Multiple research-based assessments were used in order to evaluate effectiveness of the transformations (see next poster).

All course materials are available online at www.colorado.edu/sei/departments/physics_3310.html.

Learning Goals

- Content is canonical: Griffiths Chapter 1-6.
- Ten broad learning goals were developed by faculty.
- Compared to a traditional lecture, the course has transformed in order to improve student learning.

Classroom Techniques

- Class blended traditional lecture with interactive engagement methods -- not as dramatic a departure from the traditional approach as other transformation efforts.
- Techniques included: Interactive lecture style involving high levels of student-student and student-teacher interaction.
- Clicker questions and peer discussion.
- Illustrative simulations and demonstrations.

Homework

- In order to more explicitly target learning goals, we modified traditional homework.
- For example:
  - Real-world contexts
  - Articulating expected answer
  - Making sense of final answer
  - Approximations, expansions, estimations...

Results & Conclusions

Success of the transformation was evaluated by:

- New conceptual assessment (CUE) and BEMA
- Conventional exam problems
- Student interviews and end-of-term evaluations

Compared to a traditional lecture, students scored higher on all assessments (see other poster), and were very enthusiastic about the course.

Pedagogical techniques that improve learning in introductory classes can have similar benefits in upper-division, resulting in improved learning for future physicists, teachers, and engineers.