The TAMU APPEAL program: bridging the gap between sophomore and junior level through paradigm and teaching and team learning.

**CHALLENGES FROM SOPHOMORE TO JUNIOR**

- Struggle to grasp and connect the many interwoven ideas that cut across different branches of physics and courses.
- 1st two years low math level required—In junior year a leap is expected of them in their math skills AND how the connect to physics problems.
- Only one point of view in understanding the physics, connecting the concepts, and links to problem solving.
- The teacher makes it sound easy but is it really easy too see from a novice point of view? How to smooth the step to thinking like an expert in a multi-connected way.

**Goals of a better physics undergraduate program**

- Not only teach physics—teach how to THINK like a physicist.
- Smooth the transition from novice to expert thinking: avoid the sophomore to junior gap.
- Teach collaborative knowledge building from the beginning.

**Interactive Small Whiteboard Prompts**

- **Motivation:** Students are exposed to approaches and responses they otherwise may not have been considered.
- Students are given the small whiteboards and markers at the beginning of the class. During the class the will be asked short questions (see types below) that all must write down. The professor, walking through the class can then select a few as examples of different points of views, answers, common misconceptions, etc.
- Small Whiteboard Prompts can be prepared in advance or can be implemented “on the spot” (types of Prompts: Specific vs. Yukes vs. Detailed)
- **How it work best?**
  - Keep chunks but if IT IS NOT you control the flow of the discussions and which boards to highlight.
  - Example to correct misconceptions
  - Example to show different approaches.

**Large Whiteboard Group Activities**

- **Motivation:** Students need a sense of how professional physicists must often work to solve problems in collaborative efforts.
- Working in small groups give students concentrated doses of peer instruction.
- Exposure to multiple learning styles will be gained in small groups.
- Students must learn how to express and defend their physical and mathematical reasoning as well as judge and debate their peer’s reasoning.

**Wind Sprint Problem Solving**

- **Motivation:** Strategic Wind Sprints in the PHYS 221 Course were developed as an alternative to Small Whiteboard Prompts, in order to take a new in depth look into the process of solving physics problems.
- As an evolution of Small Whiteboard Prompts, Strategic Wind Sprints share many of the same characteristics, including student engagement and peer assessment.
- Many students are adept at mathematics, but have difficulties setting up problems from a physical standpoint. Of the multitude of small whiteboard prompts, many students have difficulties choosing the most appropriate or expedient approach.
- Students are encouraged to complete each exercise on their own time.

- **The course included kinesthetic learning activities. The teaching techniques were unexpected, but the physical activity allowed everyone to relate to material in a unique way, and the discussions afterwards allowed us to talk about any details that remained confusing.”**
- **“By problem solving as a group, I discovered new methods to approach a problem. This also gave me insight into the reality of being a physicist since physicists often collaborate on tackling new questions in their field.”**
- **“I was assigned especially difficult problems for us to solve on our own. At the time, these assignments seemed unwieldy, but I now see that my understanding was truly enhanced by being challenged.”**

**Paradigms of Physics Program**

- **Motivation:** Paradigms in Physics at Oregon State University Physics Department is a novel, NSF-supported, quarter based, upper division physics curriculum implemented to renovate the connections between the fields of physics.
- Promote the development of problem-solving and mathematical skills and incorporate modern pedagogical techniques and information gained from physics education research.

**Team Testing**

- **Motivation:** The team testing component to the midterm and final exams emphasize this type of interaction.
- Students learn to work in teams to solve problems that individually would be too challenging to solve alone and to experience how collaborative problem solving works in the professional level.
- Students are broken in their usual teams of three that are given two very challenging problems, and teams are chosen with even strength of the students so no team is much stronger than the others.
- Two very challenging problems are given to the students and they have 25-30 minutes to solve over and make a choice of which one they will attack.
- The students have to discuss which one they are better positioned to solve successfully.
- During the evening session, since this is typically extra time the students agree to do, coffee and some refreshments where provided.
- **How it work best?**
  - The students agreed to do short answer small whiteboard questions.
  - New testing methods (team based tests).
  - Maintaining student engagement during class through short answer small whiteboard questions.

**EXAMPLE: Specific Heat Capacity of Lead “Survivor Style”**

- Students are told the basic relation for specific heat Q=c m ΔT
- They are given a plastic bottle ~1/4 full of lead shot and a meter stick.
- A thermometer is shared by the whole class.
- They are asked to split into groups and figure out the specific heat of lead (no further instructions or hints)
- They figure it out in ~10 minutes

**TAMU APPEAL PROGRAM**


**Further resources**


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