# Transforming undergraduate science education at UBC

# Carl Wieman Science Education Initiative and beyond

**Simon M. Peacock**
**University of British Columbia**
**Dean, Faculty of Science**

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# CWSEI Leaders include

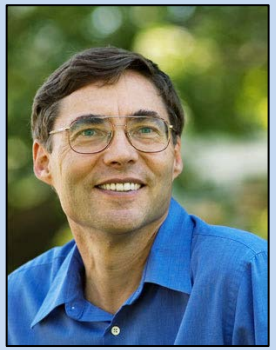

Sarah Gilbert


Sara Harris

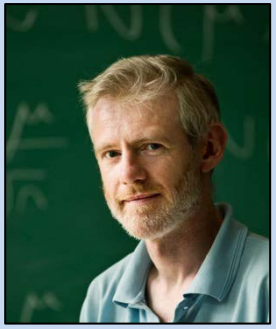

Costanza Piccolo


Paul Carter


Georg Rieger


Carl Wieman

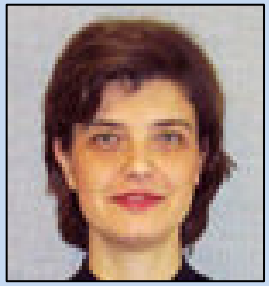

Patricia Schulte


Bruce Dunham


Jackie Stewart


Ian Mitchell

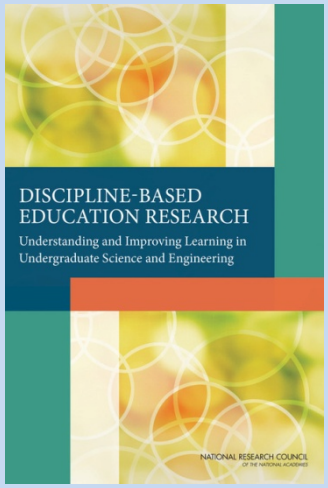

Mark MacLean


Gülnur Birol


Warren Code

Plus our talented **STLFs**, past and present!

→ Brett Gilley, Francis Jones, Louis Deslauriers, Allison Tew, Jared Taylor, Malin Hansen, Bridgette Clarkston, Mandy Banet, Lisa McDonnell, Sandra Merchant, Joseph Lo, Katya Yurasovskaya, Jim Carolan, James Day, Peter Newbury, Ido Roll, Cynthia Heiner, Gaitri Yapa




## 2012 U.S. National Academy of Sciences review

"Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering"

NAS press, free download

~1,000 STEM research studies clearly show that "research-based instructional strategies are *more effective than traditional lecture* in improving conceptual knowledge and attitudes about learning."

"Effective instruction involves a range of approaches, including making lectures more interactive, having students work in groups, and incorporating authentic problems and activities."

***→ How do we individually and collectively change the way we teach?***

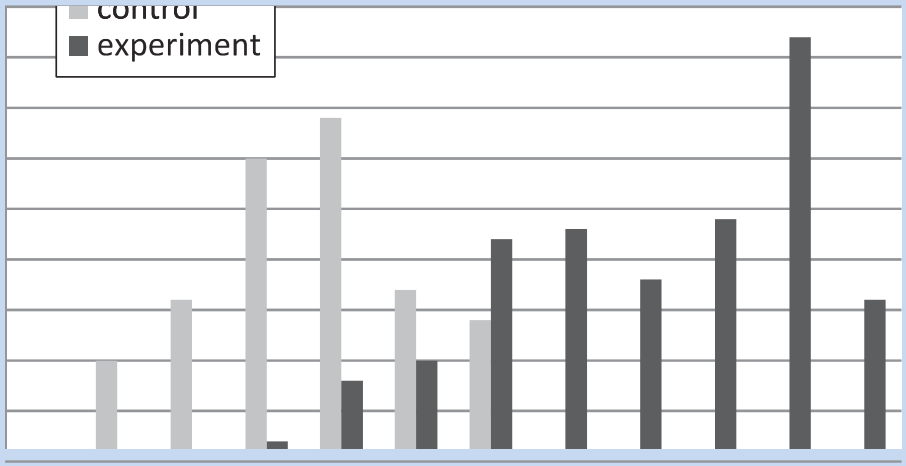
# Improved Learning in a Large-Enrollment Physics Class

Deslauriers, Schelew, and Wieman (2011) *Science*, v. 232

*PHYS 153* – Elements of Physics (required for engineering students)
Two large sections (~270 students/section)
Intervention experiment – one week (three hours of class time)

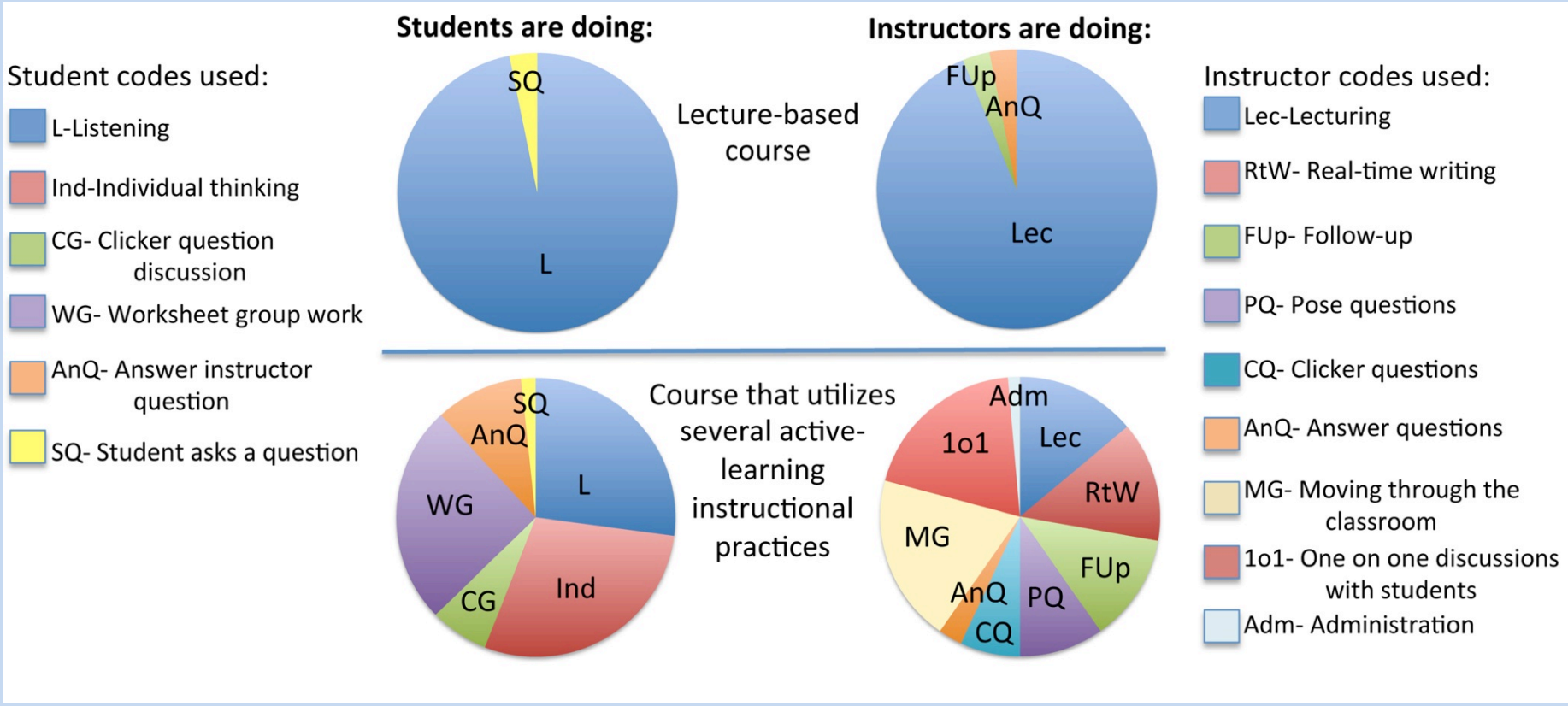
*Control* – Traditional lecture delivered by experienced highly-rated faculty

*Experiment* – Instruction based on research on learning delivered by inexperienced, but trained post-doc




→ 2X learning
→ Increased attendance
→ Higher engagement

# Traditional vs. Active Lectures

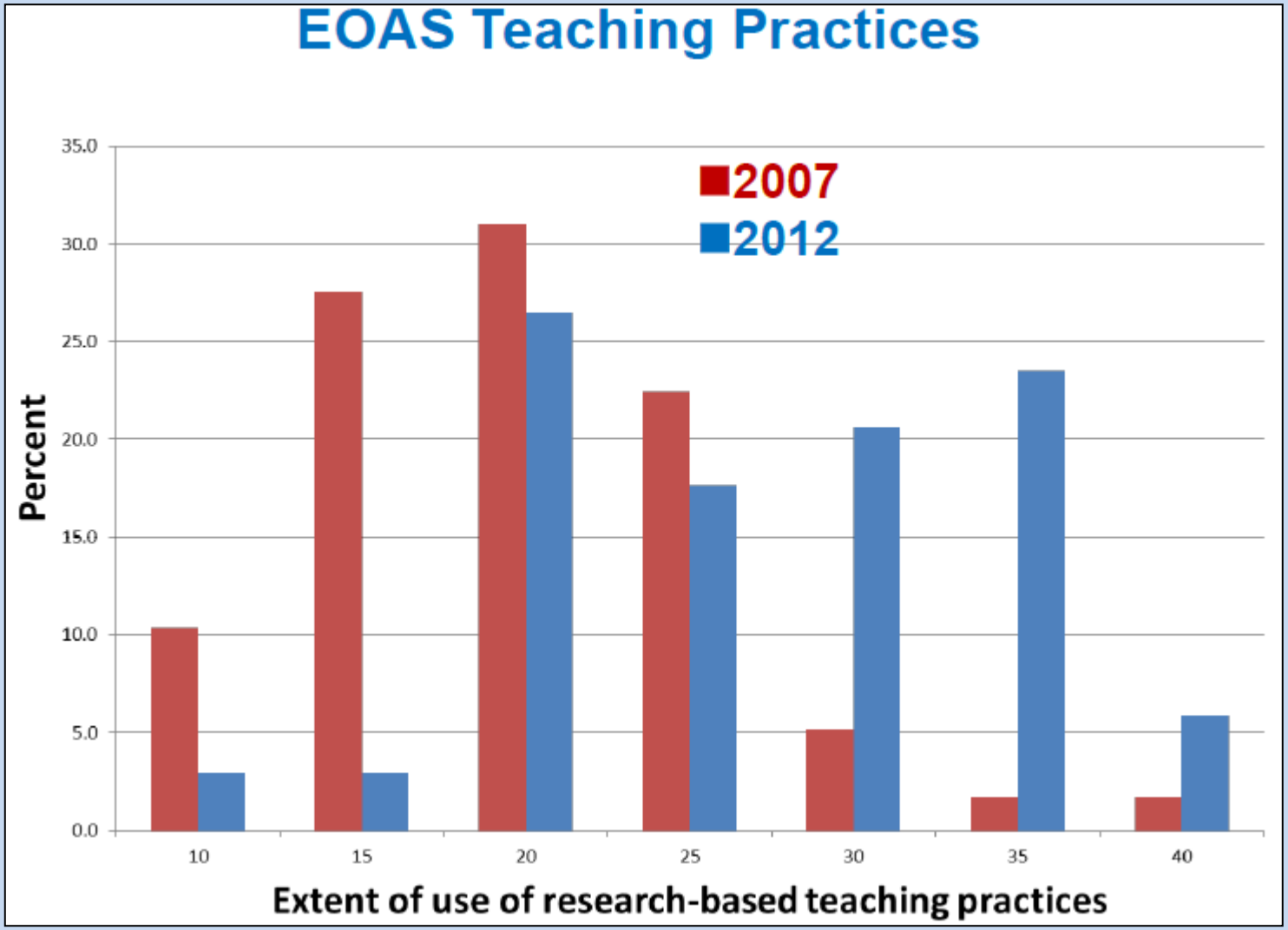



Classroom Observation Protocol for Undergraduate STEM (COPUS)

- Measure extent to which faculty teach in an interactive manner; validate reporting
- Documents classroom behavior in 2 minute intervals
- Requires only 1.5 hours of training

MK Smith et al. (2013)

# EOAS Teaching Practices



# UBC CWSEI – Current status

~7 year initiative launched in 2007, ramping down through 2014-15

**100 courses** transformed by CWSEI, mostly large 1st and 2nd year
**plus 37 additional courses** impacted (some CWSEI input, but not a major project) = *43% of our student FTEs*

**15,000 UBC undergraduate students** took one or more transformed science courses in 2012 --- Science, Engineering, Arts, Business students

UBC faculty members that tried research-based teaching practises with CWSEI support and have had ≥ 1 year to quit → **only 1 out of 70 have quit**

Currently we have ~12 STLFs at UBC (36 STLFs since 2007)

# Add'l UBC Science Education developments

**Faculty of Science**

- Recent re-engineering of Skylight
- New SCIE courses targeting nature of science, communication, sust.

**UBC**

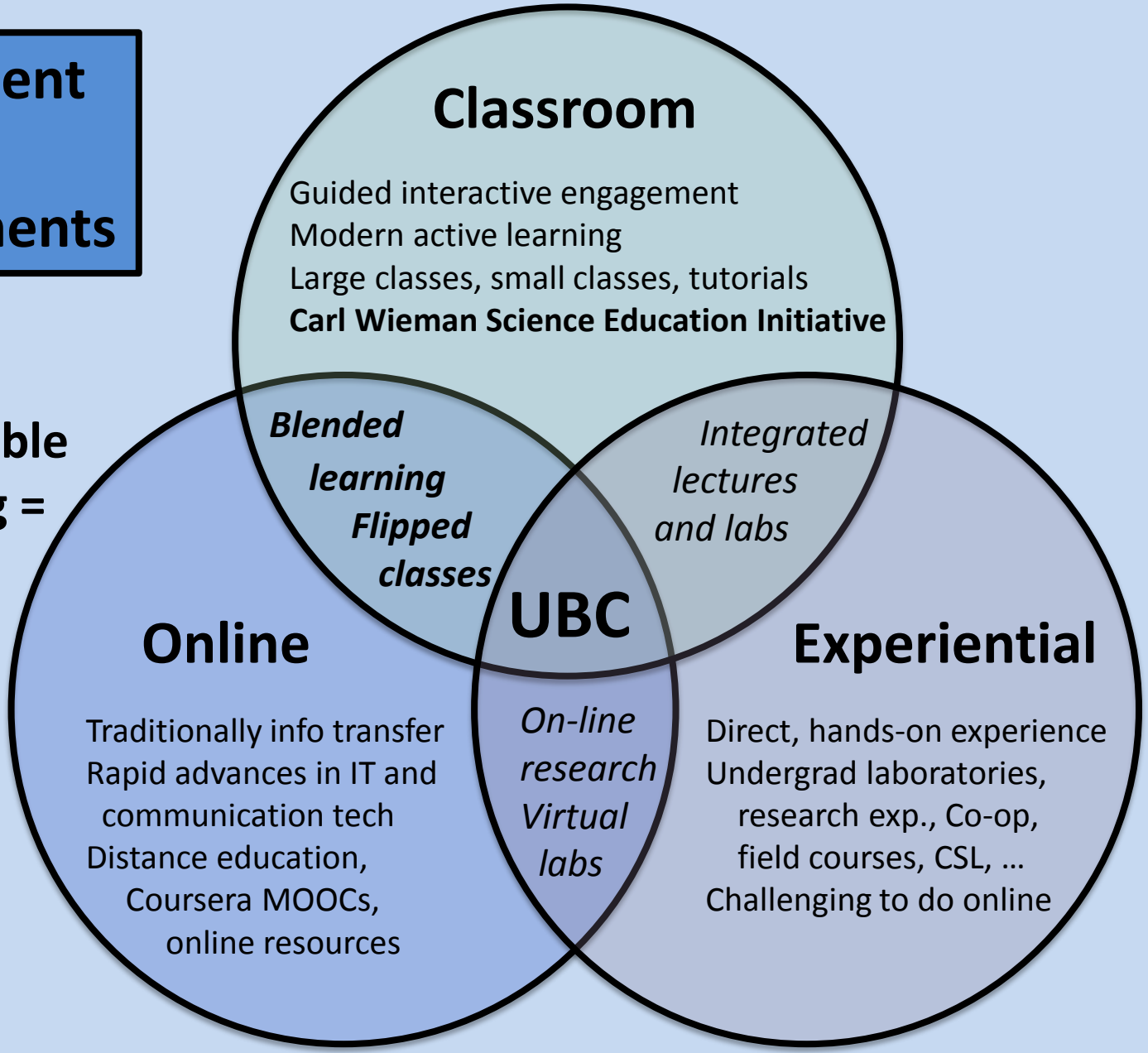
- CTLT – involving more Science Skylight personnel
- Flexible Learning Initiative, including STLFs
- Vantage College
- New Professors of Teaching (6 in Science, and growing!)

**Outside UBC**

- Bay View Alliance – UBC, Texas, Kansas*, Indiana*, Queens*, Sask. UC Davis. New members – Colorado, U Mass

# UBC Student Learning Environments

**UBC Flexible Learning =**



# Flexible Learning

UBC's response to the opportunities and challenges presented by on-line learning, driven by rapid advances in information and communication technologies, and motivated by the objectives of **improving student learning**, extending access to UBC and strengthening University operating effectiveness

UBC has years of e-learning experience from distance education to flipping-the-classroom

UBC Science using the same CWSEI evidence- and research-based approach to improving student learning

(1) MOOCs, (2) Program transformations, (3) Course transformations

Blended learning – faculty spend less time lecturing and marking exams and more time interacting with students

Stability of UBC's learning management system, *Connect*, is critical

# FL Program Transformations

Example - **Biology program**

1,000 majors and honours students

**Shona Ellis**
Professor of Teaching, Botany
Assoc. Head, Biology Program

A **program-wide effort to develop "flipped" or "blended" classes** where some course content is delivered on-line and some content is delivered in lecture, with substantial class time devoted to application of knowledge, data analysis and problem solving.

Beginning with large first-year courses - BIOL 112 + BIOL 121 (1,800 students ea)

Pre-class: Directed readings, online tutorials / videos / media, quizzes

In-class: Group / individual / call activities, clicker questions, how to,…

Proposed "blended" experimental section of BIOL 234 (Genetics) using Rosie Redfield's MOOC videos as lectures combined with two-hour tutorials

# What's next for UBC Science Teaching and Learning?

**Developing a single integrated teaching and learning unit**

# What's next for UBC Science Teaching and Learning?

**Changing leadership:**

- Carl Wieman, Senior Advisor
- Sarah Gilbert, Senior Advisor
- Gulnur Birol, Skylight's Associate Director
- Warren Code, Skylight's Assistant Director for CWSEI

**Funding long-term STLF positions in departments**

- UBC's Flexible Learning initiative
- Fundraising to extend CWSEI impact - e.g., Gift from Deb and John Harris to support our ongoing EOAS and PHAS efforts:
  - Investment in STLFs and co-teaching experiment
  - Harris' support one STLF in each Dept, plus teaching buyouts
  - FoS and Dept jointly support one additional STLF

**Our goal: transforming 80% of our classes**

- Currently ~43% of our classes have been transformed

# Thank you!