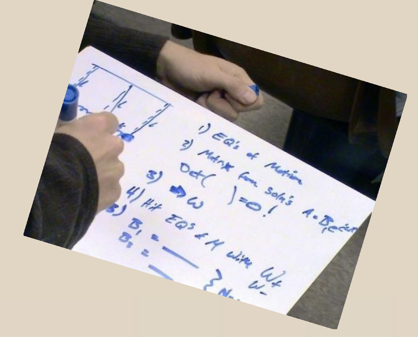
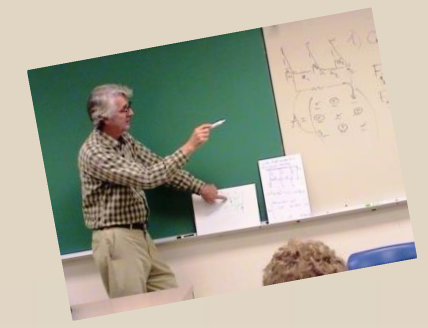
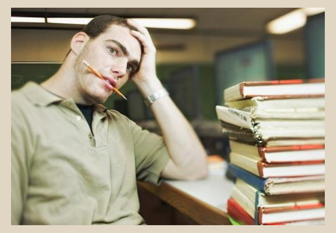


Montague – CTE Scholar
Jairo Sinova
(2006 - 2007) – Science

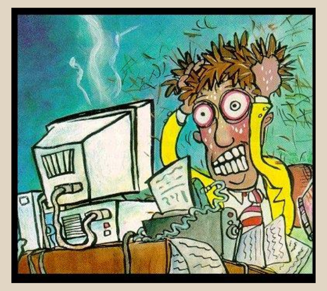



The TAMU APPEAL program: bridging the gap between sophomore and junior levels through paradigm teaching and team learning



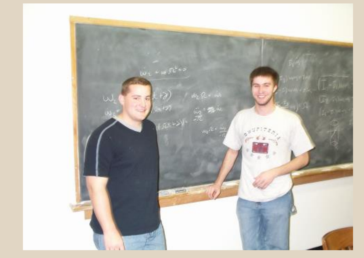
CHALLENGES FROM SOPHOMORE TO JUNIOR

- 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 physicists.
- Smooth the transition from novice to expert thinking: avoid the sophomore to junior gap
- Teach collaborative knowledge building from the beginning



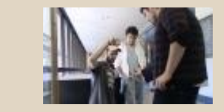
Paradigms of Physics Program

Paradigms in Physics at Oregon State University Physics Department is a novel, NSF-supported, quarter based, upper-division physics curriculum overhaul designed to:
•emphasize the connections between the fields of physics.
•promote the development of problem-solving and mathematical skills.
•accommodate non-traditional students entering the physics programs.
•incorporate modern pedagogical techniques and information gained from physics education research.

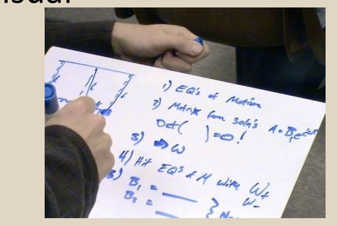

Paradigms in Physics Curriculum

Paradigms courses (junior year)	Capstone courses (senior year)
Symmetries and Idealizations (optional)	
Static Vector Fields	Electromagnetism
Oscillations	
One-Dimensional Waves	Classical Mechanics
Spin and Quantum Measurements	
Central Forces	Mathematical Methods
Energy and Entropy	
Periodic Potentials	Quantum Mechanics
Rigid Bodies	
Reference Frames	Thermal Physics

TAMU APPEAL PROGRAM
http://appeal.physics.tamu.edu/index.html



•Introduces inquiry based, peer lead active learning coupled with lectures. The 20-30 minute activities are conducted in small groups and span kinesthetic, visual and more mathematical based activities.



•Introduces a higher level of mathematical sophistication closely coupled with introductory chapters of future advanced courses to ease the transition to upper division courses.

•New testing methods (team based tests).

•Maintaining student engagement during class through short answer small whiteboard questions.

Interactive Small Whiteboard Prompts

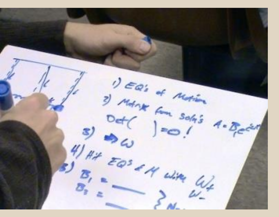
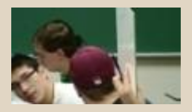
Motivation: Increases student involvement and engagement during lectures.
•Assess student understanding and background during class.
•Peer learning—students are exposed to approaches and responses they otherwise may not have considered.

How?

•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. Vague, Quick vs. Detailed

How it work best?

•Seems chaotic BUT IT IS NOT! You control the flow of the discussions and which boards to highlight
•Perfect to correct misconceptions
•Perfect to show different perspectives

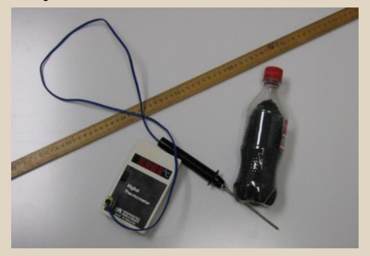
Large Whiteboard Group Activities

Motivation:
To give students 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.

The main goal of the activities is for students to make connections between the material learned in class and to explore physical phenomena right before we cover it in lecture to enhance retention. In experimental based activities it is best to avoid recipe like step description and give minimal instructions instead. Such sparse instructions require student groups to be creative, self motivated and to rely heavily on their prior physical knowledge and problem solving skills. These "MacGyver" activities are among the favorite of the students. Having to work through a concept relying solely on acquired prior knowledge leaves a greater mark on students.

EXAMPLE: Specific Heat Capacity of Lead "Survivor Style"

- Students are told the basic relation for specific heat $Q=c\,m\,\Delta T$
- 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



Team Testing

Motivation:
•Throughout the course we have encouraged peer-lead interactive learning and team work to gain multiple views and higher understanding of a problem which would be difficult to obtain individually. In the PHYS 221 course we introduced a Team Testing component to the midterm and final exam to emphasize this type of interaction.
•Students learn to work in teams to solve problems that individually would be too challenging to solve alone and begin to experience how collaborative problem solving works at the professional level.

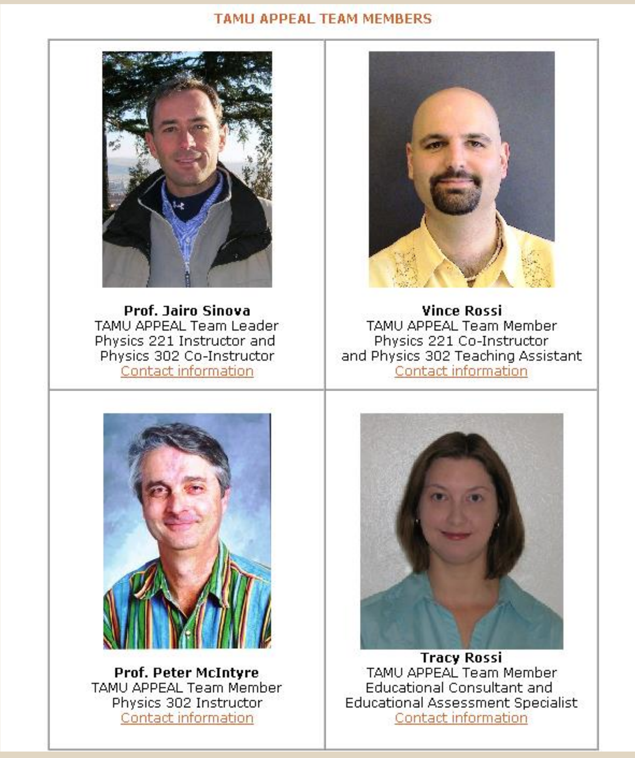

•Students are broken in their usual teams of three that they have been having throughout the course. The teams are chosen with even strength of the students so no team is much stronger than the others.
•Two very challenging problems are given to the students and they have a few minutes to look them over 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 exams, since this is typically extra time the students agree to do, coffee and some refreshments where provided.
•No hard time limit was given. Many teams, once they finished their problem stay around to learn from other teams how to do the other problems.

Wind Sprint Problem Solving

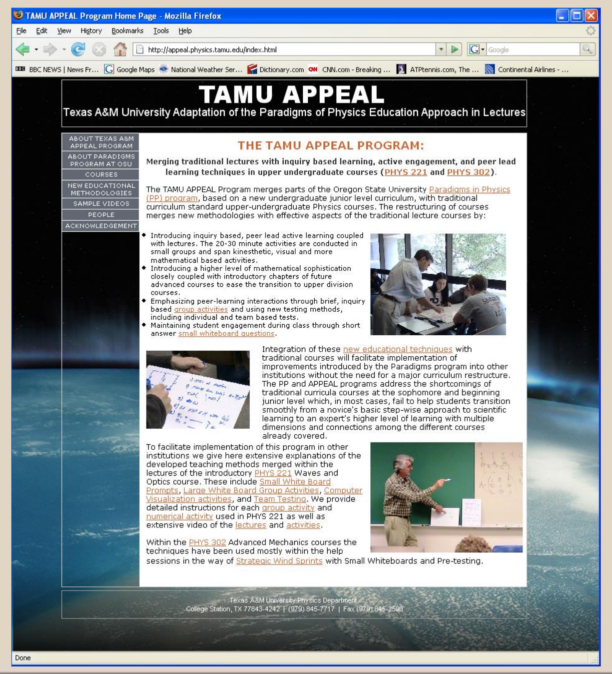
Motivation:
•Strategic Wind Sprints in the PHYS 302 Course were developed as an alternative to Small Whiteboard Prompts, in order to take a more in depth look into the process of solving physics problems.
• As an evolution of Small Whiteboard Prompts, Strategic Wind Sprints share many of the same motivations, including student involvement and peer assessment.
•Many students are adept at mathematics, but have difficulties setting up problems from a physical standpoint. Of the multiple paths to solving problems, many students have difficulties choosing the most appropriate or expedient approach.
•Establish appropriate strategic approaches to solving problems. Students are encouraged to complete each exercise on their own time.

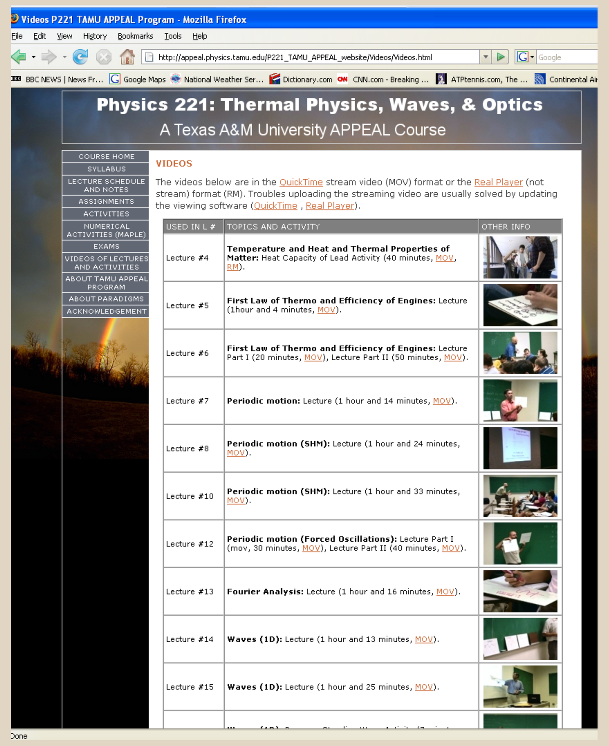
Student feedback

- "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 new insight into the reality of being a physicist since physicists often collaborate on tackling new questions in their field."
- "….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."



Further resources
http://appeal.physics.tamu.edu/index.html





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