Rhode **I**sland **I**nformation **T**echnology **E**xperiences for **S**tudents and **T**eachers

Using Embedded Assessment for Increasing Student Motivation and Teacher Engagement

October 13, 2010

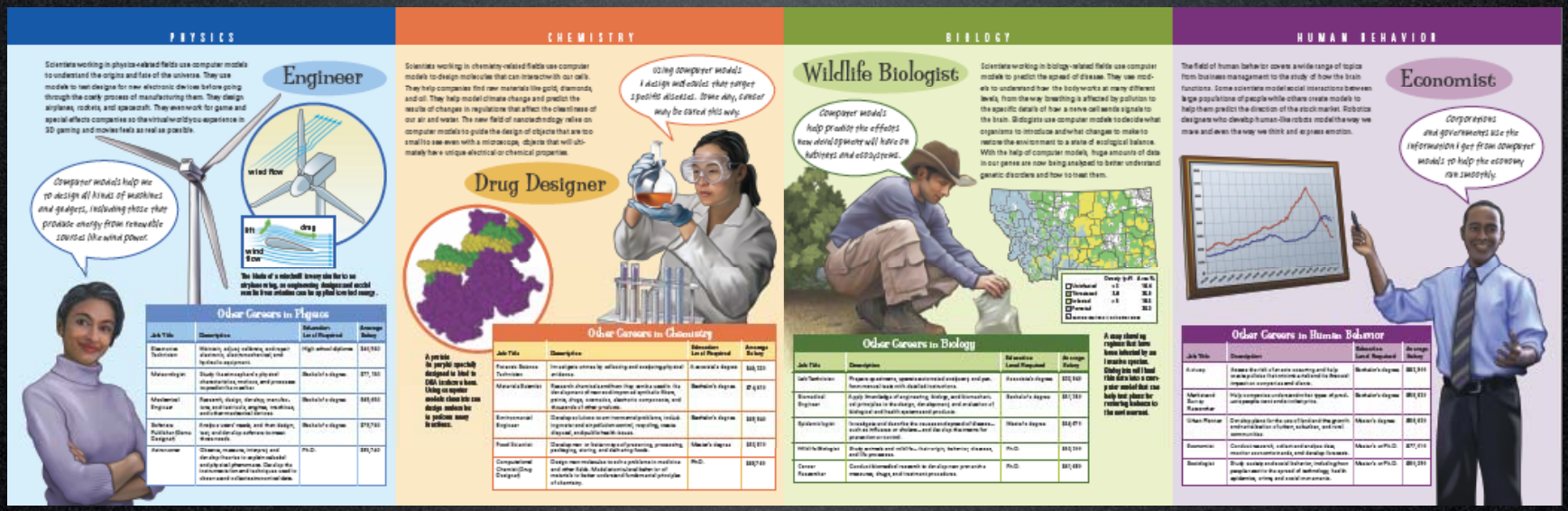
This project is supported by the National Science Foundation under Grant No. ESI-0737649.

TPD Goals

- Understand the science of atoms and molecules (SAM) and how it connects with current curriculum.
- Implement SAM learning activities in current curricula.
- Provide related IT career information.
- Utilize guided inquiry of SAM models in teaching.

RI-ITEST Goals

- Improve science content knowledge.
- Increase student awareness of related computer modeling careers.
- Bring together a more connected understanding of how the world of atoms and molecules links physics, chemistry, and biology.



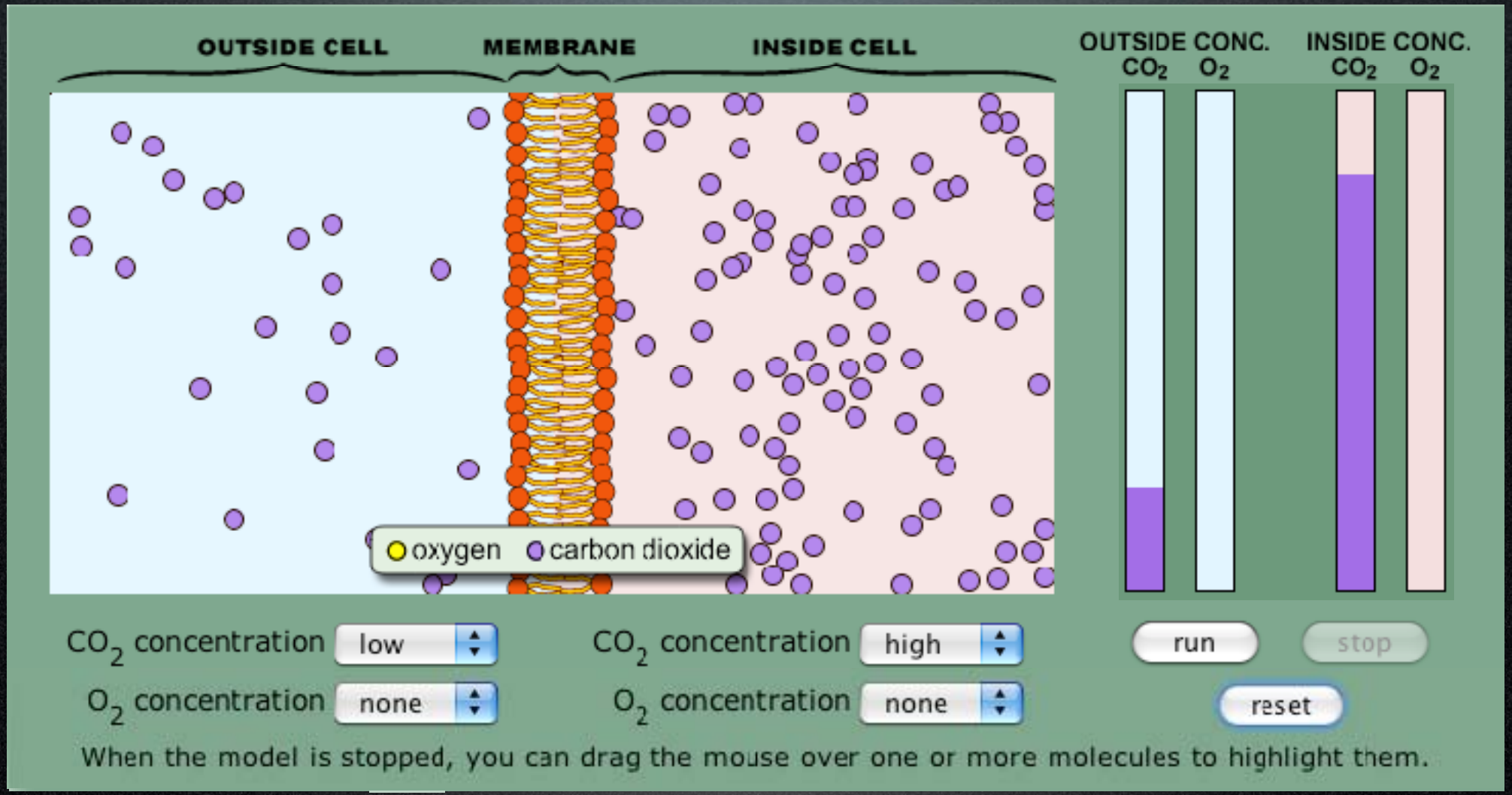
Inquiry Is Key

- Going deeper can simplify science.
  - Most scientific phenomena can be explained by fundamental ideas of energy, force, the atomic nature of matter, and equilibrium.
  - Science through this lens is more connected - less individual facts to “memorize.”
- Conceptual understanding is the goal.
- Utilize interactive models, to allow inquiry at the atomic level.
- Teachers are essential for inquiry approach to work.

SAM Activities

	Physics	Chemistry	Biology
Motion and Energy	Atoms and Energy	Phase Change	Diffusion, Osmosis, and Active Transport
	Heat and Temperature	Gas Laws	Cellular Respiration
Charge	Electrostatics	Intermolecular Attractions	Four Levels of Protein Structure
	Electricity	Molecular Geometry	Protein Partnering and Function
		Solubility	
Atoms and Molecules	Atomic Structure	Chemical Bonds	Lipids and Carbohydrates
	Newton's Laws at the Atomic Scale	Chemical Reactions and Stoichiometry	Nucleic Acids and Proteins
			DNA to Proteins
Light	Atoms, Excited States, and Photons	Chemical Reactions and Energy	Photosynthesis
	Spectroscopy		

Interactive Models



Embedded Assessments

What is true of the rate at which molecules move into and out of the cell at equilibrium?

- A. More move into the cell than out of it.
- B. More move out of the cell than into it.
- C. Equal amounts move into and out of the cell.
- D. They move randomly, so it is not predictable.

Check Answer

Embedded Assessments

"I like the Check Your Answer thing – it gives me reinforcement of my understanding of the concepts."

Embedded Assessments

Cells generally stay in equilibrium with their surroundings. What are two ways you know the cell has reached equilibrium?

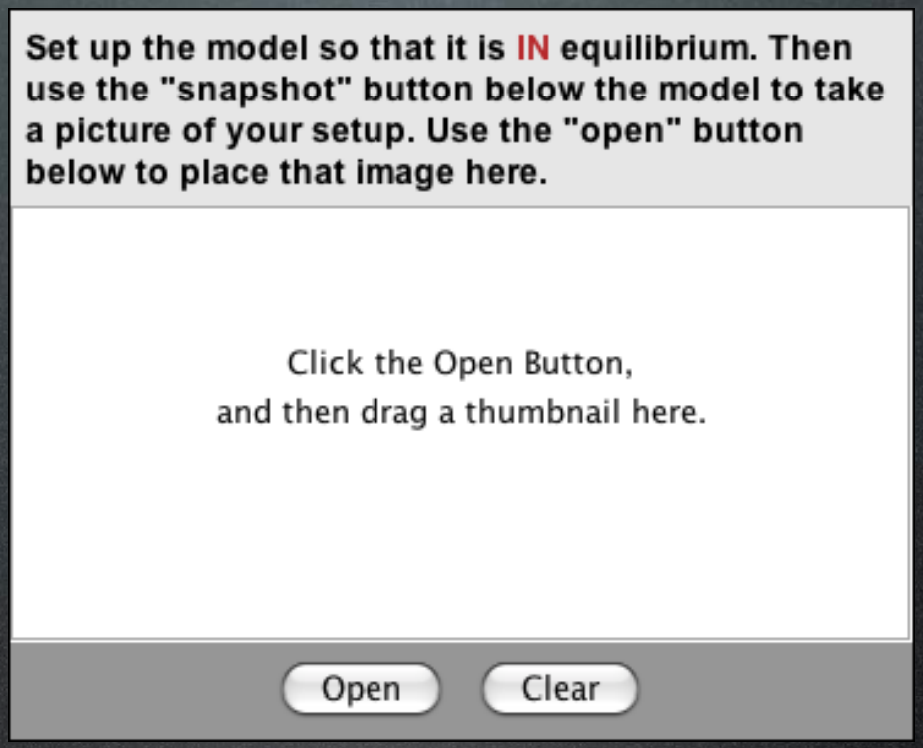
- [ ] A. Water stops flowing into and out of the cell.
- [ ] B. The concentrations inside and outside of the cell are the same.
- [ ] C. The osmotic pressure inside and outside of the cell is the same.
- [ ] D. The cell gets as small as it possibly can.

Check Answer

Embedded Assessments

Describe how the chemical energy in ATP is converted into electric potential energy. (hint)

Embedded Assessments



Embedded Assessments

"Students begging to do more units on the computer ... [and] ... writing more than they usually do in response to something they did only moments before.

Structure of Activity

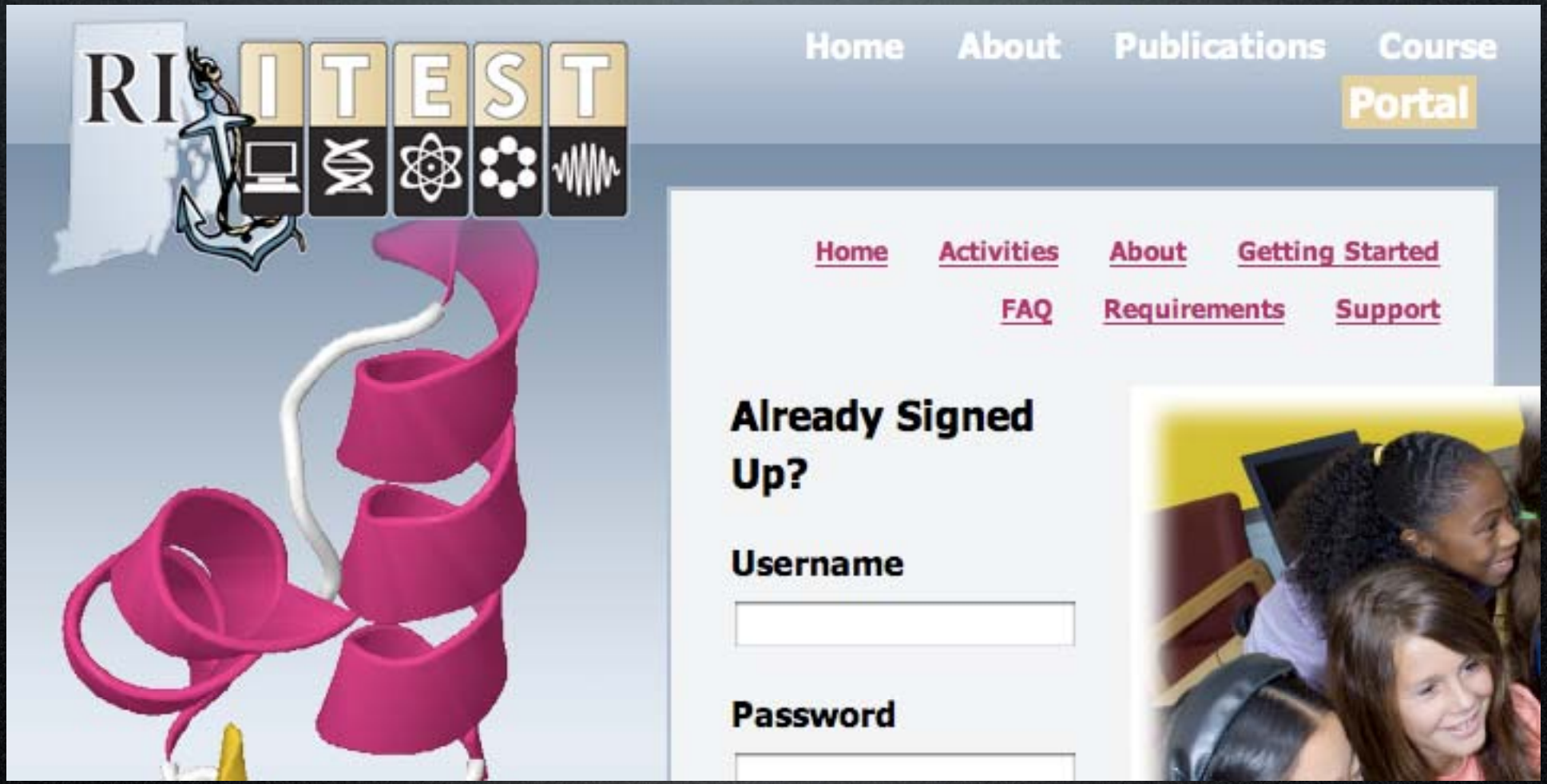
- Introduction
- Several pages of interactive models interspersed with embedded assessments of various types.
- Check answer option included in main body pages.
- Summary page with no check answer.

Constructing Activities

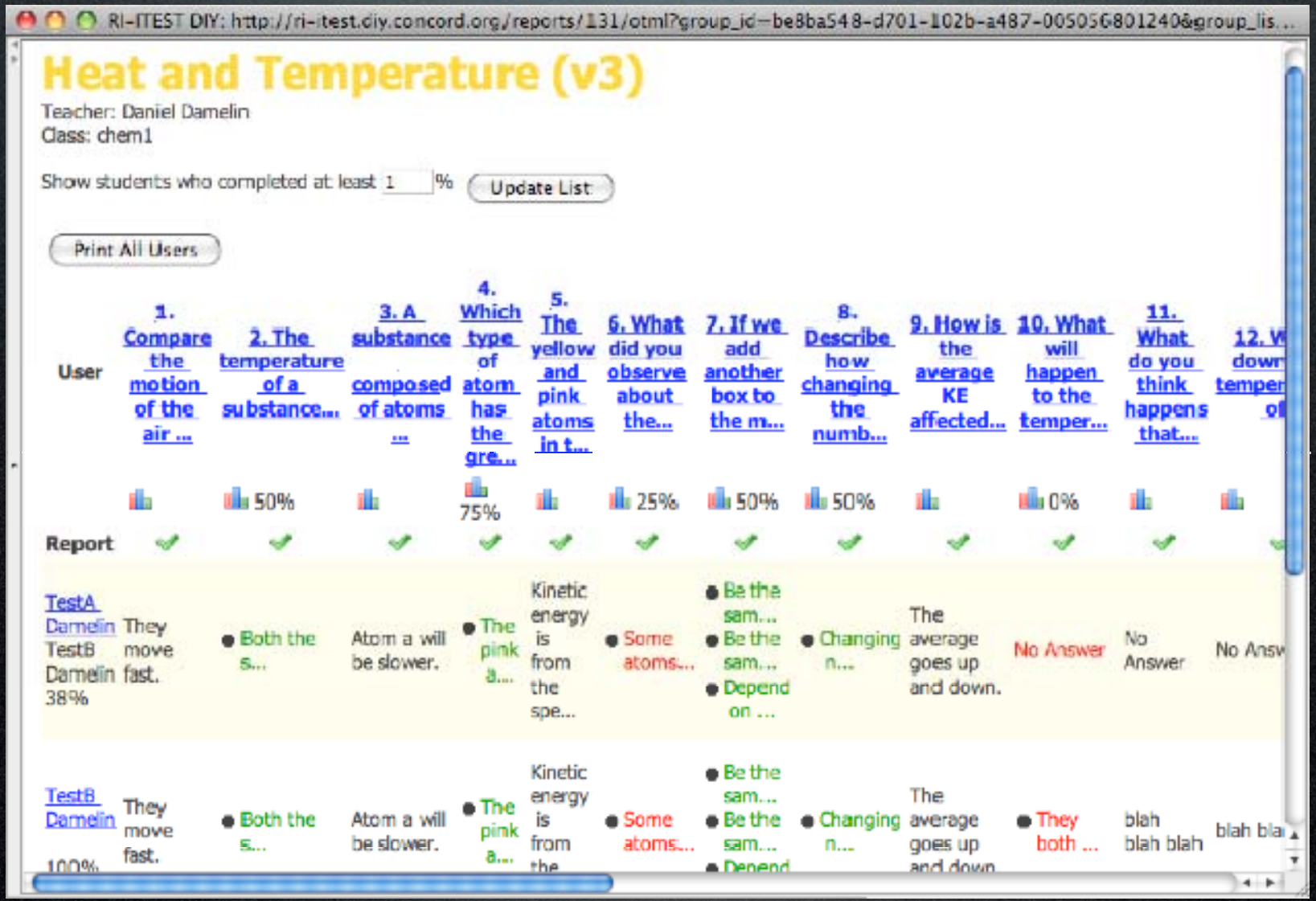
- Use Molecular Workbench
  - Flexible Tool
  - Allows for importing any Java applet
  - Can even be used just for surveys
- Transitioning to new portal/authoring system.

Materials Development

- Teacher/student portal and reporting.http://ri-itest.concord.org



Teacher Reports



Teacher Reports

RI-ITEST DIY: http://ri-itest.diy.concord.org/reports/131/otml?group_id=be8ba548-d701-102b-a487-0...

Heat and Temperature (v3)

TestC Damelin

Teacher: Daniel Damelin
Class: chem1
Other Group Members:

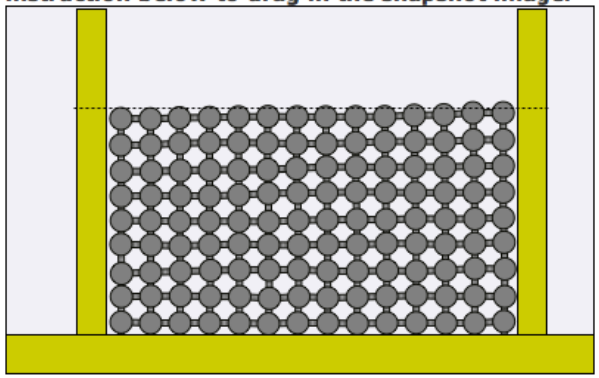
Print

1. Compare the motion of the air molecules at high and low temperatures.
They look the same to me.

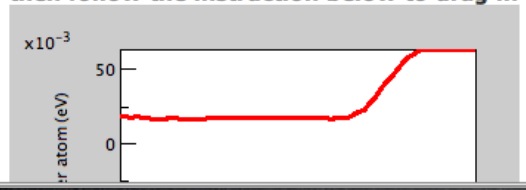
4. Which type of atom has the greater mass?

● The pink atoms.

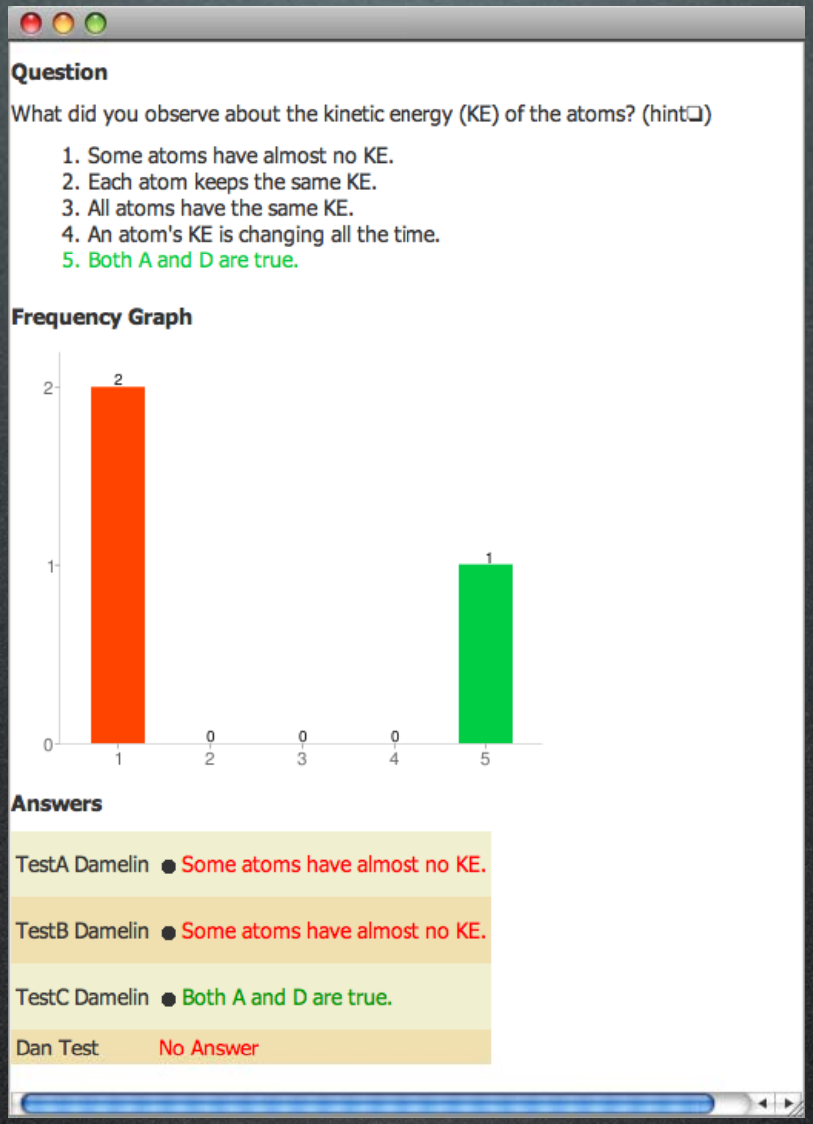
17. Take a snapshot of the model that shows thermal expansion, and then follow the instruction below to drag in the snapshot image.



18. Take a snapshot of the graph that shows the increasing of energy when heated, and then follow the instruction below to drag in the snapshot image.



Teacher Reports



Molecular Concept Inventory (MCI)

- Pre-post test of student and teacher knowledge.
- Students took subject specific test.
- Teachers took combination of student MCI tests.

Molecular Concept Inventory (MCI)

- Molecular concept tests covering Physics, Chemistry, and Biology

33. Imagine a cell that has a membrane through which potassium ions freely enter and leave. Suppose this cell contains a high concentration of potassium and is put in distilled water that has no potassium. Which is the BEST description of what will happen?

a) All of the potassium ions will leave the cell.

b) Potassium ions will move only from high concentration to low concentration.

c) Potassium ions will leave the cell until there is the same concentration of salt inside and outside the cell.

d) (correct answer) Potassium ions will reach a point when they will continuously enter and leave the cell at equal rates.

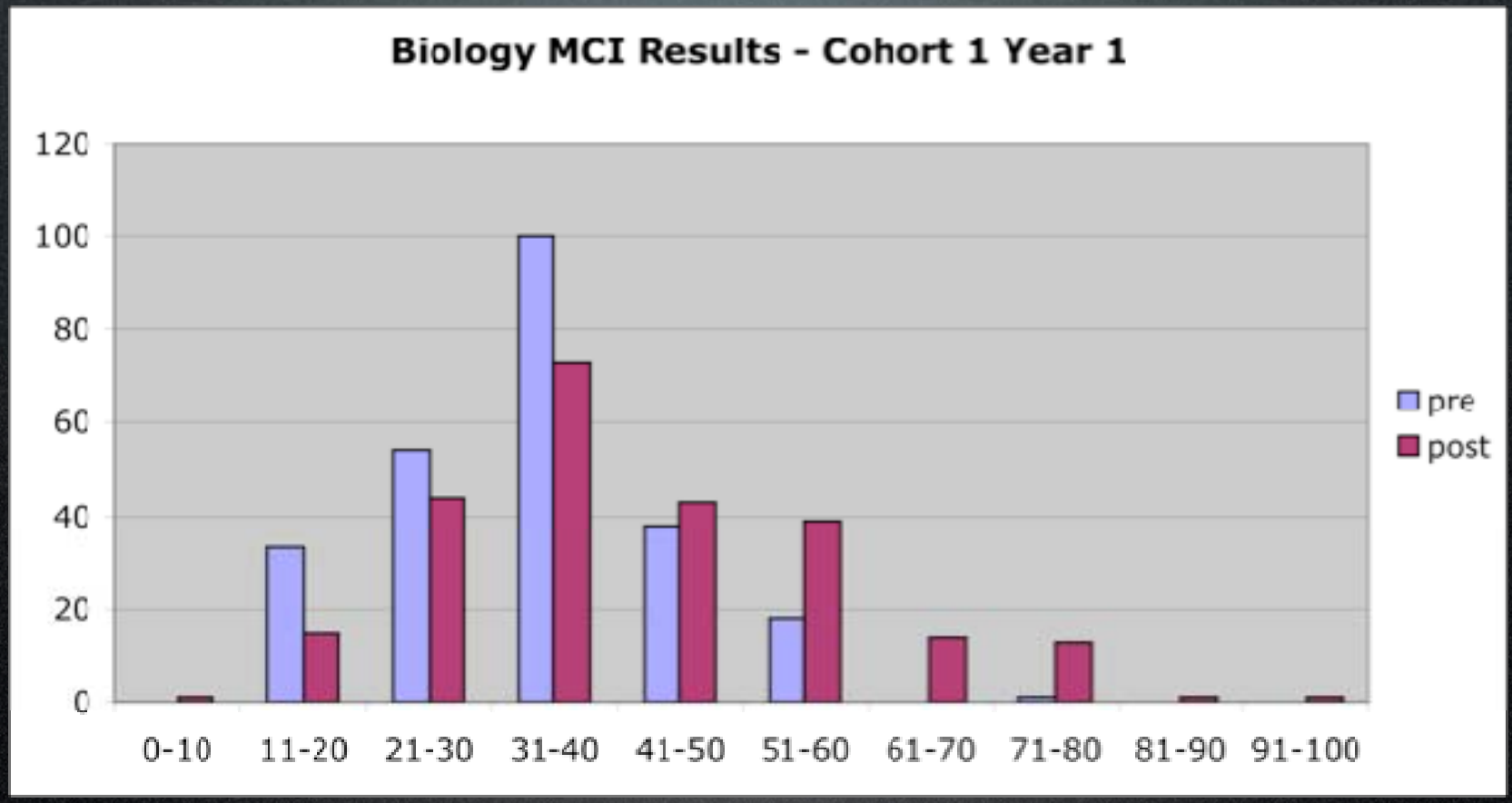
Research Findings
Some Stats

- Since project started 177 teachers registered in portal, with 11,368 students in those classes.
- Last year about 4,600 students ran activities, generating 17,000 reports.
- Doesn’t pick up DVD/LCD only usage.

Student Impact

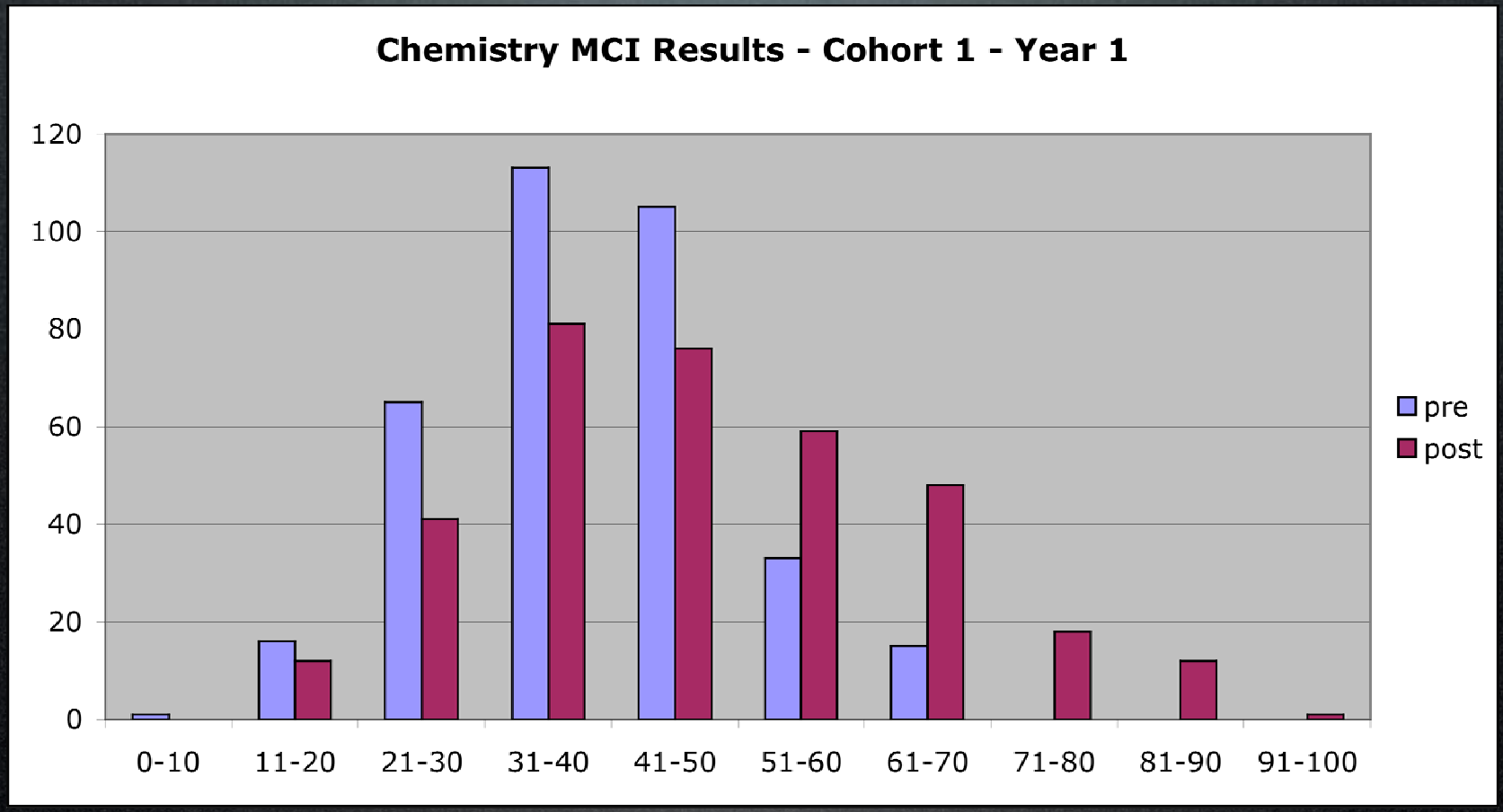
- Do understand science concepts better after using the RI-ITEST program?
  - **59% yes**
- Do you feel that you are more interested in science as a result of working with RI-ITEST?
  - **29% yes**

MCI Results
Cohort 1 - Bio



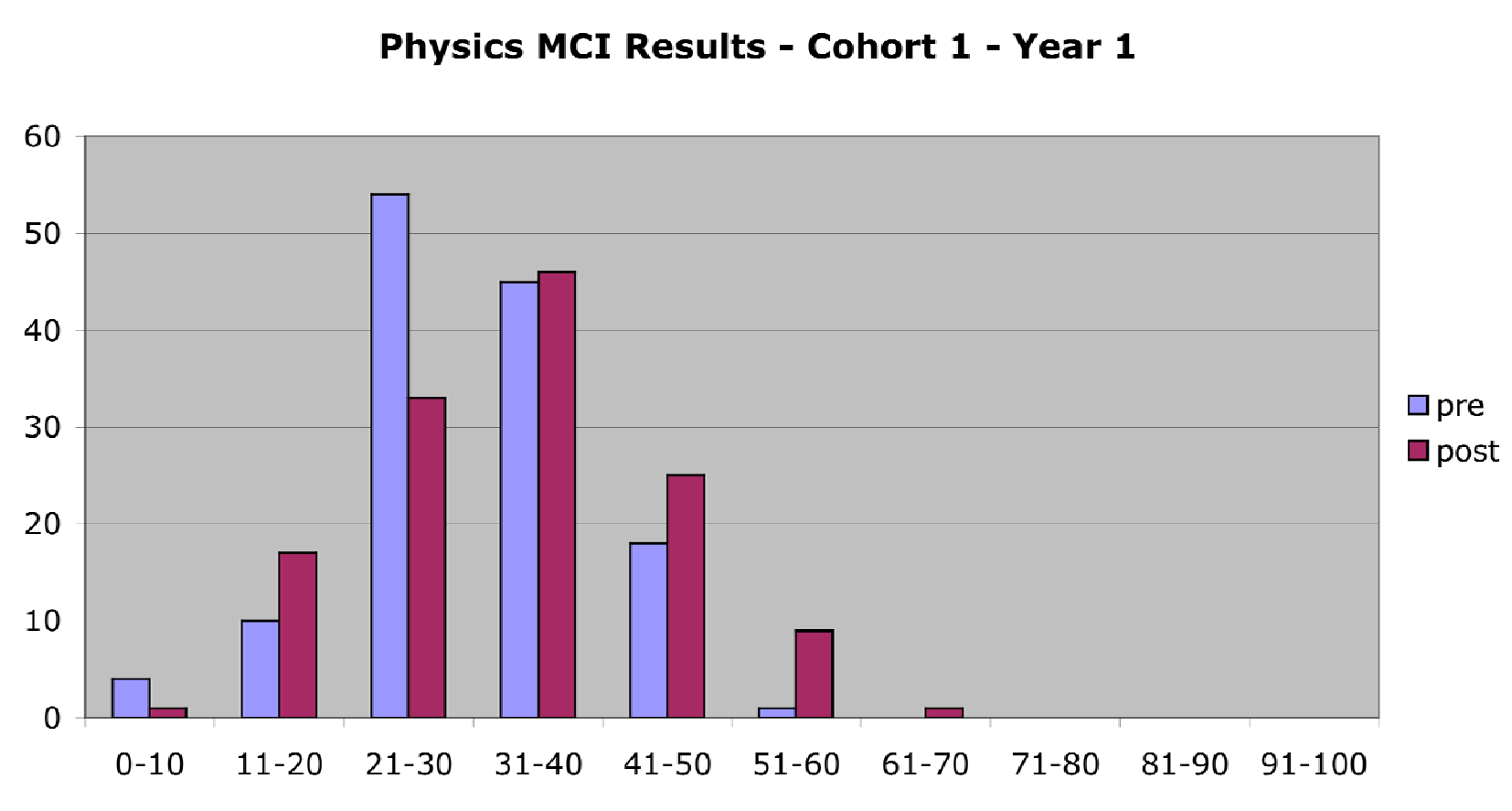
Group	Pre-test mean	Post-test mean	n	p-value based on paired t-test	Cohen's d	Effect size
Biology	34%	42%	244	1.9e-15	0.6	Moderate

MCI Results
Cohort 1 - Chem



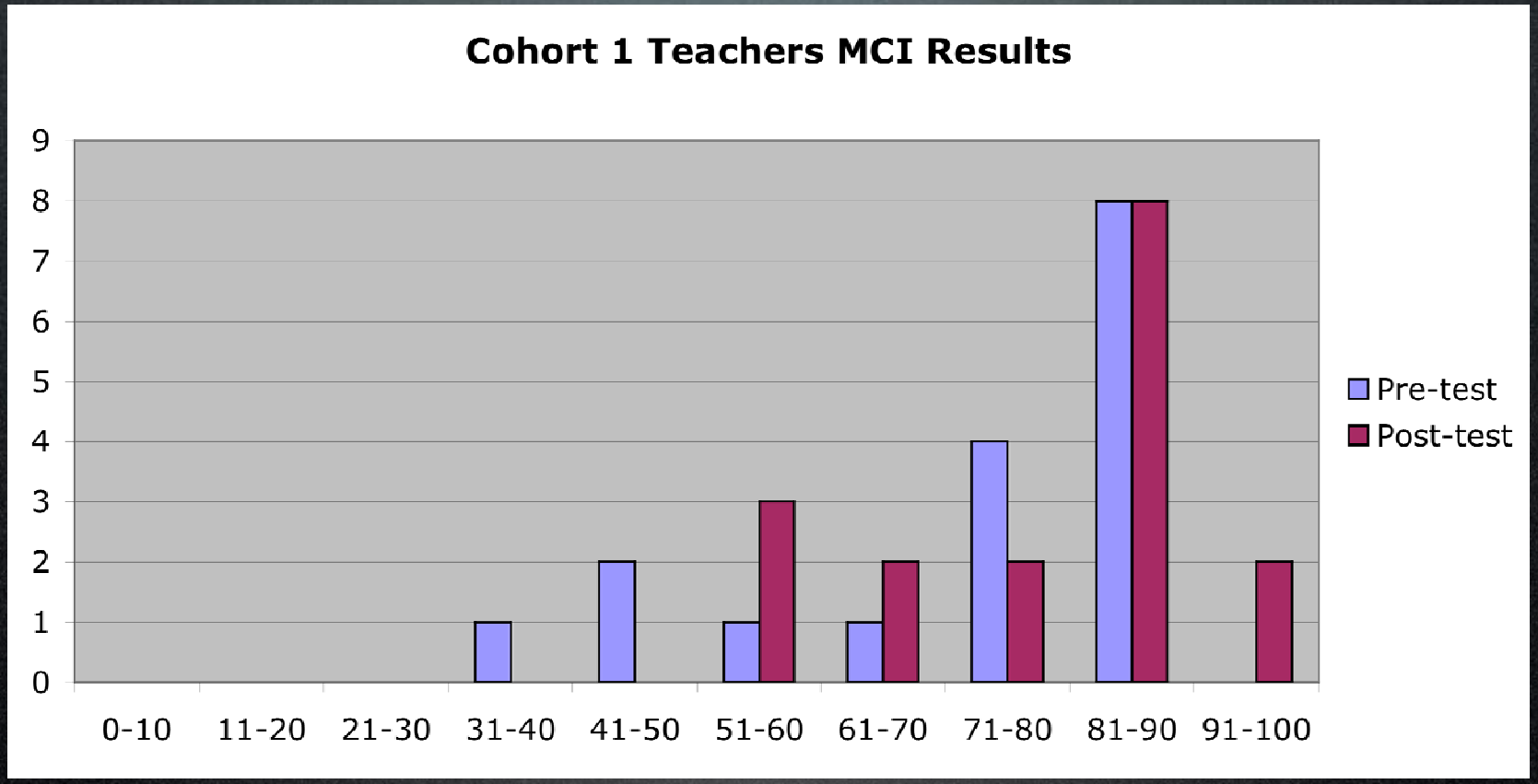
Group	Pre-test mean	Post-test mean	n	p-value based on paired t-test	Cohen's d	Effect size
Chemistry	39%	47%	348	7.8e-32	0.6	Moderate

MCI Results
Cohort 1 - Physics



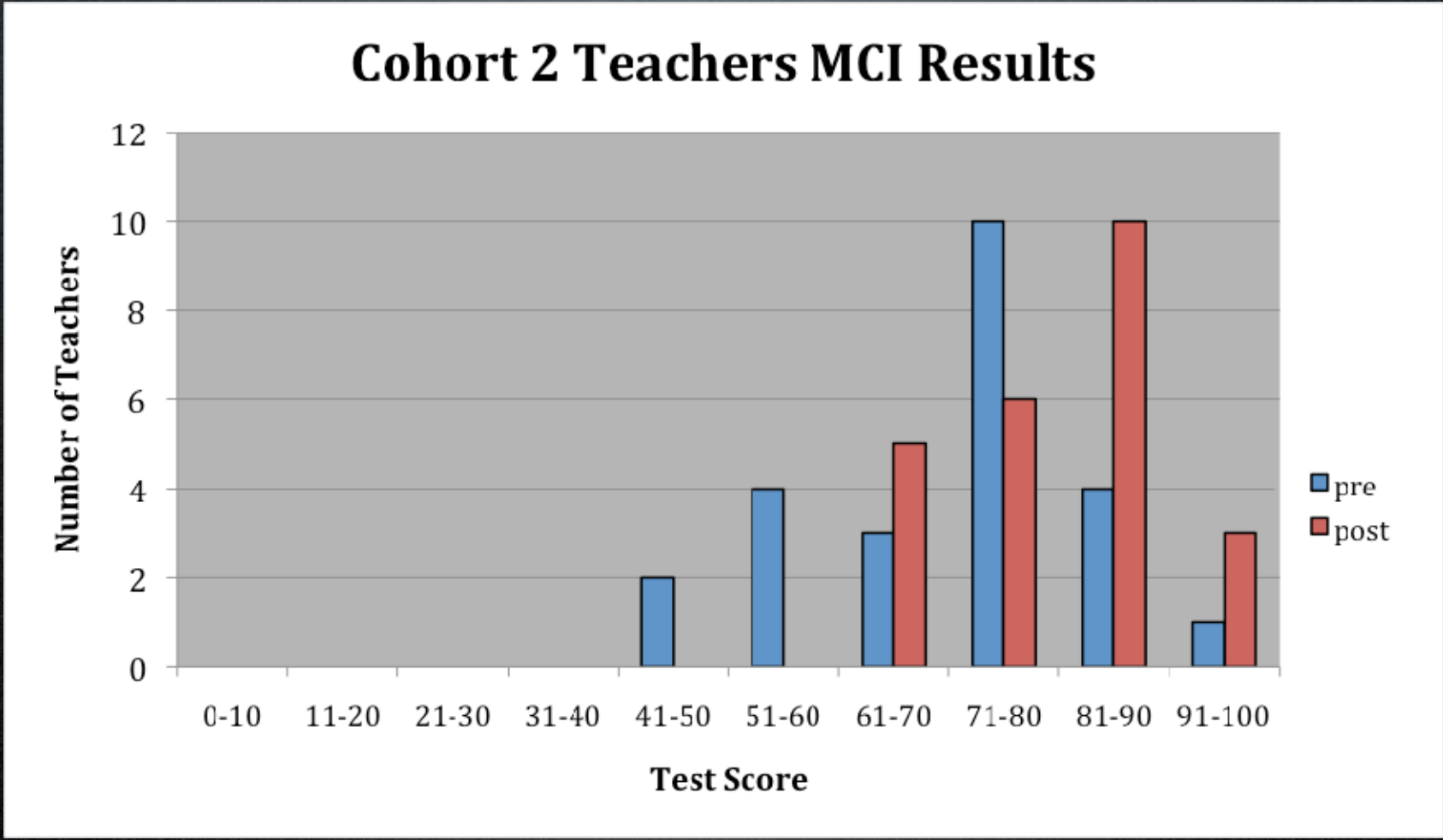
Group	Pre-test mean	Post-test mean	n	p-value based on paired t-test	Cohen's d	Effect size
Physics	32%	35%	140	0.0015	0.3	Small

MCI Results
Cohort 1 - Teachers



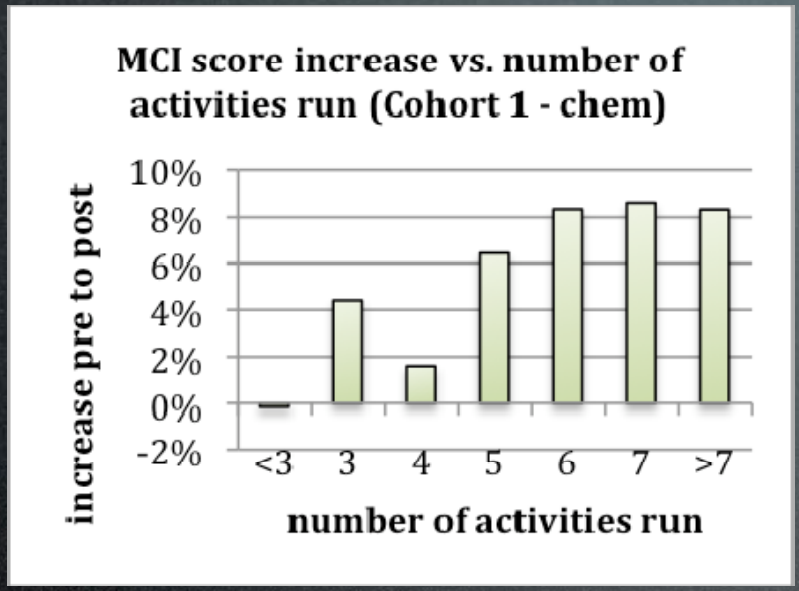
Group	Pre-test mean	Post-test mean	n	p-value based on paired t-test	Cohen's d	Effect size
Teachers	73%	76%	17	0.030	0.2	Small

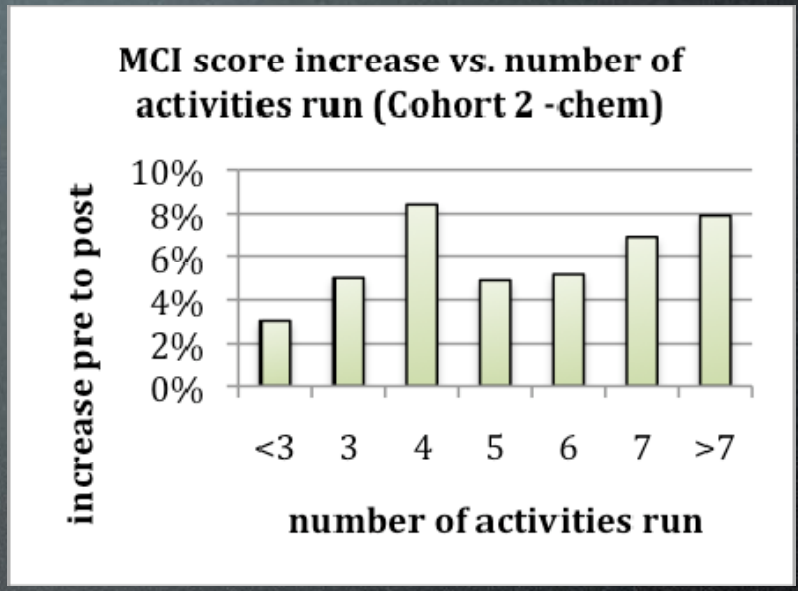
MCI Results
Cohort 2 - Teachers

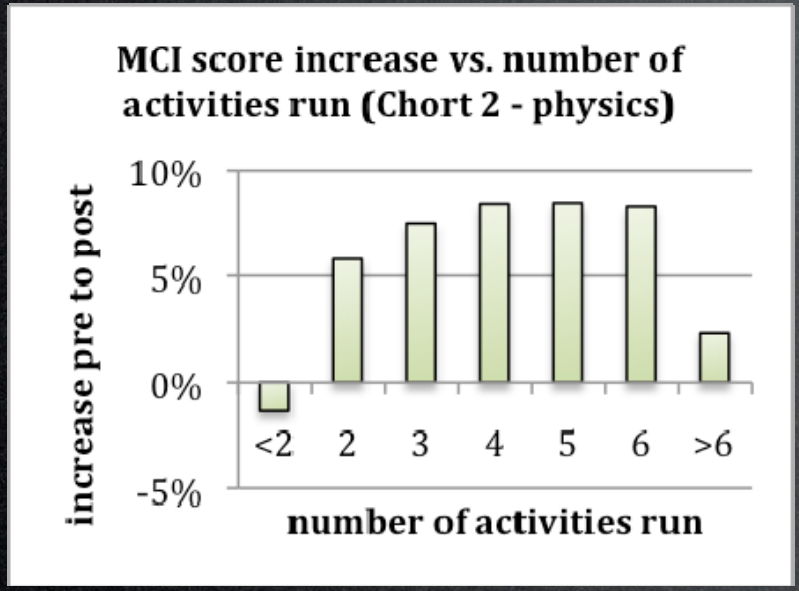


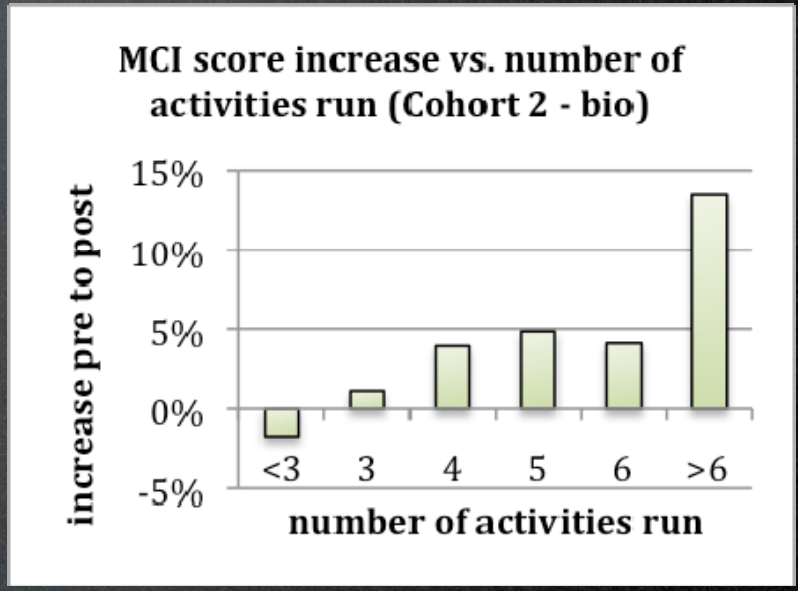
Cohort 2 Group	Pre-test mean	Post-test mean	n	p-value based on paired t-test	Cohen's d	Effect size
Teachers	72%	80%	24	5.3e-6	0.8	Large

Score increases related to number of SAM activities completed









Contact Info

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