Undergraduate Research

General Story Outline:
- Sophomore Activities / Mama Wang’s suggestion
- REU at RPI 2003
- Summer URP 2004
- Dr. Cummings Grad School suggestions

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Sophomore year:
- Newly elected head Outreach Officer for SPS
- Re-enacted Outreach events with local middle schools, elementary schools, and junior museum
- Department is content, gives us more funding, begin more activities
- REU applications become available, Department opens two positions for physics education
- Dr. Wagner (ScIT Project)
- Dr. Wang (GLAD Techniques)

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REU 2003:

Project 1: Create Demonstrational movie for Undergraduates and Graduate Students about Mechanics of Patterned Helical Si Springs on Si Substrate.
Dr. Wang’s Research related to demonstration:
- Transport properties of metallic and magnetic films and nanotubes,
- Fabrication and growth mechanism of sculptured films.
- Growth/etching techniques include thermal evaporation, chemical vapor deposition, atomic layer deposition, oblique angle incidence deposition, and ion sputtering.

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PROJECT 2: Creation of curricular material for Science of Information Technology

The Science of Information Technology (ScIT) is a course at Rensselaer introducing students to the physics underlying IT. Overall goal was to expand the online curriculum to facilitate widespread use beyond the Rensselaer course.

My portion of the Project included some of the following physical principles:
- Conductivity
- The operation of transistors (p and n type semiconductors)
By summers’ end, I began work on the reflection, refraction, and optical fibers diagnostic analysis.

In an effort to improve the curricular material used for the RROF module, an MC diagnostic was created and pilot tested for 3 of the 4 years Dr. Wagner taught SciIT at RPI.

As an answer to some of our limitations using both MC diagnostic results and open ended responses (also apart of the diagnostic), face to face and electronic interviews were conducted as a way to refine our current diagnostic tools and gauge how different curricula affect students’ understanding.

Findings drawn from these interviews were used both to check whether the revised materials addressed students’ preconceptions and to re-develop the multiple-choice diagnostic tool.

Many of the original questions were fact-based rather than conceptual. Questions added on material not initially covered. Others re-worded to better probe students’ preconceptions.

Wait...hold on a sec...how did you assess students’ preconceptions?

The model was eventually divided into two separate categorization schemes: optical fiber understanding placed into five “stages”; Refraction and TIR placed in a web diagram.

Goal: correctly describe how optical fibers work.

Students responses grouped into five stages according to how close the optical fiber descriptions were to expert descriptions. The Figure also illustrates how students could move between stages during the clinical interviews.

Goal of student: correct explanation of TIR.

Students drawing from several sources to explain refraction

-Prisms  
- Illusions (like a “broken” pencil in water)  
-Disney optical toys

Interesting outcomes:

Those providing a mathematical description using Snell’s law were asked to provide an explanation “to someone who doesn’t know what a sine function is.”

Interviewees that could correctly explain TIR qualitatively and quantitatively started from the definition of the index of refraction as a ratio of speeds.
After finishing my second summer of research with Dr. Wagner, Dr. Cummings came for a visit and took us out for delicious pasta!

While chatting I asked her about the whole Grad school finding process…

‘Gee… I wonder how that went??’