

# Transfer of Learning In Medical Image Reconstruction: Group Teaching Interviews

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# Modern Miracle Medical Machines Goals

- Conduct research on students' models in the realm of medicine-related physics
- Develop active engagement instructional materials to help students learn applications of modern physics to contemporary medicine

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# Context of Our Previous Research

1. Clinical interviews – eliciting students' models about X-rays and medical imaging
2. Teaching interviews – mock instruction sessions<sup>1</sup> – with one student each time
3. **Group Teaching Interviews – with 2-3 students – to look at the social interaction component of transfer**

<sup>1</sup>Engelhardt *et.al* (2003)

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# Cyclic Framework

Students investigate the phenomena before a formal introduction of the concept

- **Learning cycle**
  - exploration, concept introduction, application<sup>1</sup>
- **Modeling cycle**
  - model development, model deployment<sup>2</sup>

<sup>1</sup>Karplus (1974)

<sup>2</sup>Wells, Hestenes & Swackhamer (1994)

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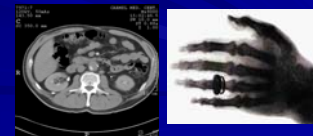
# Interviewed Students

- 8 groups (20 students) so far
  - 4 groups of Algebra-Based Physics students (2+2+3+3)
  - 4 groups of senior health-related majors (2+2+3+3)

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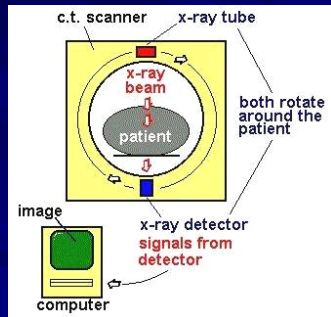
# Teaching Interview – Part I

- Discussion Around Pictures
  - Nature of X-rays, imaging properties
  - Personal experience
  - Comparison with other techniques
  - Focusing on comparing X-rays and CAT scans
    - limits of information
    - frontal pictures versus slices
    - 2D versus 3D



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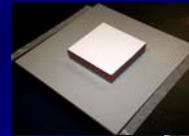
## CAT is an X-rays-based technique



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## Interview – Part II

- Playing the role of a Lego physician
  - What is inside?
- What kind of equipment do we need?



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## Interview – Part II

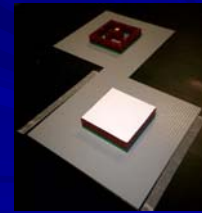
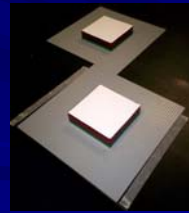
- Analog of X-rays?
- What can you get from one-side measurements?
- What else can we do?



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## Comparison Between Boxes

- How the open box can help us?

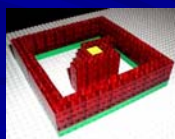
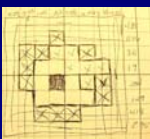


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## Opening the Box

What could have been done better and what couldn't?

- not focused light... reflections... neighboring layers are absorbing light even if they are not in the direct path of it... don't know whether it would have mattered if we have done it from all 4 sides



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## Stage II Pre-Activity Comparison Discussion (focused on WHAT they see)



"Bone structure... cannot get any real decent tissue information... we cannot really see muscles, how ligaments are attached... obviously X-ray images involving skeletal structure of the body..."

"Here you see bone, you see organ tissue, skin tissue, kind of everything..."

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## Stage II Post Activity Comparison Discussion (focused on HOW they see it)



"We can see how organs interact or are arranged according to each other... here we cannot tell for one of the fingers if it's pushed back or something... normally you really can't tell..."



"Unless you get a different picture from that side... here you definitely get more information... different kind of information..."

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## Results - I

- Students trigger and reinforce each other's transfer process:

I: "How these (sonograms) are different from these (X-rays and other EM waves)?"

B: "I don't know."

A: "Sonograms are longitudinal... vibrational, while EM are transverse and not vibrational..."

B: "Oh... sound needs a medium to go through and EM doesn't, EM waves have perpendicular electrical and magnetic components..."

I: "And what about sound waves? What do they have?"

A: "I don't know... nothing like these... just waves"

B: "They are moving back and forth."

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## Results - II

- Constructing the X-ray model for students required much less input, cueing and scaffolding from the interviewer:

I: "Are X-ray wavelengths shorter or longer than the wavelengths of visible light?"

A: "Longer"

B: "No, they are shorter... Frequency is higher"

- A peer instruction<sup>1</sup> teaching module based on the interview protocol and the proposed lab activity looks like a promising idea

<sup>1</sup>Mazur (1997)

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# Thank you!

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