SEI Physics

Summary of Activities

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**STFs:** Rachel Pepper, Steve Goldhaber, Ben Zwickl, and Stephanie Chasteen
Junior-level E&M I

• Learning goals
• Interactive engagement in lecture
  – Clicker Qs, peer discussion, and white-boarding activities
• NEW optional co-seminar
  – Developed tutorials. Students work in groups
• Augmented HW
  – Real world connections, Justification, Reasoning, Estimation and limits, Math-Physics connections
• Group HW problem solving sessions
• Validated pre-post conceptual assessment tool
• Archive of course materials
Junior-level Quantum I

- Learning goals
- Interactive engagement in lecture
  - Clicker Qs, peer discussion, and white-boarding activities
- NEW optional co-seminar
  - Developed tutorials. Students work in groups
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  - Justification, Reasoning, Estimation and limits, Math-Physics connections
- Group HW problem solving sessions
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Co-seminar Tutorials

• 1 hour optional-enrollment tutorial.
• Enhance conceptual understanding, problem strategizing, metacognitive skills, expressing reasoning.
• Students work in groups
• Facilitated by faculty and Learning Assistant
Sophomore-level Mechanics

(see poster #9)

• Learning goals
• Interactive engagement in lecture
  – Clicker Qs, peer discussion, and small group activities (in-class tutorials)
• Augmented HW
  – Justification, Reasoning, Estimation and limits, Math-Physics connections, computer/Mathematica
• Group HW problem solving sessions
• Pre-post conceptual assessment tool in development
• Archive of course materials in development
Upper-Division Labs
(see poster #10)

• Developing learning goals
• Creating tutorials for lecture part (2 hrs/wk)
  ─ data analysis in Mathematica, Measurement and automation in LabVIEW, and more...
• Expanded view of critical thinking and problem solving
  ─ Experiment/apparatus design, troubleshooting, modeling “black boxes” in the lab, time series data analysis
• Turn lab activities into formative assessments
• Creating pre-post assessment tools
• Collaborating with a network of advanced physics lab instructors
Informing Local Sustainability
(see poster #11)

• 7 faculty have taught with reforms
• Conducting faculty interviews to inform us on:
  Reuse and revision of resources and materials
  Usefulness of resources to faculty
  Optimal organization of archived materials
  Faculty views on student learning with materials
  Faculty choices and their perceived future use
Use by Other Institutions

• 23 institutions have expressed interest in or reported using Quantum materials:
  Including ... Brandeis University, CU Denver, Michigan State University, Pacific University, University of the Fraser Valley, Wright State University, Arizona State University, Colorado School of Mines, Grinnell College, McDaniel College, Mesa State College, Metro State College, Spelman College, University of Maryland, and University of Northern Colorado.

• 65 institutions have expressed interest in or reported using E&M materials:
  Including ... University of California at Berkeley, St. Mary's College of Maryland, University of New Hampshire, Grinnell College, Augsburg College, University of Kansas, Youngstown University, Ithaca College, University of Georgia, Abilene Christian University, Pacific University, Buffalo State University, Loyola College, Keene State College, Colorado State University at Pueblo, Universidad Santa Maria in Chile, California State University at San Marcos, University of North Carolina, Eastern Michigan University, University of Colorado at Denver, Oregon State University, University of British Columbia, Coastal Carolina University, Brigham Young University, Colorado School of Mines, University of North Dakota, Swarthmore College, Kansas State, Southwestern Oklahoma State, Creighton University, Dublin City University in Ireland, University of Windsor in Canada, and Central Oregon Community College.
## Expanding Use of Clickers in Upper-level Courses

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- 12 non-PER ★ and 2 PER ★ faculty
Results: Students say clickers help learning in upper-division

Q: How useful for your learning is the addition of clicker questions compared to pure lecture with no clicker questions?

- Lecture with clickers much more useful: 79% of students
- Lecture with clickers more useful
- Same
- Pure lecture more useful
- Pure lecture much more useful

Upper.div courses using clickers: 12 courses, 264 student responses
Results: Improved student learning

Electricity & Magnetism: Conceptual Assessment

Student learning gains in are above traditionally-taught courses at CU and elsewhere

N=493

Physics Education Research-Based Courses (PER)

Standard Lecture-Based Courses (STND)