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A Medley of Successful Active-Learning Methods

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A Medley of Successful Active-Learning Methods in Introductory and Upper-Level Physics Courses

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This workshop will present a medley of active-learning methods that have been implemented successfully in both introductory and upper-level physics courses. The participants will engage in methods that include Just-in-Time Teaching (JiTT), clicker questions, whiteboard activities, and virtual experiments. The workshop will be designed very much like a class that employs these methods, with a pre-workshop online assignment that is due “Just in Time” before the workshop, and whiteboard activities and clicker questions associated with the active-learning methods. The participants will work in teams to develop some JiTT assignments, clicker questions, and whiteboard activities that they could use in their own classes. The goal of the workshop is to allow the participants to experience this combination of active-learning methods and appreciate how the methods can be combined and applied in a STEM classroom to increase students’ conceptual understanding and problem solving skills.

In my Active-Learning Classroom

Students come to class with some familiarity with the material to be covered that day. They may not be experts, but they will at least recognize the concepts and they will have already thought about some of the problems to be solved that day.

Teams of four students are assigned (and then re-assigned in about four weeks) and these teams work together to solve the in-class problems.

The classroom is enabled with technology to enhance active-learning methods. There are tables rather than individual desks to promote teamwork and peer instruction. Interactive whiteboards are on all four walls of the room, making every seat a good seat. Laptop computers are available for simulated experiments and computational calculations. Individual whiteboards are used by the teammates to solve in-class problems and then present their solutions to the class.

Students work together on problems in class, showing their work on small whiteboards. This allows the teammates to discuss their solutions, thoughts, ideas, and also allow the instructor to realize the students’ (mis)understandings instantly and provide immediate feedback.

Examples of conceptual Peer Instruction questions for PHYS 2211:
- Try your intuition on the following question and then test your answer by running the animation. If the two masses are equal, and ball 2 is initially at rest, upon collision:
  - ball 1 bounces back with the negative of its initial velocity
  - ball 1 continues with ball 2 moving off with twice the initial velocity of ball 2

Test the effect of the distribution of mass: Run the animation for the larger solid sphere and the larger hollow sphere, noting the linear speed of each at the bottom of the incline and the ratio of linear to angular kinetic energy.

Does it Work?

The FCI was used to determine if students’ beliefs about Newtonian mechanics were transformed from common sense misconceptions to Newtonian understanding. Since the FCI was designed with this measurement in mind, an improved score on the FCI post-test shows a corresponding improvement in Newtonian thinking.