OUTLINE

- Basics of both materials
- My motivation...
- Physics By Inquiry
  - Background
  - Content
  - Implementation
- The Tutorials in Introductory Physics
  - Background
  - Content
  - Implementation
- Results
DEVELOPMENT OF PHYSICS BY INQUIRY AND THE TUTORIALS

- Research-based
  - Individual interviews to identify conceptual and reasoning difficulties
  - Develop instructional strategies
  - Design, test, modify instructional materials
  - Iterate
- Ellicit, Confront, Resolve
- Taught using the Socratic method
  - Instructors ask questions rather than tell answers
- Physics By Inquiry initial development preceded development of Tutorials
  - In the end – same body of research used for both

MY MOTIVATION...

- Rank bulbs in order of brightness. Explain.
- Rank voltages across bulbs. Explain.
- Write an equation that relates voltages across bulbs 3, 5, and 6 to the battery voltage.
- Remove bulb 1. How does...
  - Brightness of bulb 2 change?
  - Brightness of bulb 6 change?
  - Brightness of bulb 3 change?
PHYSICS BY INQUIRY – BACKGROUND

- Stand-alone curriculum
- “... students gain direct experience with the process of science.”
- Hands-on activities

PHYSICS BY INQUIRY – CONTENT

- Properties of Matter
- Heat and Temperature
- Light and Color
- Magnets
- Astronomy By Sight (x 2)
- Electric Circuits
- Electromagnets
- Light and Optics
- Kinematics
PBI– IMPLEMENTATION (MSU)

- Pre-service Elementary Ed. Majors (typically freshman or sophomore)
- 3 – 2 hr class periods/week
- 4 content modules/semester
  - Each covered for ~25% of semester
  - None covered completely
- ~ 20 students/class
- 1 GTA and 1-2 peer instructors
- Training meetings: 2/week (only 1 would be needed if all instructors experienced)
  - Worked through materials for that week – under guidance of experienced instructor.

PBI – IMPLEMENTATION (MSU)

- Typical class:
  - Announcements
  - Any necessary “lecturing”
  - Students work in groups
  - TA’s wander around – try to give each group equal time. Assist as needed.
PHYSICS BY INQUIRY – SAMPLE

To this point ...
- Part A, Section 1:
  - Lighting a bulb given a battery, bulb, and wire
  - Conductors vs. Insulators
  - Circuit diagrams

PHYSICS BY INQUIRY – WHERE NEXT?

- Part A, Section 3 – Further development of current model
- Part A, Section 4 – Series and parallel networks (voltage model)
- Part B: Measurements of current and resistance (Kirchoff’s 1st law, equivalent resistance)
- Part C: Measurement of voltage (multiple batteries, Kirchoff’s 2nd law, series and parallel decomposition, Ohm’s law)
- Part D: Batteries and bulbs in everyday life (real batteries, energy and power)
AT THE END OF SECTION 3...

- Predict the relative brightness of the three bulbs.
- What happens to the brightness of bulbs A and B if bulb C is unscrewed?

TUTORIALS—BACKGROUND

- Supplemental to traditional lecture
- Pre- or Post-Instruction
- Pre-test, tutorial, homework, post-test
- Students gain conceptual understanding
- Typically are not hands-on
TUTORIALS – CONTENT

- Kinematics
- Newton’s Laws
- Energy and Momentum
- Rotation
- Electrostatics
- Electric Circuits
- Magnetism
- Electromagnetism
- Waves
- Optics – Geometric and Physical

TUTORIALS – IMPLEMENTATION (MSU)

- Take place of lab for Algebra-based introductory sequence
- ~20 students/class
- 1 GTA and 1-2 peer instructors/class
- Training meetings: 1/week
  - Worked through both the tutorial and tutorial HW under guidance of course instructor
- Meet for 2hrs/week
TUTORIALS – IMPLEMENTATION (MSU)

- Typical class
  - Announcements
  - Any “lecturing”
  - Students work in groups
  - TA’s wander around – try to give each group equal time. Assist as needed.

TUTORIALS -- SAMPLE

To this point ...
- This is the 1st tutorial on circuits.
- Possibly preceded by lecture on circuits.
- Most likely have had lectures, traditional homework, tutorials and tutorial homework on electrostatics
TUTORIALS – WHERE NEXT?

- Tutorial HW – ranking tasks, current through circuit elements
- Electric Circuits 2 – resolving issues with combination parallel and series circuits
  - Development of voltage model
- Tutorial HW – ranking tasks, potential differences across circuit elements
  - Example from beginning of the presentation.
- Additional tutorial and homework on RC circuits

USEFUL REFERENCES