Paired teaching +
Course transformation:
Incorporating active learning in Astronomy 101

Linda Strubbe (Science Teaching & Learning Fellow)
Aaron Boley (Astronomy faculty)
Goals of the project

1. **Professional development in teaching** for less experienced partner: learn and become confident in active learning strategies

2. Incorporate active learning into Astronomy 101
Paired Teaching at UBC

• Goal: Professional development in teaching for both instructors

• 2 instructors share responsibility for all aspects of course

• Weekly meetings (or more often) to plan and discuss teaching

• We alternate weeks that we teach

• Both always in the classroom
Course Overview

• “Introduction to the Solar System”
• First-year students
• Mostly science majors (not physics or astro)
• ~100 students
• 3 one-hour lectures / week
• 1 two-hour lab / week

• Taught for many years in (popular) pure-lecture style

Major Learning Goals

• Develop a life-long interest in astronomy
• Develop understanding of the scientific process
• Ask "Why" and "How do we know?"
• Develop your skills and mindset for evidence-based thinking
Active learning strategies we incorporated in Astronomy 101

- Peer instruction via clicker questions
- Get students comfortable contributing in class
  - learn names, ask students to prepare to share, wait long time
- In-class worksheets
- Pre-class reading assignments (with online questions)
- Online discussion forum
- Two-stage (individual + group) midterms & final

Selected research references:
- Active learning: Freeman et al. (2014);
- Inclusive teaching: Tanner (2013);
- Pre-class reading: Heiner, Banet, Wieman (2014);
- Group exams: Wieman, Rieger, Heiner (2014);
- Research-based materials from Center for Astronomy Education & UNebraska
Our process

- Drafted learning goals together
- Challenge: Had to make most key decisions before course started:
  - textbook, HW format, exam format
- LS and AB (pair) alternated responsibility by topics / weeks

- What LS did each week:
  - read chapter
  - list key topics
  - draft extremely rough topic-level learning goals
  - decide on pre-class reading sections, pre-reading HW questions, in-class activities, post-class HW questions

- Borrowed large amounts from Center for Astronomy Education (slides, ranking tasks) & UNebraska (clicker Q’s, simulations)
Results: COPUS observations (2016 only)
Results: Attitude survey (CLASS) (2015 and 2016)

2015
Traditional lecture

Similar results in 2015 and 2016: Small negative shift in student attitudes

2016
Transforming

(Analysis by Physport)
Results: Astronomy Diagnostic Test 2.0 (2016 only)

Mean fraction correct on pre-test = 0.503 +/- 0.013
Mean fraction correct on post-test = 0.622 +/- 0.013
Mean normalized gain = 0.239

ADT 2.0 written by Collaboration for Astronomy Education Research (2004)
(No data available for 2015)
Results: Student perceptions of class activities (2016 only)

“Please indicate how helpful you found the following class elements of ASTR101 -- for learning astronomy, or skills useful for other science courses.”

Student perceptions of in-class activities (from most to least helpful)

- Demonstrations with props
- Listening to the instructor explain the...
- Clicker questions
- Derivations (writing on the document...)
- Worksheets
- Small-group discussions about a...
- Theatrics (story-telling, theatre-based...

Student perceptions of out-of-class activities (from most to least helpful)

- Reviewing class notes / lecture slides
- Group-stage of midterm exams
- Mastering Astronomy
- Pre-class reading assignments
- Office hours
- Labs
- Online discussion forum
- Online journal

Not at all helpful  | Slightly helpful  | Moderately helpful
-----------------|------------------|---------------------
Very helpful      | Extremely helpful

Challenges

• Support / long-term planning at dept level has been unclear (though improving now)
  • No observations of previous untransformed course
  • Vision for pair and for transformation
  • Future teaching assignments?
  • Future astronomy transformations?

• Not enough time:
  • to discuss lesson plans days before class
  • to digest, analyze and incorporate results from students through the term
Next steps: Transform Lab Curriculum

- AB will teach Astronomy 101 lecture alone in Fall 2017

- We plan to begin lab transformation in Fall 2017:
  - Currently: Linear step-by-step lab activities
  - Plan to introduce inquiry-based labs to focus on scientific thinking

“What changes to the labs would improve your learning in ASTR101?”