

Assessment:
A key aspect of teaching and learning

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Overview

- Overview of the logic & findings from *Knowing What Students Know (KWSK)*
- Give an example of an assessment system

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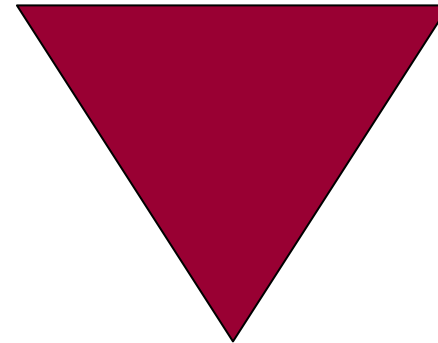
Knowing what Students Know

The Science
and Design
of Educational
Assessment

The Assessment Triangle

- cognition
 - model of how students represent knowledge & develop competence in the domain
- observations
 - tasks or situations that allow one to observe students' performance
- interpretation
 - method for making sense of the data

observations interpretation



cognition

*Must be
coordinated!*

The BEAR Assessment System

4 principles: 4 building blocks

Principle 1: Developmental Perspective

Building Block 1: Construct Map

- Developmental perspective
 - assessment system should be based on a developmental perspective of student learning
- Construct map
 - Visual metaphor for
 - how the students develop and
 - how their item responses change

Developmental Progress Variables from ChemQuery

- **Matter** is composed of atoms arranged in various ways: composition, structure, properties and amount of matter.
- **Change** is associated with rearrangements of atoms: type, progression and conservation in change.
- **Stability** is maintained unless change occurs with energy input: possibilities, influence and effort of stability.

Matter progress variable

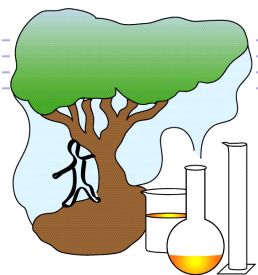
(read from bottom)

- 13-15. Generation:** Students use the models to generate new knowledge and to extend models. (~graduate school)
- 10-12. Construction:** Students integrate scientific understanding into full working models of the domain. (~upper division)
- 7-9. Formulation:** Students combine unirelational ideas, building more complex knowledge structures in the domain. (~lower division)
- 4-6. Recognition:** Students begin to recognize normative scientific ideas, attaching meaning to unirelational concepts. (~high school)
- 1-3. Notions:** Students bring real-world ideas, observation, logic and reasoning to explore scientific problem-solving. (~middle-school)

Principle 2: Match between instruction and assessment

Building Block 2: Items design

- Instruction & assessment match
 - there must be a match between what is taught and what is assessed
- Items design
 - a set of principles that allows one to observe the students under a set of standard conditions that span the intended range of the item contexts



ChemQuery

Items Design

20. There are two sealed flasks. Flask A is labeled C_2H_6 . Flask B is labeled NH_3 .

- a. It is not possible to prepare a flask containing N_2H_6 . Explain why.

Principle 3: Management by teachers

Building Block 3: Outcome space

- Management by teachers
 - that teachers must be the managers of the system, and hence must have the tools to use it efficiently and use the assessment data effectively and appropriately
- Outcome space
 - Categories of student responses must make sense to teachers

Outcome Space

- Notions 2.
 - **Facet 6:** Not enough nitrogen when made from NH_3
 - **E.g.:** "It is not possible to prepare a flask containing N_2H_6 because flask B only has one nitrogen. ”
 - **Analysis:** Using macroscopic reasoning or logic to generate an explanation.

Outcome Space

- Recognition 4.
 - **Facet 17:** Valence electrons, octet rule or Lewis dot, with inaccuracies
 - **E.g.:** "to many hydrogens the electrons dont match"
 - **Analysis:** These answers correctly draw on ideas of valence electrons and/or charge to answer this question, but are incomplete or include major inaccuracies.

Principle 4: Evidence of quality

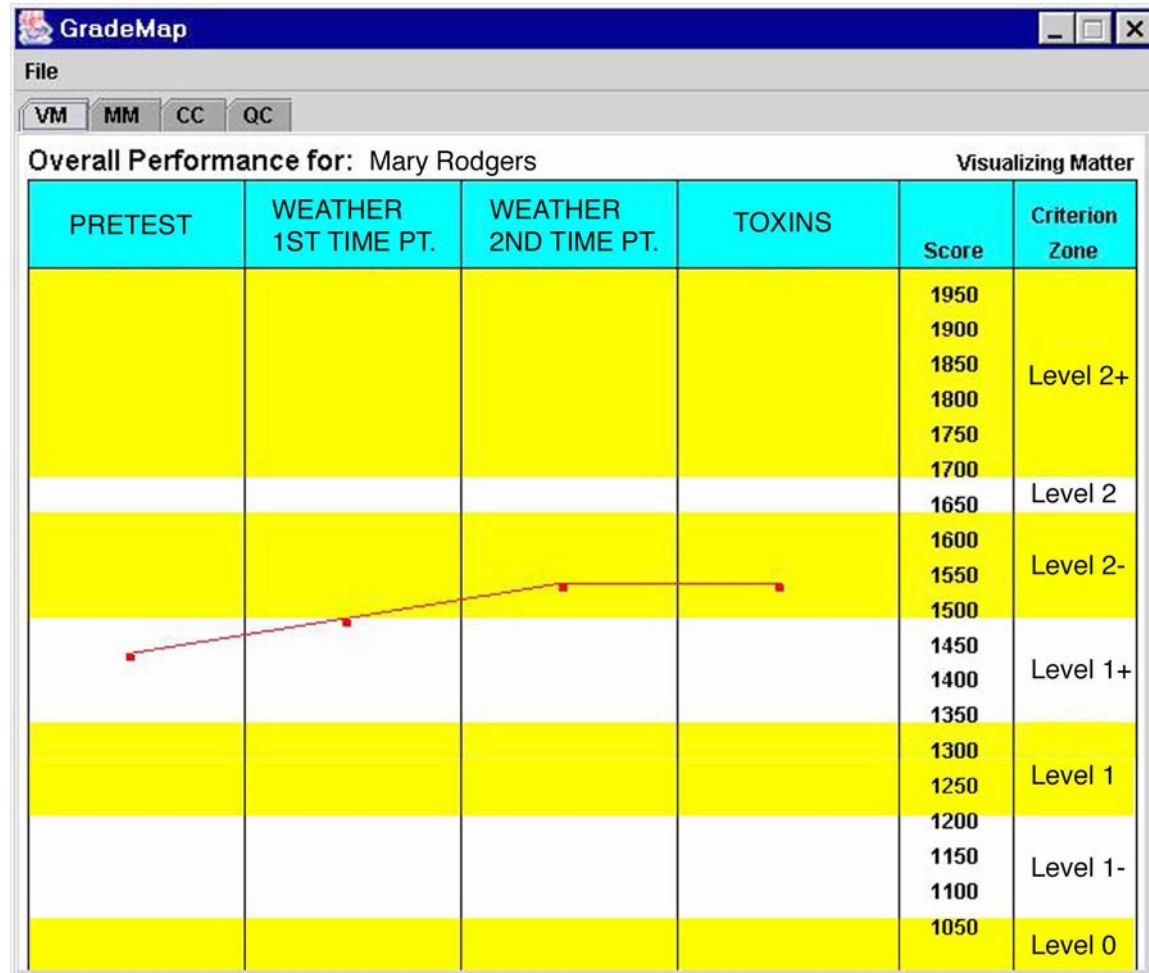
Building Block 4: Measurement model

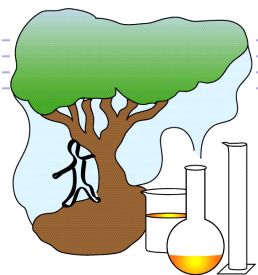
- Evidence of quality
 - reliability and validity evidence, evidence for fairness
- Measurement model
 - multidimensional item response models

Quality evidence: student profile

GradeMap				
File				
Name: Mary Rodgers				
	Visualizing Matter	Measuring Matter	Characterizing Change	Quantifying Change
2+				
2		*		
2-	*			
1+			*	
1				
1-				*
0				
To improve your performance you can:	Review periodic table trends, octet rule and phase changes. Be careful to answer questions completely and do not leave out key details.	You will often need to consider two or more aspects of the atomic model when you solve problems. Don't rely on just 1 idea.	Review phase changes and the kinetic view of gases. You need to know more about motions of atoms and molecules.	Keeping track of mass as it reacts or changes form is challenging. Consider the info you are given and be willing to take a best guess.

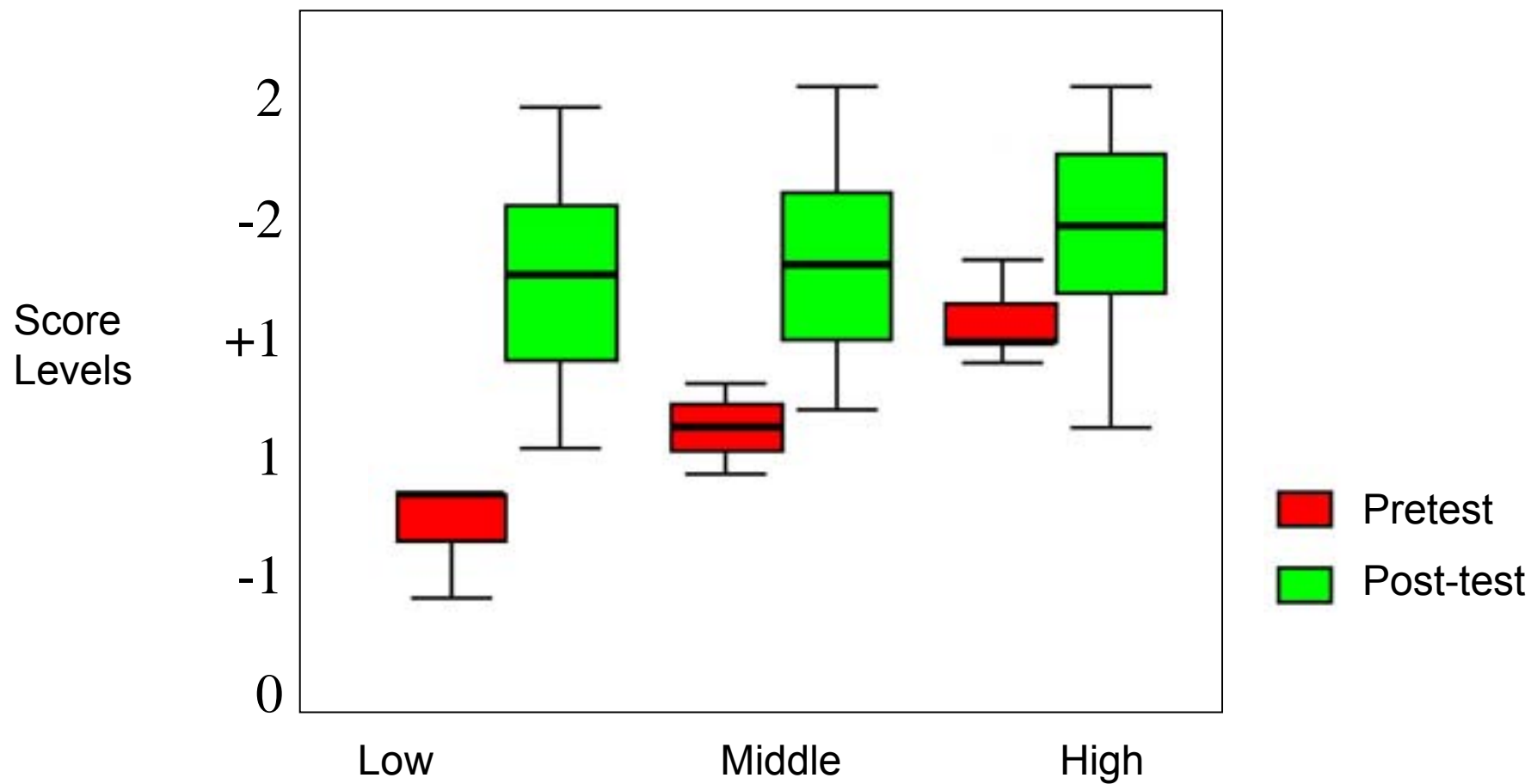
Quality evidence: track student over time



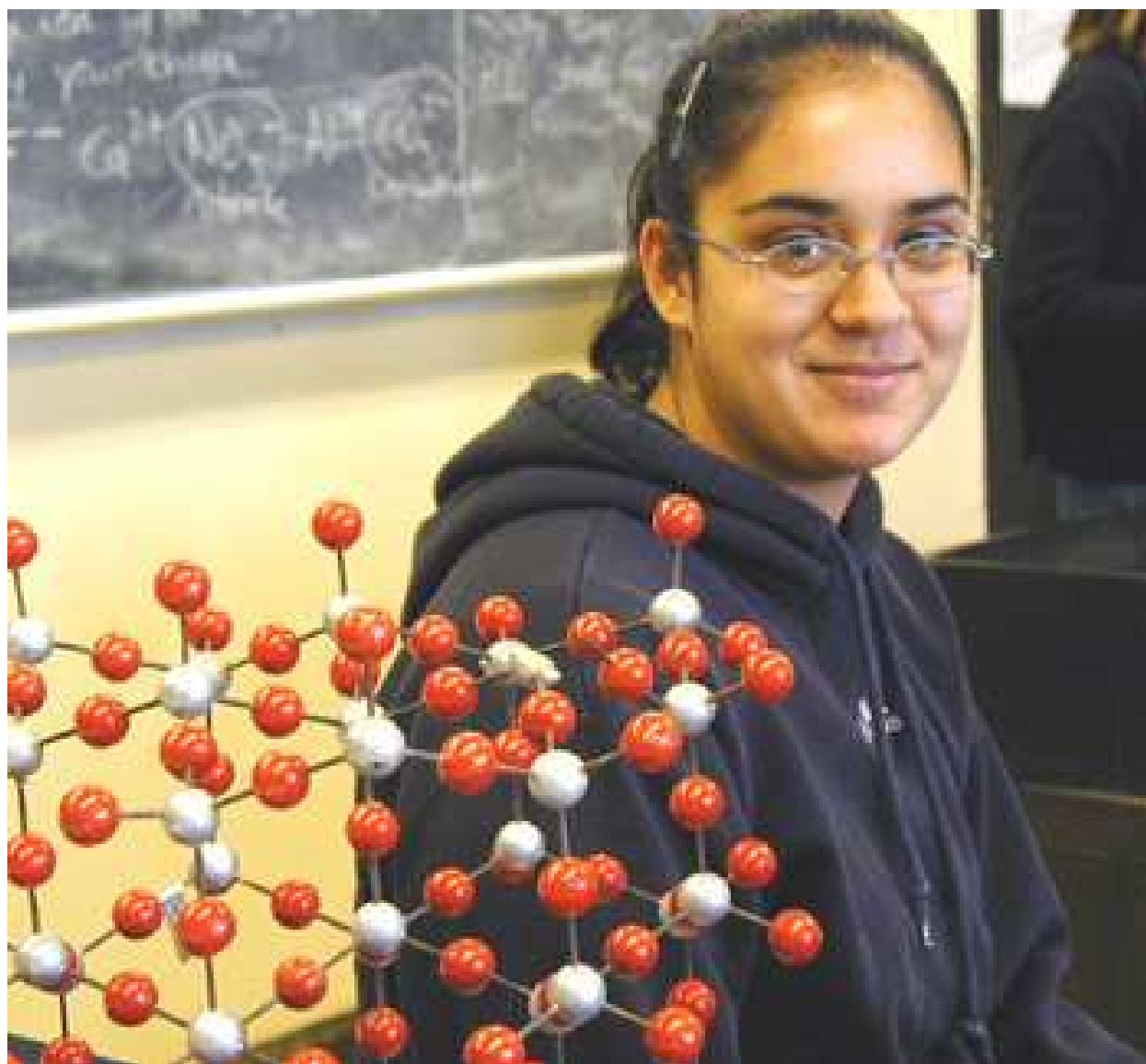


ChemQuery

Quality evidence:
To help ALL students increase understanding of chemistry



Fall 2000 Student Gains, Grouped by Pretest Score



To know what
they know.

And how to help.

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For More Information

- NRC's KWSK report:
 - <http://www.nap.edu/catalog/10019.html>
 - A summary with commentaries:
Measurement: Interdisciplinary Research and Perspectives (2003), whole Issue #2, Erlbaum.
<http://bearcenter.berkeley.edu/measurement/pubs/toc12.html>
- BEAR Assessment System:
 - Wilson, M. & Sloane, K. (2000). From principles to practice: An embedded assessment system. *Applied Measurement in Education*, 13(2), 181-208.
 - Wilson, M., & Scalise, K. (in press). Assessment to improve learning in higher education: The BEAR Assessment System. *Higher Education*.
 - See also: <http://bearcenter.berkeley.edu/>
- Living By Chemistry Project:
 - www.lhs.berkeley.edu/LBC