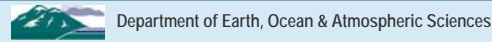


# Fossils, Facies and Geologic Time;

## Active Learning Yields More Expert-Like Thinking in a Large Class for Senior Science Students

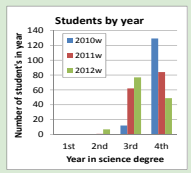
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### Context: Why transform this course?

#### Course

- o eosc326, "Earth and Life Through Time".
- o Elective for 150 non-geoscience B.Sc. Students
- o 82-84% students in (2010 – 2012) are in Combined Major in Science ...or.. Life Science
  - Mostly 3<sup>rd</sup> and 4<sup>th</sup> year students
  - Younger students in 2011 and 2012.



#### Course Level Learning Goals

- o Express how the concept of geological time is an important factor in our understanding of the evolution of the Earth System.
- o Apply basic geological principles and geoscience knowledge in the interpretation of Earth's geological and biological history.
- o Describe how the biosphere has adapted to exploit various environments in the Earth's oceans over time.

#### Before 2010, then after ....

- o Primarily 3 x 50 min. lectures for 13 weeks.
- o 2 labs introduced 2007 – refined in 2010, 2011, 2012.
- o Active Fridays introduced 2011 – refined in 2012.

Class & grading comparison ...	2010	2011 & 2012
Labs / midterms / final	1 / 1 / 1	2 / 2 / 1
Hours: lecture / active	35 / 2	22 / 13
Final exam: MC / Short Ans. weights	50 / 50	40 / 60
Grading Scheme:	- Final exam: 45%	- Final exam: 40%
	- 1 midterm: 25%	- 2 mid terms: 15 / 15%
	- 1 lab exercise: 25%	- 2 labs: 10 / 10%
	- clickers in class: 4%	- homework: 4%
	- homework: 1%	- diagnostic test: 1%
		- activities in class: 2%

#### Course improvement objectives:

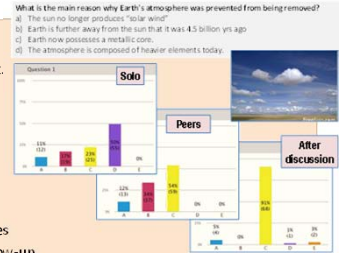
- o Incorporate known "best practices" into a senior science elective for 150 students.
- o Have senior, non-geoscience, B.Sc. students study the tightly coupled geologic and biological history of Earth using the tools and modes of thinking of experts.
- o Enable non-specialists to engage in the unique aspects of geoscientific thinking.
- o Incorporate more active learning within class time.
- o Enhance the variety of ways in which students engage with new concepts and skills.
- o Increase individual interactions with, and feedback from, experts (instructor & TAs).
- o Minimize low level content delivery in lectures.
- o Balance the competing needs of large enrollment against the importance of the hands on experiences.

Some pointers:  
 Teaching activities at <http://www.carleton.edu/NAGTWorkshops/time/activities.html>  
 Eosc326 described at <http://www.carleton.edu/NAGTWorkshops/time/courses/EOSC326.html>  
 Activity: Biozones, stratigraphic log correlation, and corresponding interpretation of paleoenvironments described at <http://www.carleton.edu/NAGTWorkshops/time/activities/61334.html>  
 Also includes: - The three page worksheet for students + Instructor's Powerpoint for running the activity + Solutions; - Generic guidelines for running group-based worksheet activities, & Worksheet timing chart.

### Initiatives: What changes were made ?

#### Pedagogic choices

- o Pre-course diagnostic + remedial content.
- o Text; weekly readings + online quizzes.
- o 2 Lectures/week with clickers. Eg. →
- o 2 hands-on laboratory experiences.
- o 8 "active Fridays" (no lecturing)



#### "Active Fridays"

- o Group work (4-6), worksheets, 50 minutes
- o Apply knowledge, practice skills, Lab follow-up
- o Enables expert ↔ novice interaction
- o Well liked (data to the right)



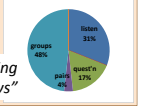
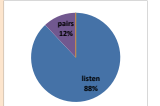
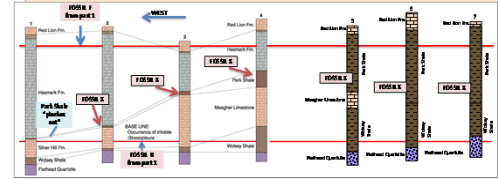
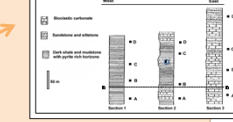
#### Lab experiences

- o 150 students in 3 groups
- o Enables expert-novice interaction for a large class
- o I.D. fossil & rock samples
- o Analyze for genus, age, structures and environment
- o Construct litho- & bio-stratigraphies
- o Mix of in-lab, at-home and in-class group work.

Stratigraphic columns containing fossils used in lab.  
 Tasks: (1) Identify and date fossil samples.  
 (2) Use ages to correlate rocks across sections.  
 (3) Also carry out lithostratigraphic correlation.

#### Complexity of thinking

- o Before (also for labs): simpler, 3-section settings.
- o Now: more sophisticated settings; used in class with expert guidance as clicker questions, group activities and in exam questions.

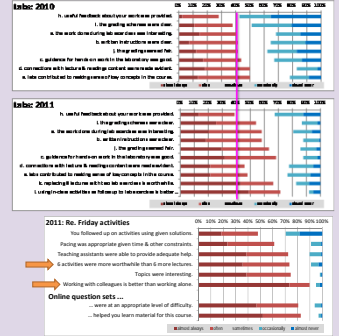


#### Compare two 50 minute classes:

- o What are students doing during two types of classes?
- o Class observations protocol is active research in Faculty of Science, UBC (2012).

### Results: What evidence of improvements ?

#### Student perceptions of value

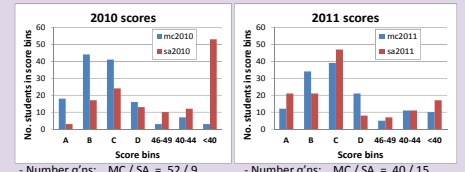


#### Student engagement:

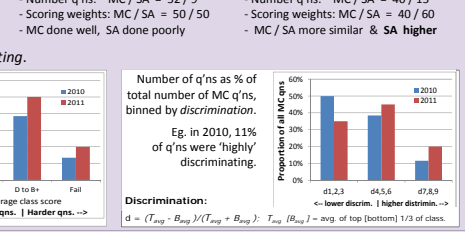
- o Avg lecture: 2010 → ~80% 2012 → ~90%
- o Grp-work class, 2012: @30mins: ~90% @45mins: ~75%

#### Different exams ... Different results

- o 2010: Fewer short answer and much more poorly done
- o 2011: More figures, more short answer questions, AND more sophisticated student answers.
- o Also, Multiple choice questions were **harder and more discriminating**.



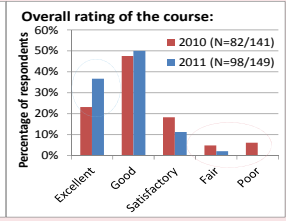
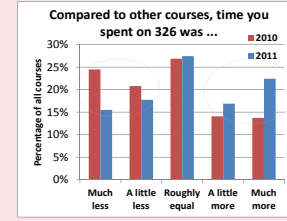
Number of questions as % of total number of MC q'ns, binned by avg. class score.  
 Eg. In 2010, 12% of the questions yielded an average class score of 0-60%. These were "harder" questions.



#### Workloads & Overall Rating

- o Compared to other 3<sup>rd</sup> / 4<sup>th</sup> year science courses, more balanced work loads in 2011 than 2010.

AND  
 o higher overall rating of this course in 2011 than 2010.



Compare 2010 / 2012 lab work

Pin lab comparisons here

Pin lab comparisons here

Compare 2010 / 2011 short answer questions in exams

Pin exam comparisons here File "SAquestions.docx" pg1.

Pin exam comparisons here File "SAquestions.docx" pgs 2,3