ocean Sciences – Science Education Initiative.

April 28, 2008
Outline

• EOSC114
• Course transformation context
• Process
  – Examples of effort to date
• Aims for the September 2008 fall term
• Faculty experiences during the process
EOSC114:
The Catastrophic Earth - Natural Disasters

- First offered Fall ’01
- Maximum No. students
- Minimum cost of delivery
- Intro. to Earth, Ocean, Atmospheric Science
- Highlight EOS Faculty and research areas

- Fall ’06: Begin increasing activity in lectures (clickers).
EOSC114: Course transformation context

• Very popular
  – 2005W: 785
  – 2006W: 826 + 211 Distance Ed
  – 2007W: 809 + 320 Distance Ed

• Efficient & Effective
  – Lecture style: 6 modules; 4-5 instructors;
  – Assessments: 2 midterms + final exam, all multiple choice.
  – Drop-in centre with graduate student TAs.

Poster Presentation
Balancing the diverse goals of a large team-taught first year science course
F. Jones, R. Stull & J. Caulkins
EOSC114: Course transformation context

- What needs modifying?
  - Learning & assessments are very “passive”.
  - Continuity and consistency are challenging with multiple instructors.
  - Needs, prior knowledge, and abilities of different student groups: a trade-off.
    - B.Sc.
    - B.A.
    - EOS degree programs
    - Data from Spring 2008 EOT.
Course transformation process for eosc114

1. Learning about the course and student’s needs
2. Goals (course and module)
3. Assessments of learning, keyed to goals
4. Active learning and feedback, including: class time, homework, resources.
5. Measuring effectiveness
6. Sustainability of initiatives
1. Learning about the course & student’s needs

– Observations of class in action
  • Example next slide

– Interviews with instructors (not “discussions”)
  • “What challenges do you perceive with this course?”

– Interviews / focus groups with students
  • Example next slide

– Past assessments
  • Assignments
  • Class activities (clickers, others ...)
  • Tests – aligned with apparent goals?
Example of observations

• Simple coding helps.
• Focus on specific issues chosen by instructor.
• Example later if interested.
Example of interviews / focus groups

• Regarding EOS service course curriculum:
  – WorkStudy: 2 focus groups (6 stds) & 10 interviews.
  – Strive for consistent data without “discussion”.

<table>
<thead>
<tr>
<th>QUESTIONS</th>
<th>Positive</th>
<th>Neutral</th>
<th>Negative</th>
<th>Notes</th>
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<td>1</td>
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• EG: When asking about what students did not enjoy:

  ...and with me I thought I could just do the readings because the lectures were so similar to them and there wasn’t much new stuff in class that I couldn’t have just studied on my own at home.
2. Goals (course and module)

• For instructors: learning goals workshop
• **Course** level
  – Initial attempts
  – Iteration
• **Module** level
  – Range of Bloom’s Levels
  – All cognitive domains
    (cognition, metacognition, psychomotor, affect)
• **Lesson** level goals are more “moveable”
• Connection with curriculum
Course & module level goals

- EOT survey shows improvement in recognition of goals:

  Three questions: Agree or disagree?
  
  a. Overall learning goals were clearly expressed for the course.
  b. Ditto ... for each module.
  c. Relationship between modules was clear.

  » Spring 08 left
  » Fall 07 right.
3. Assessments of learning

• Closely connected with goals
• Integral part of “active learning”.
  – Informs students of progress towards goals
  – Instructors see areas needing support.

• Tests / Exams
  – No surprises for students
  – Range of cognitive domains and Bloom’s levels that match those of goals.
  – Improved from F’07 to S’08 (EOT):
    • “The grading system is adequate.”
      (two midterms and a final exam)
    • BUT ... student “likes” & “best practice” are not always the same ...?
Course transformation process for eosc114

1. Learning about the course and student’s needs
2. Goals (course and module)
3. Assessments of learning, keyed to goals
4. Active learning and feedback, including: Class time, Homework, Resources.
5. Measuring effectiveness
6. Sustainability of initiatives
4. Active learning: Class time

- When instructor can be useful.
  Quote from EOT comments:

What are things you really like about this course?

“PRS and how 2 instructors would go over confusing aspects at the begging of each of the classes.”

and

“the enthusiasm of the teachers and the way they took feedback and responded the next class.”
Active learning 1: Class time

• When instructor can be useful
  – Clickers: many uses, but non-trivial to do well.
  – Alternative activities:
    • 5-min projects
    • Questions on paper
    • Many other ideas in the literature
  – JiTT: Just in time teaching  (www.teachingdvd.com)
    • (Video examples of pedagogy are very helpful.)
  – “Disaster scenario” day.
    • Observations show this was highly effective.
Active learning 2: Homework

- Readings, Pretests, Bulletin board activity, etc.
- Assignments to increase “depth” and provide ownership of content.

• Requires
  - Management
  - Coupling with class work (JiTT)
  - Time (e.g. better use of TAs)
Active learning 3:  Resources

– Clickers
– WebCT
– Questions bank or database (*SkyLight grant*)
– Text book. Was poorly integrated into the course.
  • EOT: 70% disliked it or were neutral
  • EOT: 90% LIKED or neutral  re. notes on web

– NEW: custom text
  • All instructors agreed – R. Stull will implement ASAP.
Course transformation process for eosc114

1. Learning about the course and student’s needs
2. Goals (course and module)
3. Assessments of learning, keyed to goals
4. Active learning and feedback, including: class time, homework, resources.
5. Measuring effectiveness
6. Sustainability of initiatives
5. Measuring effectiveness of initiatives

- Comparing the current to the “optimal” course
- Analyzing assessments
  - Comparing to previous terms
    - Specific questions.
    - “Level” or complexity of questions that are being asked.
  - Analysis of how “maturity” changes during term
    - Requires product from students, and analysis time
  - Specific pre-post questioning strategies.
- Carefully prepared EOT surveys
  - Use precedent about surveying (eg SALG instrument)
  - Evolve towards long term consistency
  - Example: Spring 2008 summary pdf.
5. Measuring effectiveness of initiatives

- Example of EOT comments (203 of 348 students)
- Look for what was “liked” and what was “not liked”

### Comparing comments only

- Arts vs. Science
- Class Size
- The text or notes provided
- Instructors - skills, personality etc
- Media and videos
- Activities in class
- Use of clickers
- Multiple professors (team...)
- Relevance to me
- Material covered - topics
- Pacing of coverage
- Timing
- Organization of the course
- Math
- Testing and assessment

Number of students providing comments.
6. Sustainability of initiatives

- Faculty become more *expert* about learning and pedagogy

- Procedures & tools
  - Eg. **Questions Database** (*SkyLight grant*)
  - Eg. Streamlined administrative procedures (Vista??)

- Archiving and transfer
  - CWSEI archiving project: Content & Pedagogy
Aims for the September 2008 fall term

In progress – priority list by 1\textsuperscript{st} quarter of May

• All instructors need to be involved. Hence time buy-outs
• Recommendations: priorities based upon S.W.O.T. summary
• SWOT to be built by mid-May based upon
  – all class observations,
  – Interviews & Focus groups (WorkStudy assistant)
  – Assessments – clickers and exams
  – End Of Term surveys from Fall’07 and Spring’08.
Aims for the September 2008 fall term

Opportunities for research .... (very tentative)

– Evaluate initiatives related to JiTT
  (use of Vista, BB use, QuestionDB, transfer to new instructors, etc)

– Study questions that students pose.

– Observe improvements in ...xxx... from early to late in the course.

– Compare sophistication of tests / activities / questioning to previous yrs.
Faculty perspective

• Roland Stull
People involved so far... at a minimum...

<table>
<thead>
<tr>
<th>TIC &amp; 1&lt;sup&gt;o&lt;/sup&gt; instructors</th>
<th>Sara Harris, Mary Lou Bevier, Jim Mortensen, Greg Dipple, Douw Steyn, Phil Hammer, Tom-Pierre Frappe, Erik Eberhardt, Francis Jones, Brett Gilley, Ben Kennedy, Mark Jellinek, Roland Stull, Michael Bostock, Roger Francois, Stuart Sutherland, Stuart Mills, Lee Groat, Uli Mayer, Maya Kopylova</th>
</tr>
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<tbody>
<tr>
<td>Working Groups &amp; Other</td>
<td>William Hsieh, May Ver, Kurt Grimm, Mark Bustin, James Scoates, Ken Hickey, Lori Kennedy, Dominique Weis, Susan Allen, Maite Maldonado, Kristin Orians, Kelly Russell, Philippe Tortell, Paul Smith, Mati Raudsepp</td>
</tr>
<tr>
<td>Grad students</td>
<td>Peter Lelievre, Melissa Gray, Jackie Dohaney, Leigh Gurney, David Cassis, Brendan Smithyman, Mark Halverson, Chris Leslie, Kirsten Hodge, Alyssa Shiel, Mika McKinnon, Danny Bay, Holly Peterson</td>
</tr>
<tr>
<td>Undergrads</td>
<td>Jamil Rhajiak, KC Smith, Ryan Harvey, Jonathan Elmer, 111 students, 221 students (past &amp; present), also hiring now for summer Skylight/EOS-SEI project</td>
</tr>
</tbody>
</table>
Plans for the future

• Continue work on course transformations
• Continue work on Attitudinal Survey
• Continue developing TA training program
• Serious effort toward examining curricula
• Work on archiving and effective transfer of materials to new instructors
• Expand seminars/discussions – visibility, maximize departmental involvement

...a work in progress...