Are We There Yet ?

Assessing Our Reforms

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Reform Conference

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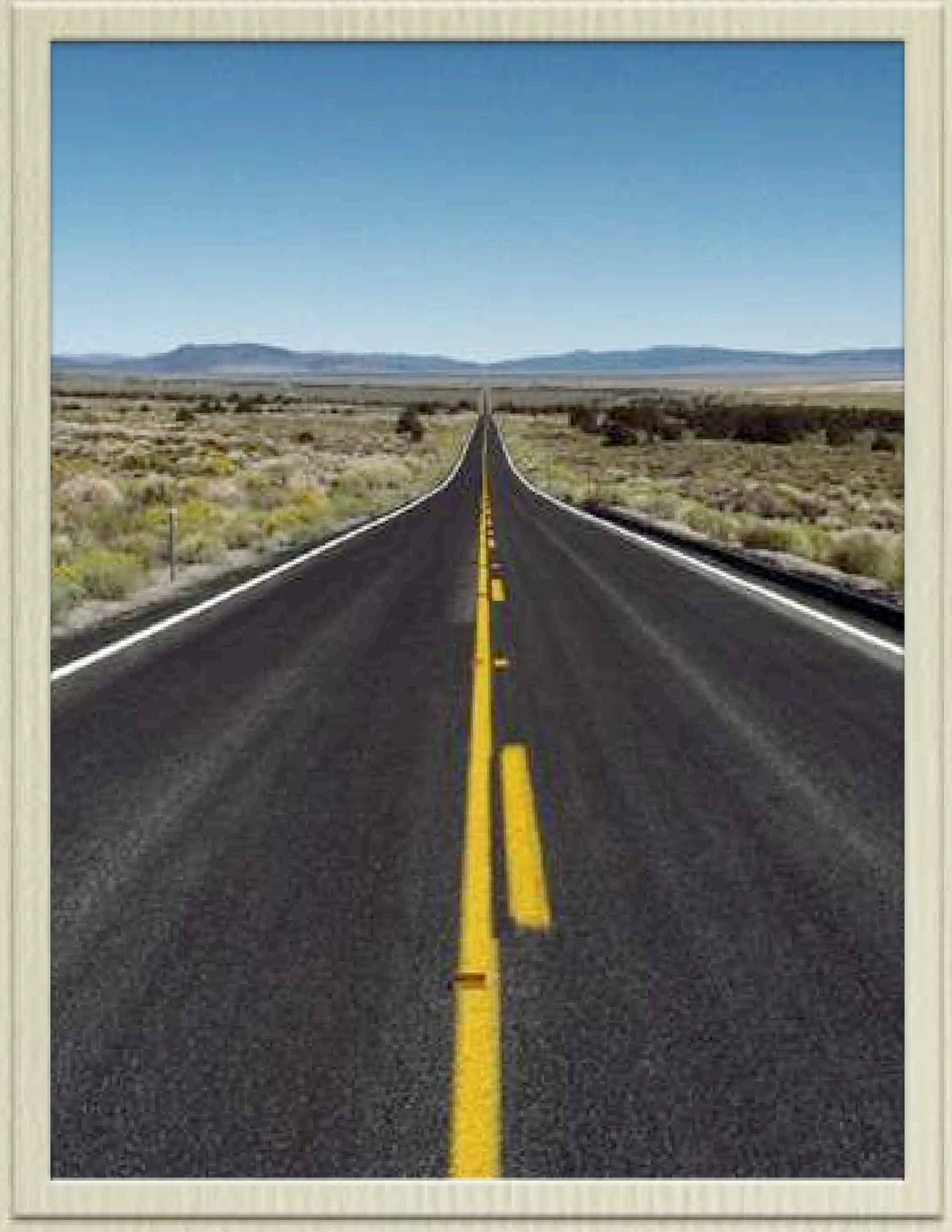
NC STATE UNIVERSITY
Physics Education R & D Group



What is Assessment ?

- Assessment is a two-way street
  - Feedback loop for faculty/students
- Assessment is a journey
  - We never “arrive”
  - There’s more than one route
  - It “drives” student learning
- Assessment is a road to scholarship

Types of Assessment

- Formative vs. Summative
- Quantitative vs. Qualitative
- Program vs. Course vs. Topic

Types of Assessment

Have we gone off the road ?

Did we arrive at our destination ?

- Formative vs. Summative
- Quantitative vs. Qualitative
- Program vs. Course vs. Topic

Types of Assessment

- Formative vs. Summative
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- Program vs. Course vs. Topic

High Generalizability
Low Resolution

High Resolution
Low Generalizability

Types of Assessment

- Formative vs. Summative
- Quantitative vs. Qualitative
- Program vs. Course vs. Topic

Grain size: what is your purpose?

Methods

- Pre/post Testing
- Student Evaluation of Instruction
- Comparisons to Others
- Longitudinal Studies
- Portfolios
- Interviews & Focus Groups

Quantitative

Qualitative

Methods

- Pre/post Testing
- Student Evaluations
- Comparisons to Others
- Longitudinal Studies
- Portfolios
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Quantitative

Qualitative

Outcomes

- The methods you use are determined by your reasons for conducting an assessment
- You have to be able to measure something

COURSE GOALS FOR THE SCALE-UP CURRICULUM

Measurable learning objectives of what students should achieve after one year of SCALE-UP introductory physics

I. Students should develop a good functional understanding of physics.

II. Students should begin developing expert-like problem solving skills.

III. Students should develop laboratory skills.

IV. Students should develop technology skills.

VI. Students should develop attitudes that are favorable for learning physics.

COURSE GOALS FOR THE SCALE-UP CURRICULUM

I. Students should develop a good functional understanding of physics. They should be able to:

A. describe and explain physics concepts including knowing where and when they apply

B. apply physics concepts when solving problems and examining physical phenomena

C. apply concepts in new contexts (transfer)

D. translate between multiple-representations of the same concept (for example: between words, equations, graphs, and diagrams)

E. combine concepts when analyzing a situation.

F. evaluate explanations of physical phenomena

II. Students should begin developing expert-like problem solving skills. They should be able to:

A. satisfactorily solve standard textbook problems

B. apply all or part(s) of the GOAL expert problem-solving protocol in any context

C. solve more challenging problems, including:

1. context-rich (“Real World“) problems
2. estimation problems
3. multi-step problems
4. multi-concept problems
5. problems requiring qualitative reasoning

D. evaluate other people’s written solutions and solution plans

COURSE GOALS FOR THE SCALE-UP CURRICULUM

III. Students should develop **laboratory skills**. They should be able to:

A. interact (set up, calibrate, set zero, determine uncertainty, etc.) with an apparatus and **make measurements**

B. **explain the underlying physical principles** of the operation of the apparatus, measurements, physical situation being studied and analysis of data

C. **design, execute, analyze,** and **explain** a scientific experiment to test a hypothesis

D. **evaluate** someone else's experimental design

COURSE GOALS FOR THE SCALE-UP CURRICULUM

IV. Students should develop technology skills. They should be able to:

A. use simulations to develop mathematical models of physical situations

B. utilize a spreadsheet to graph and do curve fitting

C. find information on the web

D. use microcomputer, video, and web-based software and hardware for data collection and analysis

COURSE GOALS FOR THE SCALE-UP CURRICULUM

VI. Students should develop attitudes that are favorable for learning physics. They should:

A. recognize that understanding physics means seeing the underlying concepts and principles instead of focusing on knowing and using equations

B. see physics as a coherent framework of ideas that can be used to understand many different physical situations

C. see what they are learning in the classroom as useful and strongly connected to the real world

D. be cognizant of the scientific process/approach and how to apply it

E. indicate a willingness to continue learning about physics and its applications

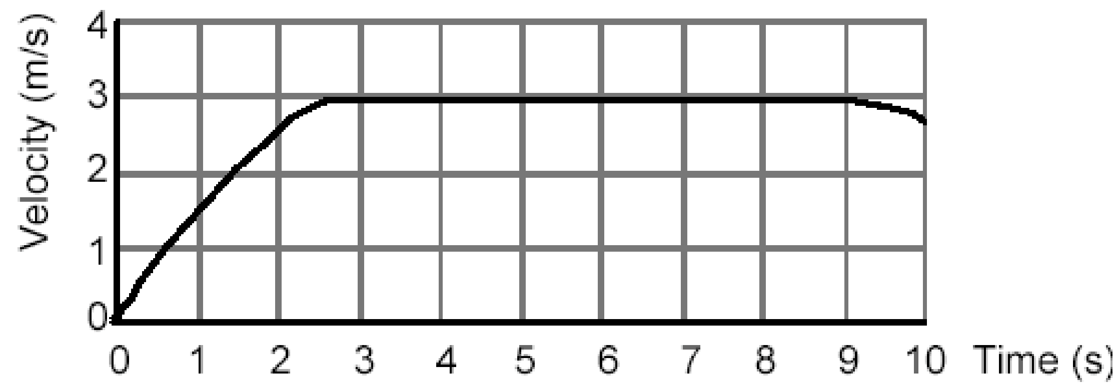
F. see themselves as part of a classroom community of learners

Conceptual Tests

- Lots of tests available
- Generally well thought-out and evaluated
- Can normalize across different institutions
- Often deceptively "easy" for us

Test of Understanding Graphs-Kinematics

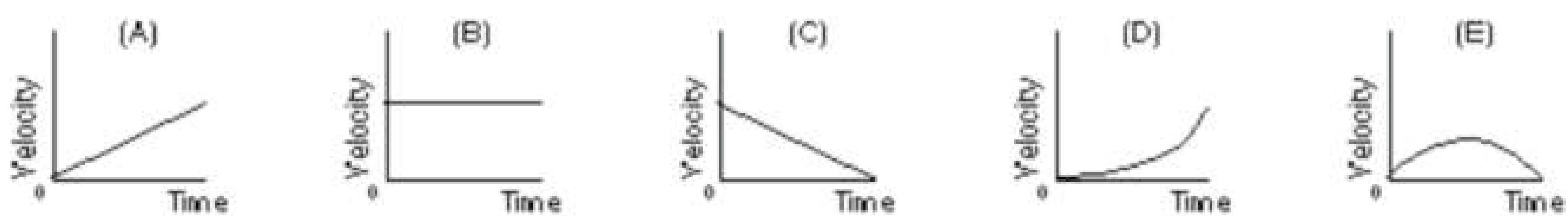
20. An object moves according to the graph below:



How far does it move during the interval from t = 4 s to t = 8 s?

(A) 0.75 m (B) 3.0 m (C) 4.0 m (D) 8.0 m (E) 12.0 m

1. Velocity versus time graphs for five objects are shown below. All axes have the same scale. Which object had the greatest change in position during the interval?



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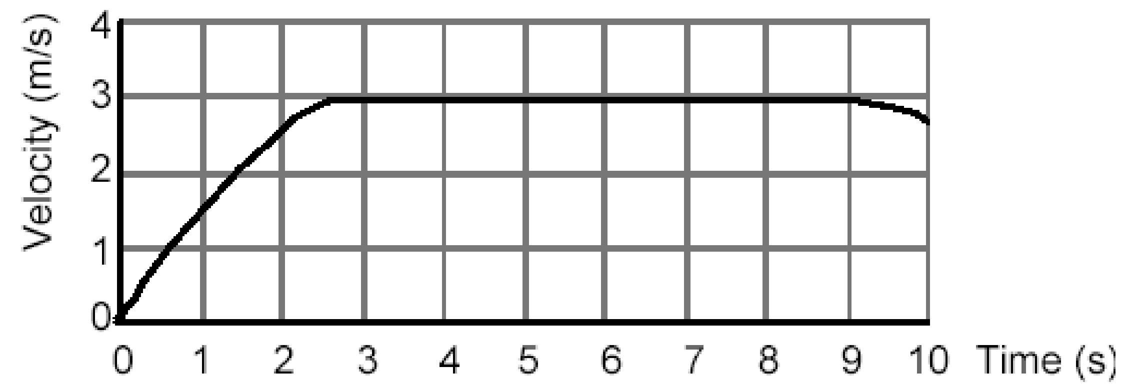

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73 %

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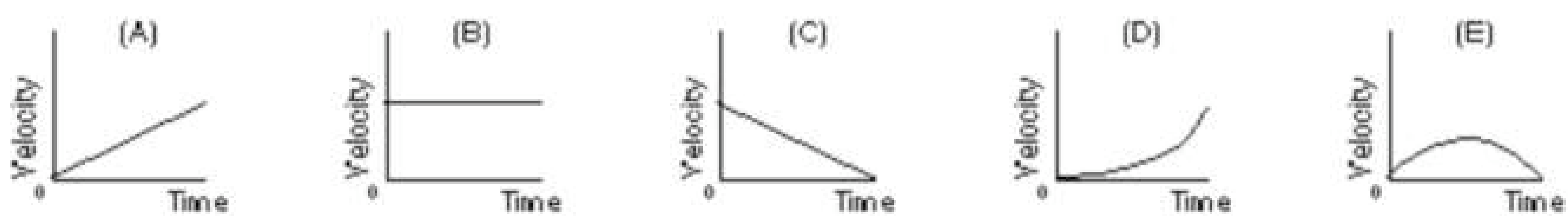

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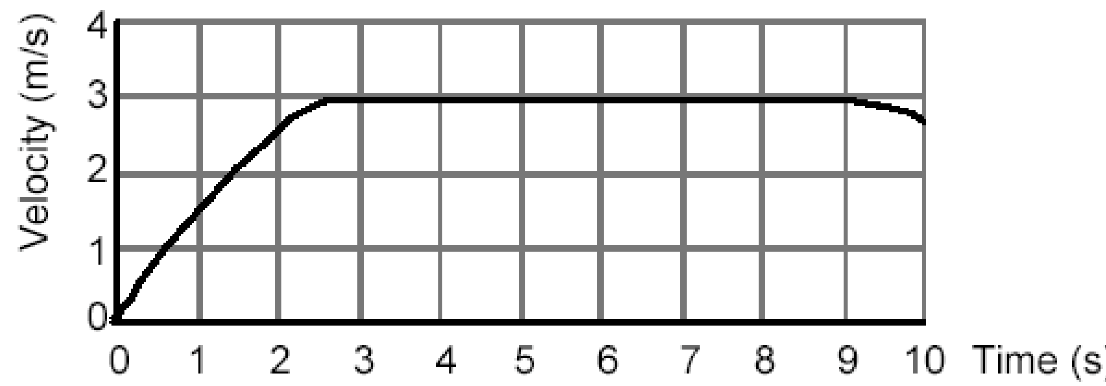

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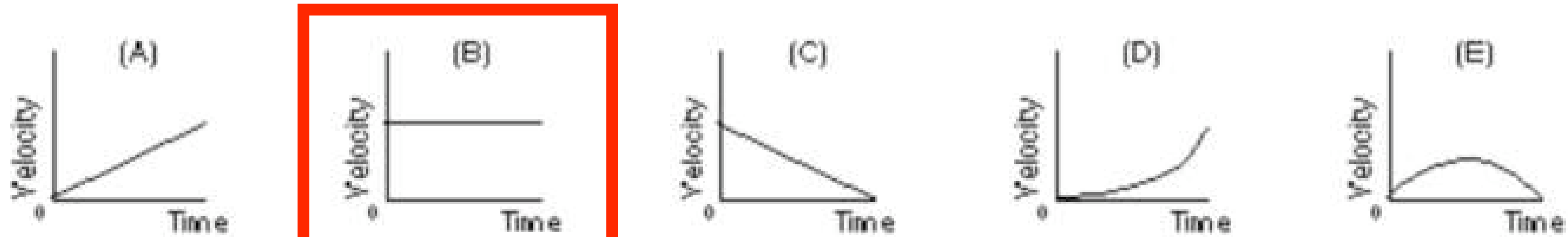


10 %

www.ncsu.edu/per/TestInfo.html

FCI Halloun, Hake, Mosca, & Hestenes' ***Force*** *Concept Inventory*
FMCE Thornton & Sokoloff's *Force & Motion Conceptual Evaluation*
MBT Hestenes and Well's *Mechanics Baseline Test*
ECS Singh's ***Energy*** *Concepts Survey*

BEMA Chabay & Sherwood's *Brief* ***Electricity & Magnetism*** *Assessment*
CSEM Maloney, et.al.'s *Conceptual Survey in Electricity and Magnetism*
DIRECT Engelhardt & B's *Determining & Interpreting Resistive Electrical Circuits Test*
ECCE Workshop Physics' *Electric Circuits Conceptual Evaluation*

HCTE Workshop Physics' ***Heat*** *& Temperature Conceptual Evaluation*

QMVI Robinett's ***Quantum Mechanics*** *Visualization Instrument*

TMUC Deardorff & Beichner's *Test of Measurement* ***Uncertainty*** *Concepts*
MMCE Workshop Physics' *Mathematical* ***Modeling*** *Conceptual Evaluation*
TUG-K Beichner's *Test of Understanding* ***Graphs*** *in Kinematics*

MPEX UMd's *Maryland Physics* ***Expectations*** *Survey*
VASS ASU's *Views About Science Survey*

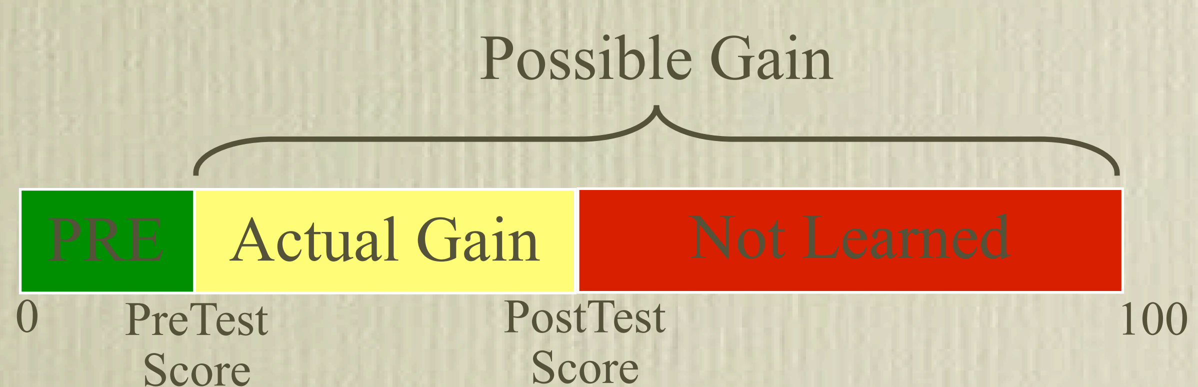
etc.

Conceptual Tests

- You want to compare classes, but how do you account for differences in students?
- Hake's "normalized gain"
  - Goal is 100% by all students
  - How much progress was made?

Traditional 23%
Interactive 48%

$$< g >= \frac{\text{actual gain}}{\text{possible gain}} = \frac{\text{posttest - pretest}}{\text{100 - pretest}}$$



Caveats

- Try small scale first, if you can.
- Higher level outcomes are harder to measure.
- Do you want to “reform to the test?”
- Assess program/course/topic, not students or instructor.
- Be open to unexpected findings.
- Don’t do a single type of assessment - triangulate.
- Assessment is never finished.

Caveats

- Be prepared for initially lower results & evaluations.
- Iteration is important. Trying and giving up is worse than not trying at all.
- If reforming service courses, review the ABET criteria.
- It's unsettling to change things - be prepared for discomfort. Seek out support and resources.

Resources

- Angelo, T., & Cross, P. (1993). *Classroom Assessment Techniques: A Handbook for College Teachers, 2nd ed.* San Francisco: Jossey-Bass.

- Brookhart, S. (1999), *The Art and Science of Classroom Assessment: The Missing Part of Pedagogy.* ASHE-ERIC Higher Education Report (Vol. 27, No. 1) Washington, DC: The George Washington University, Graduate School of Education and Human Development.

- Doran, R., Chan, F., & Tamir, P. (1998). *Science Educator's Guide to Assessment,* Arlington, VA: National Science Teachers Association.

- Stevens, F., et. al. (1993). *User-Friendly Handbook for Project Evaluation*, Arlington, VA: National Science Foundation. NSF 93-152.

Resources

- NCSU site <www.ncsu.edu/per/TestInfo.html>
- FLAG site <www.flaguide.org>
- WebAssign or similar system
- Campus-based help
  - University assessment teams
  - Education department
- Professional evaluators (but not too soon)
- Colleagues (start by writing objectives)


Enjoy the trip !