

# Diagnostic Testing

David E. Meltzer  
University of Washington

# Goal:

## Assess Student Understanding

- Among important goals of physics instruction is for students to learn fundamental concepts
- Understanding can be expressed by solving problems in unfamiliar situations, in varied contexts, and using diverse representations

# Limitations of Traditional Quantitative Problems

- ***Research finding:*** students *may* be able to solve standard quantitative problems even with weak understanding of fundamental concepts
- Practicalities and logistics of traditional testing make it difficult to deeply probe student understanding

# Deeper Probes of Student Understanding (Used by Researchers)

- One-on-one “speak-out-loud” problem-solving interviews
- Written questions that require detailed explanations of reasoning and problem-solving method
- Questions that emphasize non-quantitative reasoning
  - use of words, graphs, diagrams; helps minimize “plug-and-chug”

# Research-based Diagnostics

- Informed by insights from research into student understanding
  - acknowledge key learning difficulties
- Emphasize non-quantitative reasoning
- Designed to reveal common student learning difficulties and confusions
- Validated through other research methods (e.g., interviews)

# Types of Diagnostics

- Free-response
  - 1-4 questions focused on single concept
  - Require explanations of students' reasoning
  - **Examples:** University of Washington Assessment Packet
- Multiple-choice
  - 20-50 questions addressing diverse but related concepts
  - **Examples:** Force Concept Inventory (FCI); Force and Motion Conceptual Evaluation (FMCE); Conceptual Survey on Electricity and Magnetism (CSEM)

# Score Assessment Tools

- Comparison to published baseline data, pre- and post-instruction, in diverse instructional contexts
- Computation of “normalized gain,”  $g =$  (gain from pretest to posttest) divided by (maximum possible gain)
  - Research shows  $g \approx 0.25$  (or less) in most traditional physics courses

## *Caution:*

### Many Factors Affect Student Performance

- Student preparation, motivation, and background can impact significantly their performance on diagnostic tests
- School and teacher resources, faculty workload, degree of familiarity with curricular materials, etc., can impact significantly student performance

➤ *All diagnostics must be assessed in context!*