

**“The Science and Engineering
of
How Things Work”**

**An Attempt to Enhance Teacher
Preparation**

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Background Information

1. National Science Foundation's Collaborative for Excellence in Teacher Preparation (CETP)
2. Improve the science education of pre-service teachers.
3. In 1998, New Mexico was awarded a CETP grant.
4. Our proposal included:
 - Scholarship and Mentor Programs
 - Reform of existing classes
 - Development of new classes
 - Natural Science I, II
 - Physics
 - How Things Work (EE 110)

New Mexico Information

- 77% of the general public in New Mexico describe science and math as boring or hard.
- 60% of the elementary school teachers in New Mexico skip science sections because they don't feel comfortable teaching the material.

Goals of EE 110

Make it fun. Perhaps the most important goal of this class is to show the preservice teachers that SMET can be fun, exciting and dynamic. If just a small amount of this enthusiasm for SMET can be passed on to their future classes, it will go a long way in building everyone's appreciation for science and math.

Teach the student how to *learn* science. Education majors are required to take 12 credits of science. This is far too few hours to learn everything that is needed to be a good teacher of science even at the K-6 levels. However, if the preservice teacher can learn science on his/her own, she/he will be able to gain the expertise needed to teach a wide variety of SMET topics.

Build the student's scientific intuition. I have noticed that scientific intuition is a quantity that is highly correlated to how well a person does in science (SMET). Most of the time, a student's scientific intuition is adequate, but it has not been developed. By using experiments/exercises that incorporate everyday phenomena, a student's scientific intuition can be developed.

Teach the class the way you want SMET taught to kids. Education majors spend many credit hours learning how to teach SMET. Why not just teach education majors SMET the way you want them teaching it to their students?

Demonstrate the creative aspects of science. "Real" SMET is more than memorizing facts. There is a human side to SMET.

Engineering = design under constraints

Structure of EE 110

Hands-on learning There may be a debate on whether students learn physics, for example, better via a traditional lecture format or by the more modern *inquiry based method*. However, there is little debate over which one is more fun. All of the SMET principles in EE 110 are taught in a hands-on inquiry based method.

Integration of Lecture and Lab The lab and lecture for EE 110 are integrated. Often the class begins with 30-45 minutes of discussion followed by a lab portion. As questions arise during the lab, mini-discussion periods are integrated.

Modular design The subject matter of EE 110 is divided into modules where a specific problem is investigated in depth. The modular design allows for successful portions of the class to be continued and new modules to be added.

Science of the every-day All of the topics in EE 110 deal with every-day phenomena. This increases the student's *comfort level with the material* and provides a good starting point on which their scientific intuition may be strengthened.

Modules used during the Fall 2001 Semester

- Batteries:
 - Ohm's law and basic electricity; Concept of power
 - The chemistry of how batteries are made
 - Environmental issues
 - Economic issues
- Physics of the playground:
 - Rolling balls
 - Slides
 - Merry-go-round
 - Swing
- How to gamble:
 - Coins
 - Dice
 - Cards
 - Lotto
- Bridges:
 - Forces (review)
 - Tension
 - Compression
 - Construction principles

Challenges for This Type of Program

- Funding
- Assessment
- Engineering / Education interface
- Where does this fit into the goals of the department?
 - Teaching load
 - Publications
 - P & T
 - Recruitment
 - Class size

How's It Going

- A few problems at the start.....
- Entrance and exit surveys show that the students' attitudes towards science have improved and that they feel they have learned from the class.
- During the last two semesters between 10% and 15% of the education students have changed their area of specialization to math or science, which seems to support the findings of the survey.
- Noise problems (Learning can be loud.)