UMBC

AN HONORS UNIVERSITY IN MARYLAND

LSC Webinar: The Chemistry Discovery Center at UMBC

Bill LaCourse

Professor & Interim Dean

College of Natural & Mathematical Sciences

OUTLINE of WEBINAR

The first step in transforming spaces: Looking into the mirror.

I. Introduction

II. Understanding your students and learning objectives

III. Defining your learning space to match your learning goals and outcomes

IV. Documenting, assessing, and evaluating the your learning goals, outcomes and space.

DISCLAIMER

"If I have seen further it is by standing on the shoulders of giants."

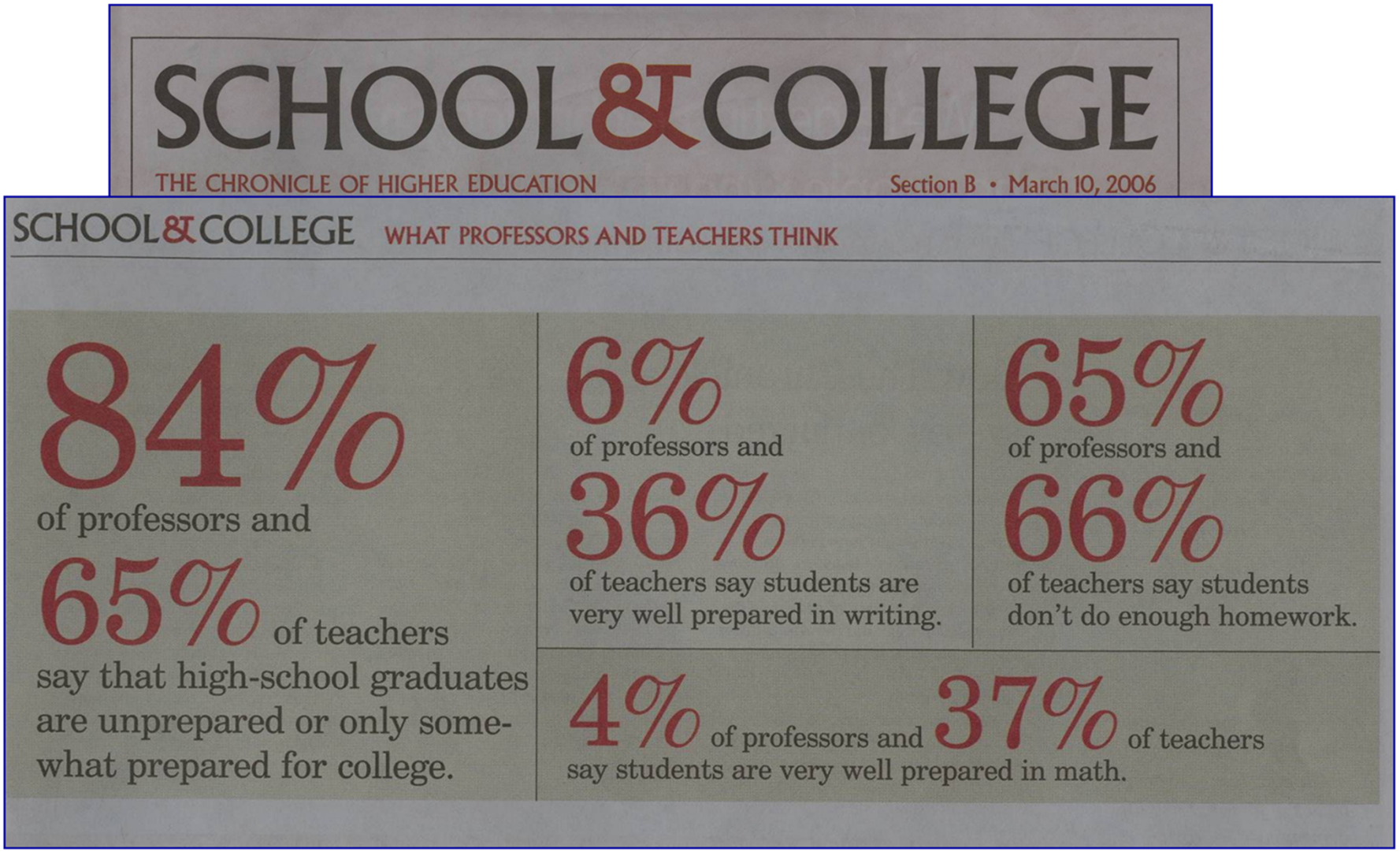
Sir Isaac Newton (1675)

Letter to Robert Hooke

OVERVIEW

- **Problem** – *Where did we go wrong?*
- **Vision** – *There's got to be a better way!*
- **Mechanics** – *Designing a brave new world.*
- **Results** –*Who's on first?*
- **Planning Ahead** – *What's on second?*
- **Acknowledgments** – *It takes a ~~village~~ ~~money~~ vision!*

LEARNING: BY THE NUMBERS



SCHOOL & COLLEGE

THE CHRONICLE OF HIGHER EDUCATION Section B • March 10, 2006

SCHOOL & COLLEGE WHAT PROFESSORS AND TEACHERS THINK

84% of professors and **65%** of teachers say that high-school graduates are unprepared or only somewhat prepared for college.

6% of professors and **36%** of teachers say students are very well prepared in writing.

65% of professors and **66%** of teachers say students don't do enough homework.

4% of professors and **37%** of teachers say students are very well prepared in math.

IT'S AN AGE OLD PROBLEM!

Let no one enter who does not know geometry [mathematics].

Inscription on Plato's door, at the Academy at Athens

…..FACTS ON LEARNING

- The median cognitive level in classes of:

-- 15 or fewer students was analysis
-- 16 – 45 students was comprehension
-- 46 – 300 students was recall.

- If students are not thinking, what are they doing:

-- attention drifting after 10 – 20 minutes
-- listening/taking notes only ½ the time
-- 15% of the time fantasizing (!)
-- (now texting, etc.)
-- ? = cheating = ?

TRANSITION DIFFICULTIES

Results-oriented K-12

- Rote learning (painful, easily lost, consciously rejected)
- Learning unconnected to existing knowledge (the alphabet/the multiplication tables)

Process-oriented (> 12 and up)

- Meaningful learning (well-integrated, branched, retrievable, usable)
- Learning connected to existing learning (patterns/metaphors /similies/parables/allegories

WHAT PRICE FREEDOM?

Everything cannot be memorized.

Multiple paths to the same answer.

No one path may be better than another.

Research leads to new outcomes and new knowledge.

Decision-making at work/life is often-based on novel situations.

Critical thinking is a form of higher-order cognition that society requires and faculty esteem.

……involving students in discussion fosters retention of information, application of knowledge to new situations, and development of higher-order thinking skills – and discussions do this much better than lectures do…

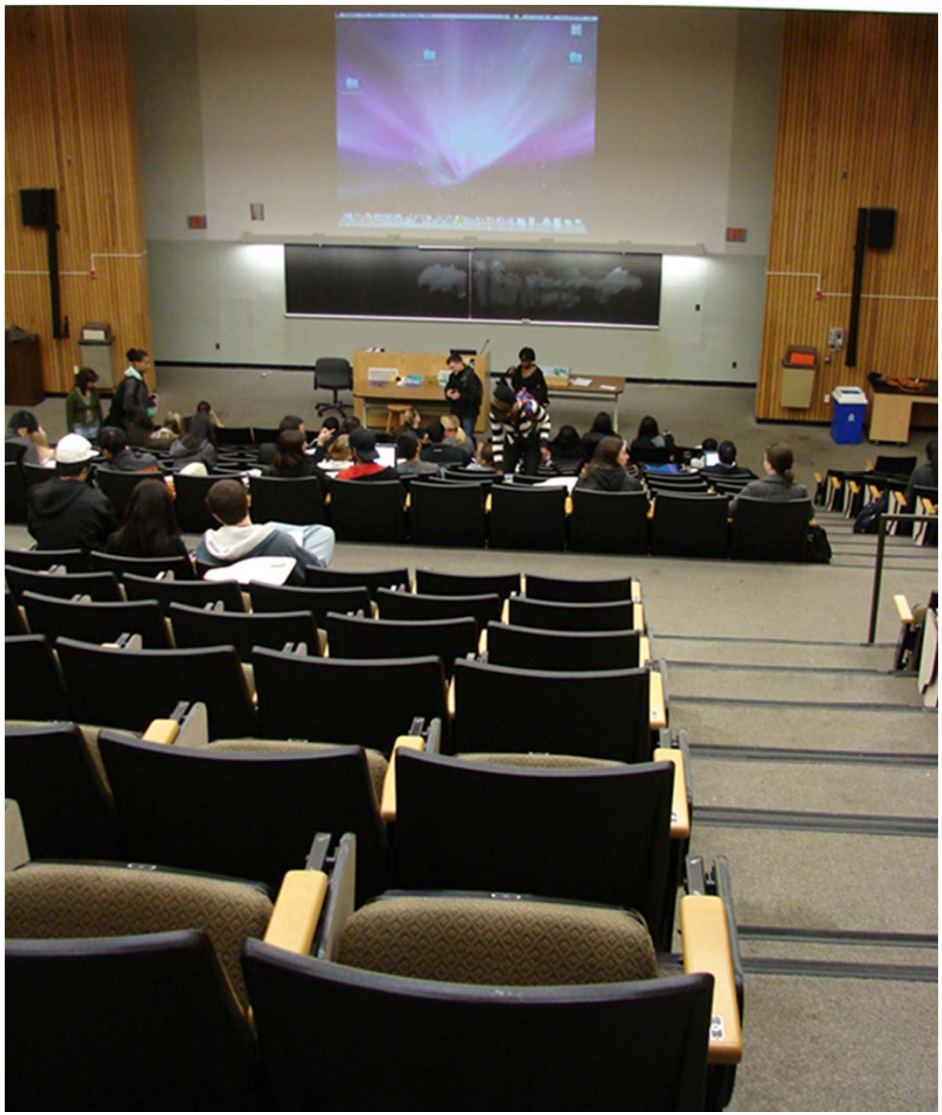
…..UNFORTUNATELY

- "In a study of 155 class sessions at four different institutions, questioning of students comprised 0.2 to 9.2 percent of class time."
- "…….in most courses, transmission of facts from teacher to students and discussion that requires only the recall of facts are the dominant class activities, regardless of discipline, the number of weeks into the semester, or size of institution."
- "In one study only 89.3% of questions asked by the faculty required only recall to answer, not comprehension of concepts……."
- "In only 0.3% to 2.5% of class time were students required to use the more complex skill of evaluations."

THE 'OLD' WAY

- **Lecture**
  - One instructor
  - ~700 students (350 per section) - Fall 101 only
  - Three (3) tests and a final exam

LECTURE HALL – Student's View



THE 'OLD' WAY

- **Recitation**
  - One Teaching Assistant
  - ~90 students per section
  - Graded quiz – mostly to enforce attendance
- **Tutorial Center**
  - Peer-oriented tutoring
  - Directed towards help with homework.

"We looked in the mirror!"

- The class average on tests and exams had been dropping slowly in the past few years. This observation is independent of the course instructor, streamlined material of uniform content, and the use of test banks for randomized question selection. The result is that higher numbers of students do not pass introductory chemistry, leading to a less than positive experience for the students.
- Student attendance in the classroom continued to decline, with complaints of the onerous nature of freshman workload on the increase.
- Large section sizes of recitations are proving ineffective for most students. Even with mandatory attendance, most come only for the quizzes and only the bright students ask questions.
- The Tutorial Center, which is self-initiated assistance, is overwhelmingly utilized by the A and B students, with C and D students rarely taking advantage of this resource.
- Anecdotal accounts of increased student frustration and failure. Many students feel CHEM 101 is a "weed- out course".

Brasted Lecture: Award Address

....shallow learning....can become a way of life for students that imagine that this is what chemistry is all about. The interlinked, multidimensional learning... described as deep learning....requires commitment on the part of the student (and the teacher) to see this as a necessary and satisfying condition of learning.

.....It is our responsibility .....to enable and encourage students to learn how to learn.

"Chemistry Teaching – Science or Alchemy"

A.H. Johnstone

Dept. of Chemistry, Glasgow University

Questions? Comments?

OUR MOTTO, OUR MISSION

LEARNING, COMMITMENT, and RESPONSIBILITY

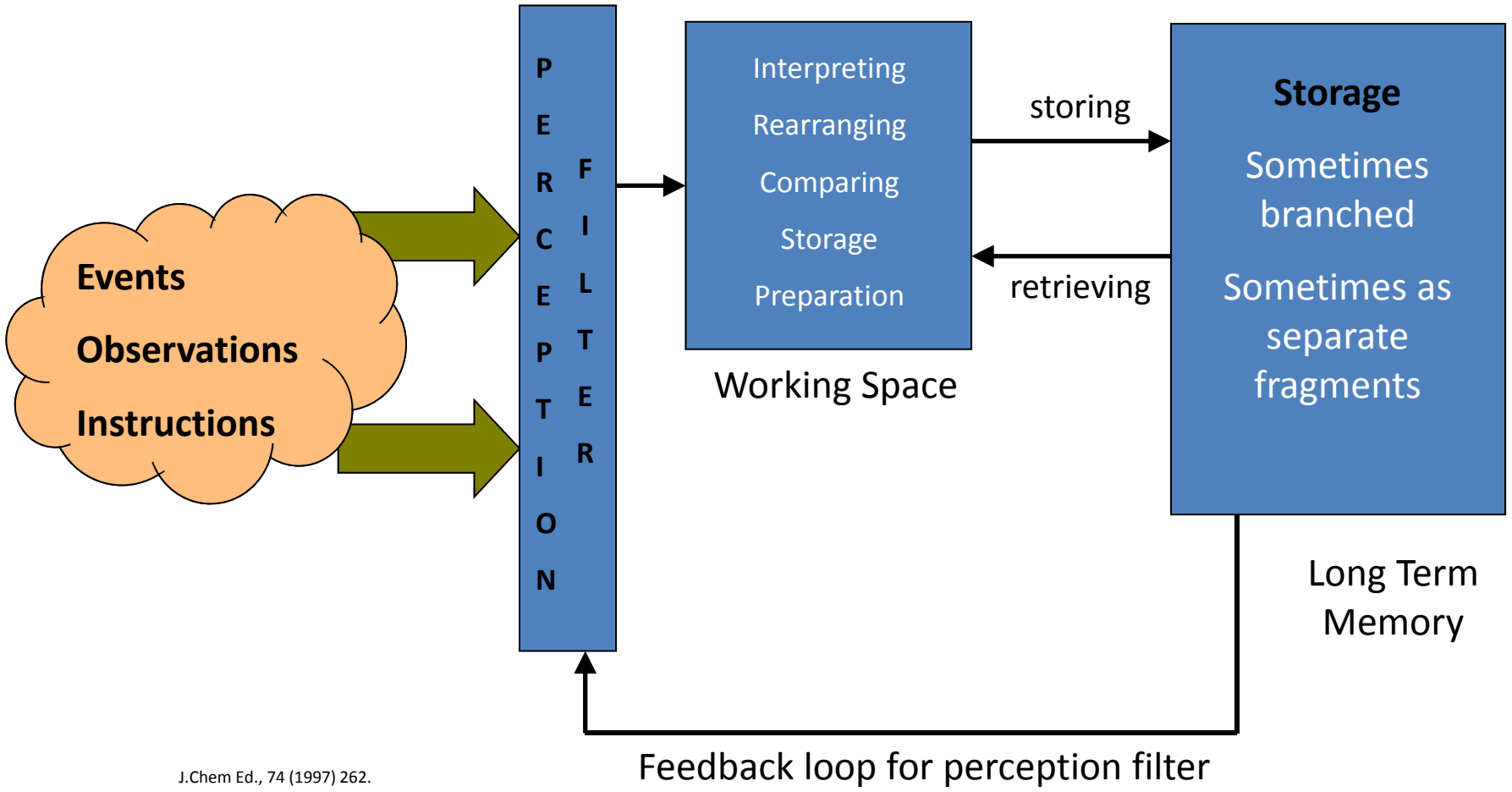
WE ARE COMMITTED TO YOU!

- *Increase student involvement* in the learning process through active learning.
- *Promote "discovery learning"* through knowledge construction and extension techniques.
- *Promote problem-solving skills* with positive competition and open debate.
- *Promote increased independence and responsibility* in the learning process by developing critical work skills - teamwork, communication, management, and self-assessment – *an Entrepreneurial skill set*.
- Integrate the learning curriculum of freshman chemistry courses from concept (CHEM 101 &102) to practice (CHEM 102L).
- Envelop the student in a multi-faceted learning environment – lecturing, discovery, and tutoring.
- Cross interdisciplinary boundaries (e.g., physics, mathematics, computer science) in order to leverage knowledge and establish a learning community among entering science students.
- Improve the student's experience with freshman chemistry courses.

THE ENVIRONMENT IS IMPORTANT

…..we are victims of our environment, informed by our senses and reactions. However, we have mechanisms by which we reduce the torrent of sensory stimuli to manageable proportions, attending to what seems to be important, interesting, or sensational.

INSPIRATION & "ACTIVE" INTERVENTION.



J.Chem Ed., 74 (1997) 262.

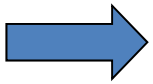
NO DISTRACTIONS PLEASE

IMPROVING EFFICIENCY of LEARNING *not* TEACHING

- ENERGY SAVINGS
  - more insulation, less friction, reduced leakage, etc.
- ENGINE OUTPUT
  - Increase the temperature difference between the heat source, part of which is converted to useful work, and delivering the rest to the cold temperature heat sink.
- LEARNING
  - Chunking or coalescing data to a smaller quantity.

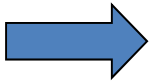
G – R –O – S – S

5 data bits



GROSS

1 data bit



GROSS:

unattractive image

or 144 objects

1 data bit/concepts

Driven by pedagogy!!!

WISDOM

Wisdom denotes pursuing the best ends by the best means.

Francis Hutcheson (1694-1746)

IT'S NOTHING NEW!

I cannot teach anybody anything.

I can only make them think.

– Socrates -

Knowledge must be gained by ourselves.

– Benjamin Disraeli -

The one real object of education is to have a man

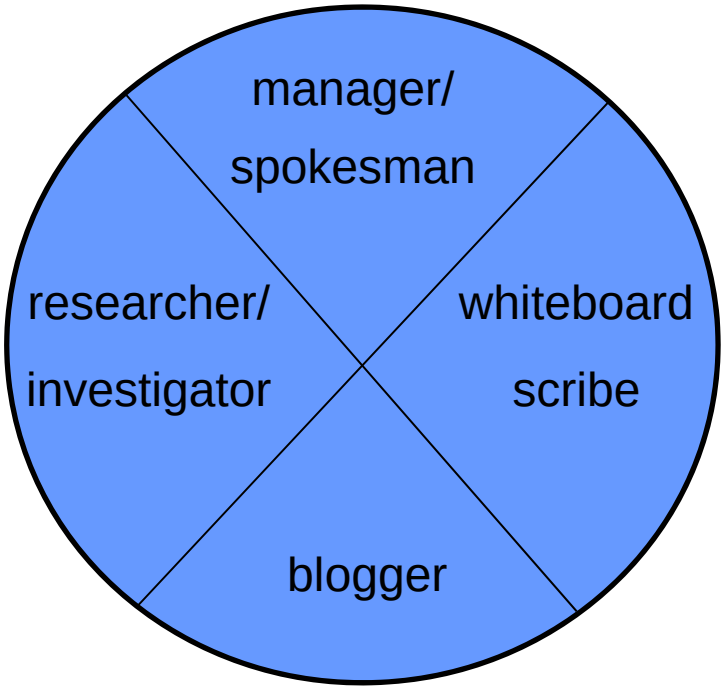
in the condition of continually asking questions.

– Bishop Mandell Creighton -

LEARNING OUTCOME

Can the pedagogy and *learning space* facilitate the student's "responsibility" in the learning process?

LEARNING is YOUR RESPONSIBILITY



Development of entrepreneurial skills to become a life-long learner.

Discovery Learning

Students work in small groups with assigned roles.

Activities are specially designed to develop both mastery of course content and key process skills.

Targeted Skills

Information processing
Critical thinking
Problem solving
Communication
Teamwork
Management
Assessment

PRIMITIVE DISCOVERY ROOM

THE "PAPERLESS" APPROACH

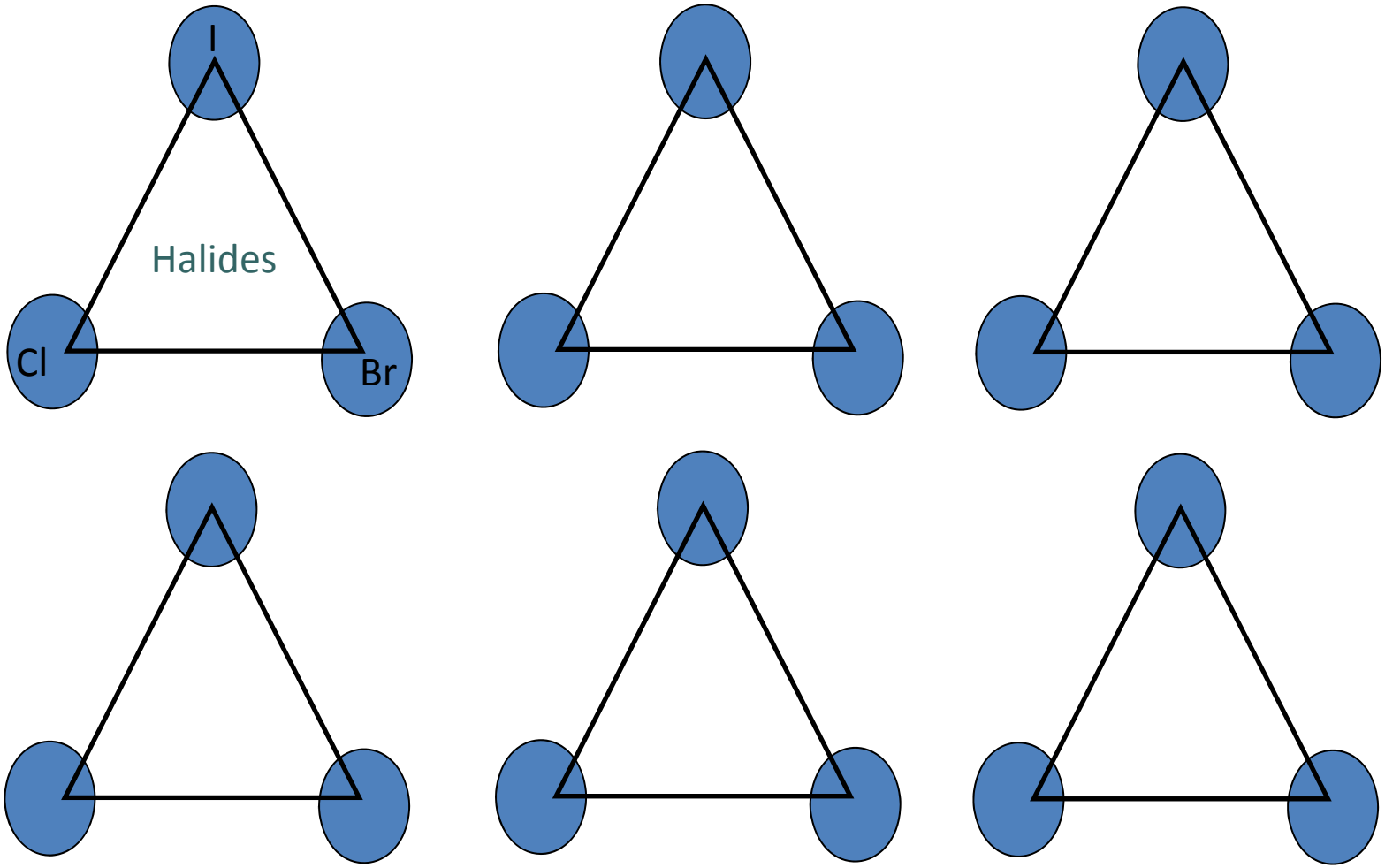
Table for ~1200, please!

- No paper or pencils/pens allowed – documents delivered by SchoolVue™
- Completed documents sent to students by email.
- Completed documents are recovered by SchoolVue™
- Documents are removed from terminal by SchoolVue™
- All 18 tables are monitored and controlled by Facilitator
  - "Real-time" monitoring leads to early intervention by facilitator

CHEMISTRY DISCOVERY CENTER

CHEMISTRY DISCOVERY CENTER

COLLABORATIVE TRIADS



"Promotion of ownership and trust by constructive collaboration!"

The Facilitator

- Oversees Discovery Session
- Coordinates with Instructional Team
- Responsible for Teaching Assistants
  - Training/Assessment
- Group/Role Assessment
- Grading Oversight
  - Penalties

Teaching Assistants

- Direct interaction with teams via manager
  - Conceptual guidance only – extensive training
- Contract management
- Competition/game coordinators
- Grading of assignments
- Office/tutoring hours

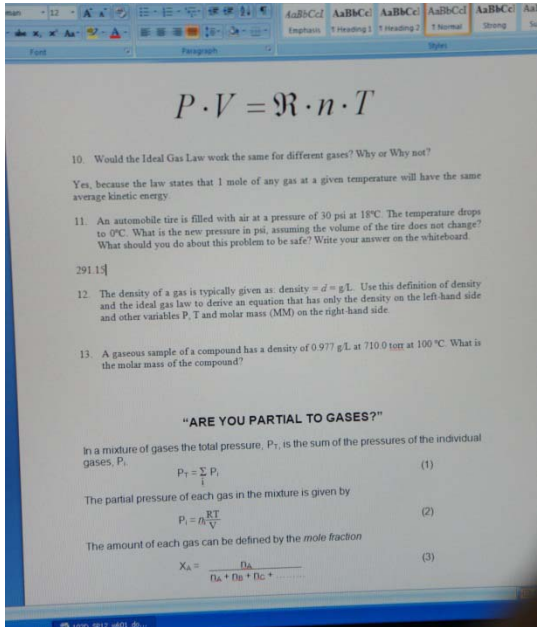
The *Student* Team

- **Manager / Spokesman**
  - Assess condition of area/equipment at beginning and end of session
    - Manager's Contract
  - Keep track of team progress
  - Are members working within their roles?
  - Check for penalties
  - Deliver reports when called upon
- **Blogger**
  - Only person permitted to use the PC
  - Documentation only
  - Send finished worksheets to all team members
  - LOG OFF!

- **Whiteboard Scribe**
  - Record team's "brainstorming"
  - Draw diagrams, etc.
  - Write in real time!
  - Stand at the whiteboard
  - At the end of the session: erase board, return pens/eraser to tray.
- **Researcher / Investigator**
  - Responsible for hands-on supporting materials
  - Calculator, CRC Handbook, periodic table
  - At the end of the session: return materials to whiteboard bin.

Selected randomly (initially).
Roles will rotate each week.
Changed after each test by class standing.

The *Student* Teams



$$P \cdot V = \Re \cdot n \cdot T$$

10. Would the Ideal Gas Law work the same for different gases? Why or Why not?

Yes, because the law states that 1 mole of any gas at a given temperature will have the same average kinetic energy.

11. An automobile tire is filled with air at a pressure of 30 psi at 18°C. The temperature drops to 0°C. What is the new pressure in psi, assuming the volume of the tire does not change? What should you do about this problem to be safe? Write your answer on the whiteboard.

291.15

12. The density of a gas is typically given as: density = d = g/L. Use this definition of density and the ideal gas law to derive an equation that has only the density on the left-hand side and other variables P, T and molar mass (MM) on the right-hand side.

13. A gaseous sample of a compound has a density of 0.977 g/L at 710.0 torr at 100 °C. What is the molar mass of the compound?

"ARE YOU PARTIAL TO GASES?"

In a mixture of gases the total pressure, P_T, is the sum of the pressures of the individual gases, P_i.

$$P_T = \sum_i P_i \qquad (1)$$

The partial pressure of each gas in the mixture is given by

$$P_i = n_i \frac{RT}{V} \qquad (2)$$

The amount of each gas can be defined by the *mole fraction*

$$X_A = \frac{n_A}{n_A + n_B + n_C + \ldots} \qquad (3)$$

The Chemistry Discovery Center

The Chemistry Discovery Center

RESPONSIBILITY: Manager/Group

MANAGER'S CONTRACT

(For full credit - please write legibly)

As manager, you are responsible for your team, its conduct, and the equipment assigned to you. The following information will ensure that your team is protected from point loss resulting from damaged or stolen equipment and materials. Damage reported by the following group will result in a loss of your team points (up to 10) for the session. This form will also be used to denote team infractions.

I. GROUP DATA **CIRCLE ONE: CHEM 101 or 102**

Team Name		FOR INSTRUCTOR USE ONLY
Section #		
Day/Time		
	STUDENT'S NAME (list only if present)	
Manager		
Researcher		
Scribe		
Blogger		

III. TEAM INFRACTIONS:

ITEM	POINTS

IV. MANAGER'S ASSESSMENT (*upon return*):

ITEM	COMMENT
Equipment	
Materials	
Other	

INDIVIDUAL RESPONSIBILITY

II. CONDITION OF EQUIPMENT (*as received*):

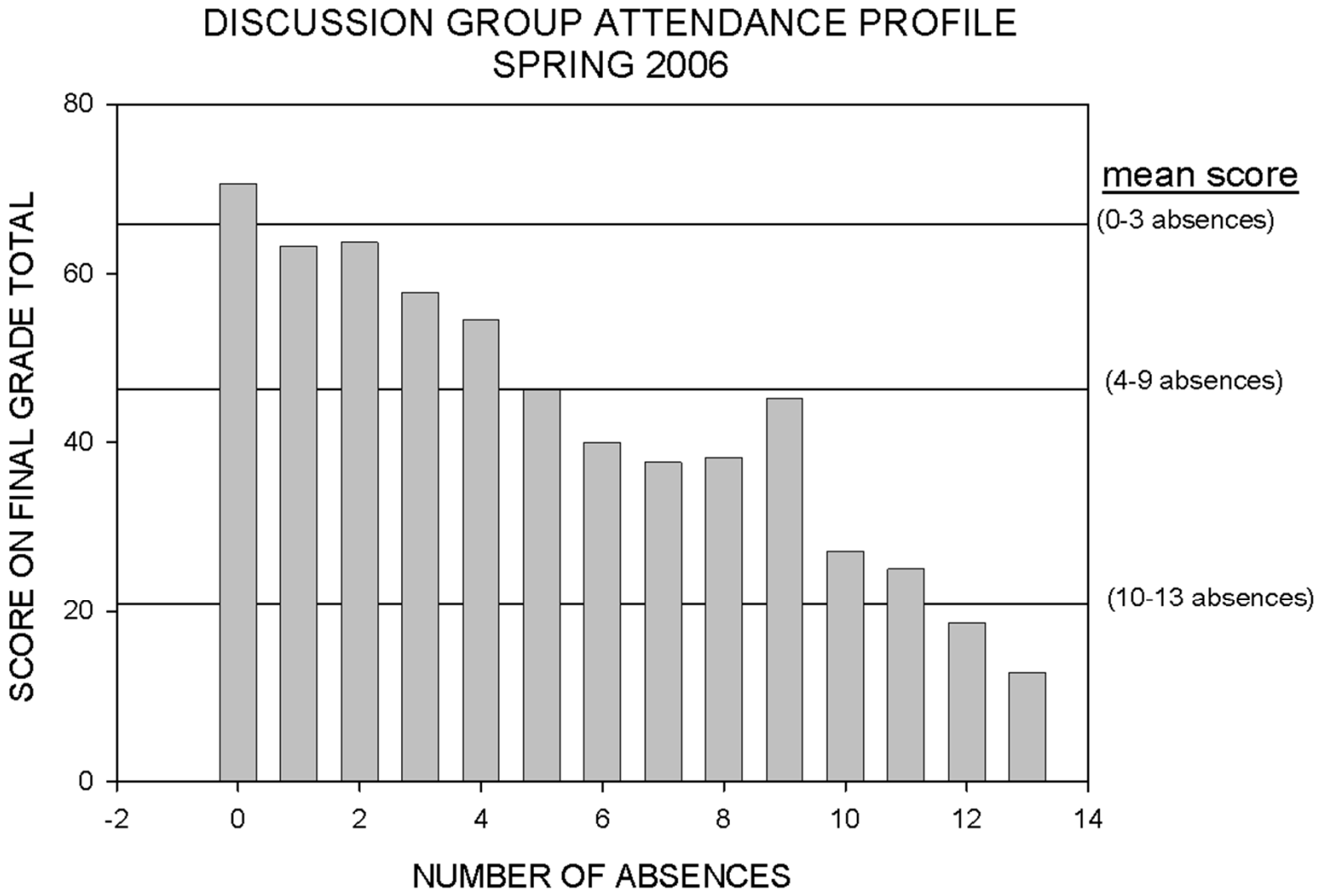
ITEM	SUGGESTIONS	CONDITION
Computer	present, clean, working, missing parts, issues	
Calculator	present, clean, working	
Whiteboard	clean, missing parts	
Markers, Eraser	present, usable	
CRC	present, good condition	
Periodic Table	present, good condition	
Manager Docs.	present, good condition	
Model Kits	present, missing parts	
Table	clean, no gum	
Chairs	clean, labeled, only 4, in place	
Miscellaneous	item dependent	

I, the team manager, hereby acknowledge that the data provided above is accurate and true to the best of my knowledge. I assume responsibility for my team, its conduct, and assigned equipment and materials.

_____ signature

_____ date

ATTENDANCE – *Hard Lessons Learned*

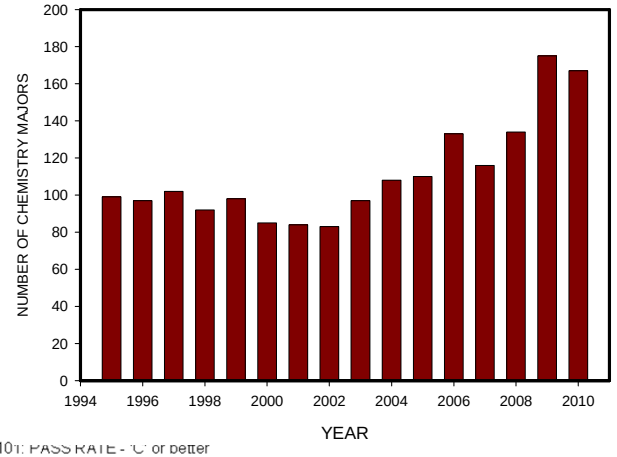


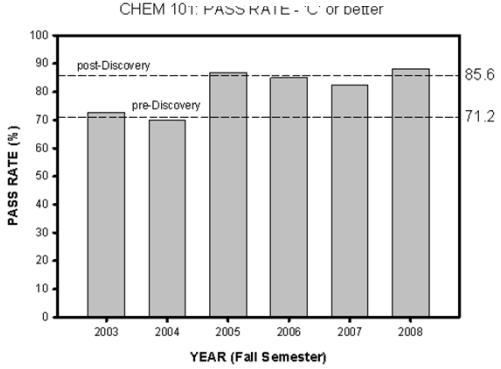
ATTENDANCE: UNEXCUSED ABSENCES

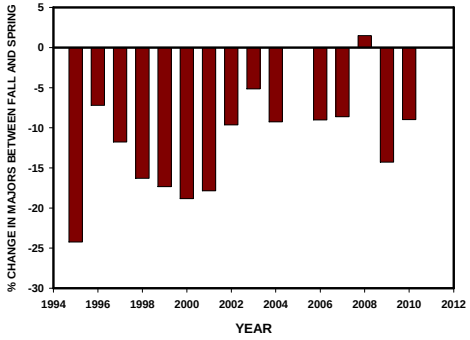
# Classes Missed	Penalty: % points from FINAL CLASS AVERAGE	Total % points deducted from FINAL CLASS AVERAGE
1	2	2
2	4	6
3	6	12
4	8	20
5	10	30
>5	automatic failing grade in course	

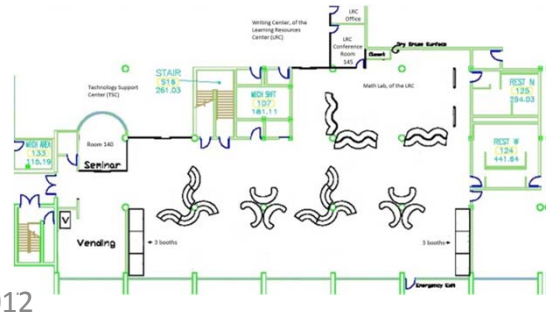
Questions? Comments?

IMPACT: DISCOVERY CENTER

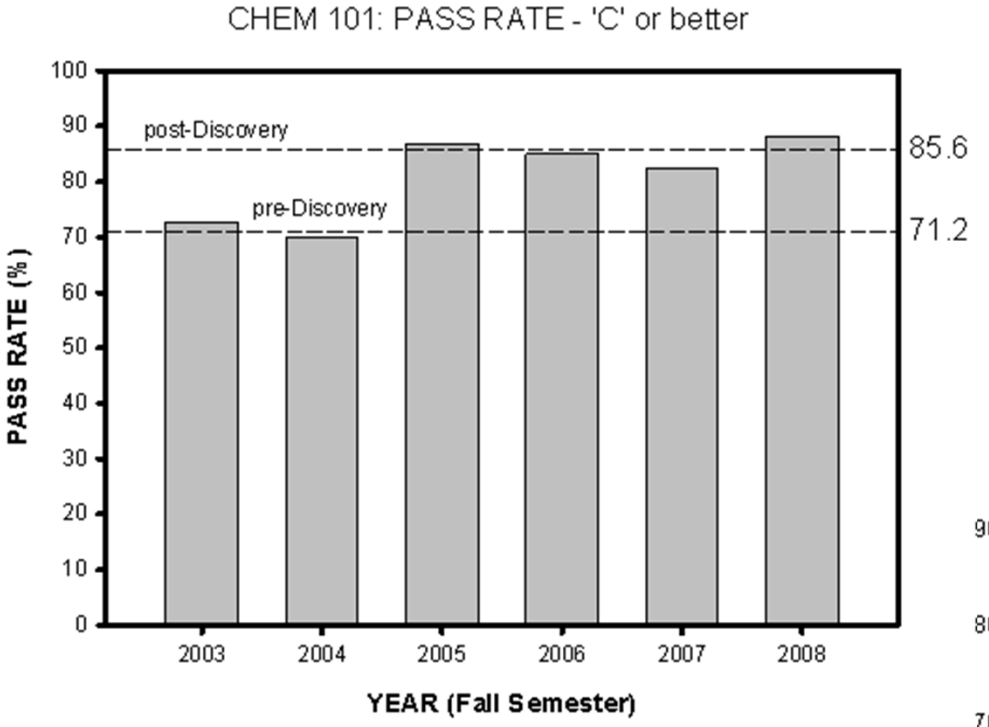


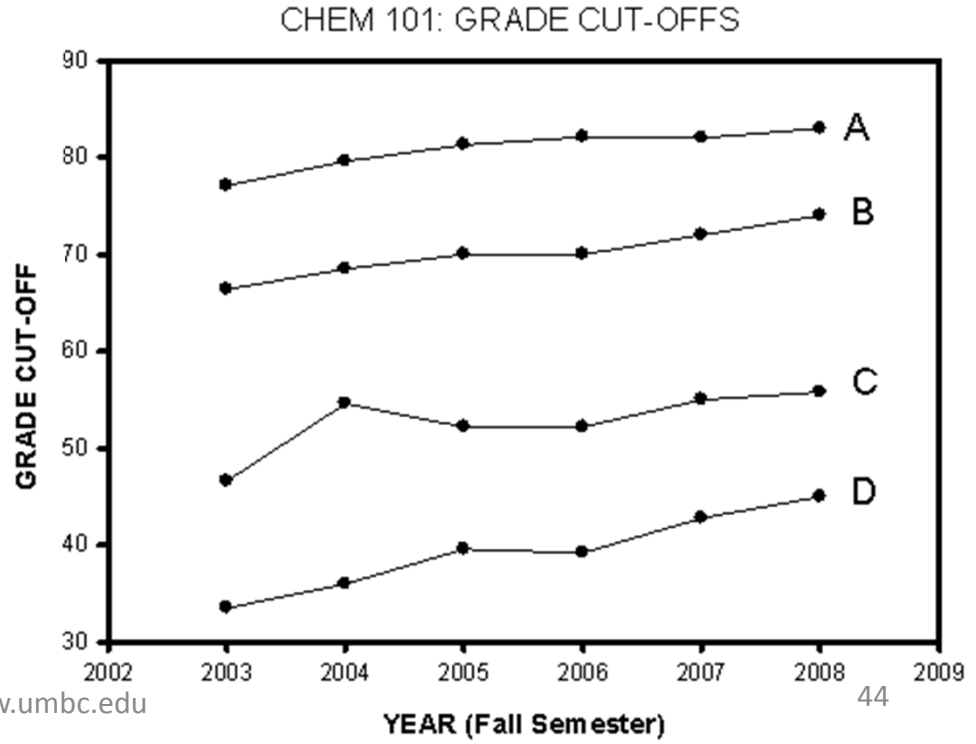




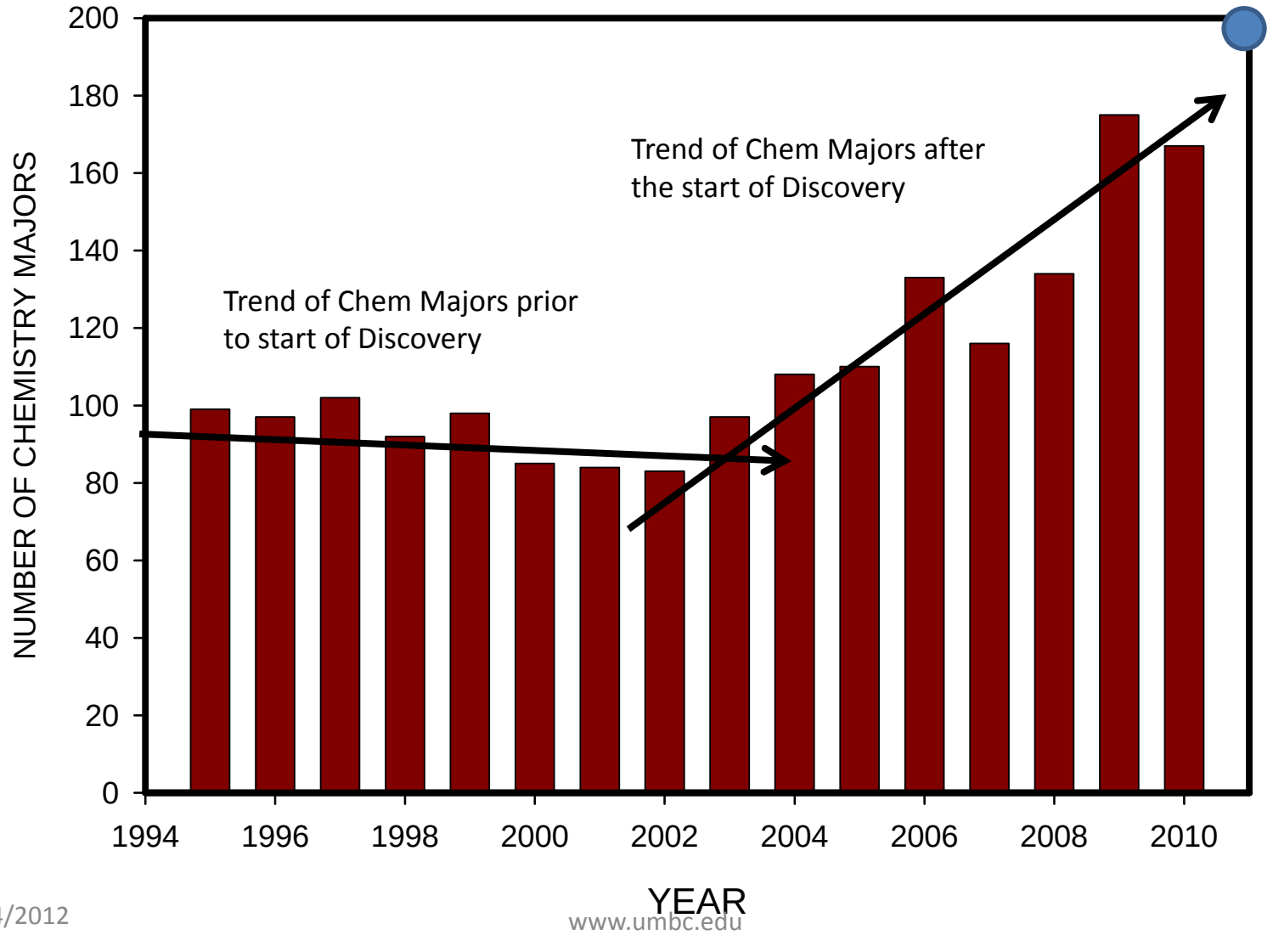


INCREASING STANDARDS

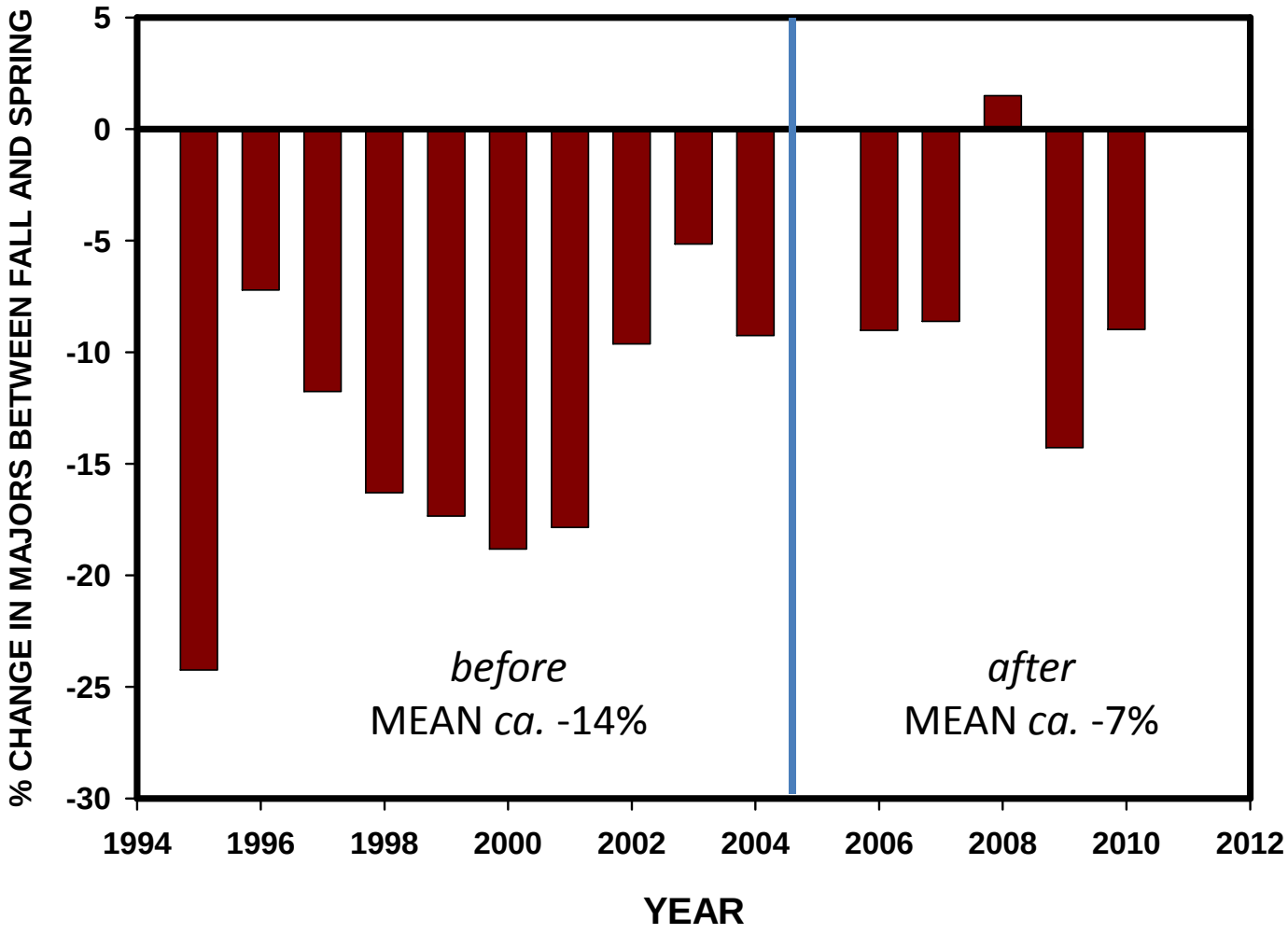




NUMBER OF MAJORS - *Reversing a trend*



RETENTION OF MAJORS – *A Dramatic Development*



BULLET FACTS about DISCOVERY LEARNING

- ✓ Improvement at all grade levels – not just the top of the class.
- ✓ Decrease in the number of Summer students – fewer repeaters.
- ✓ Improvement in the number of CHEMISTRY and BIOCHEMISTRY MAJORS.
- ✓ Improvement in retention in General Chemistry.
- ✓ Improvement in the retention of majors between Fall and Spring semesters.
- ✓ Dramatic increases in the number of 2nd majors and Chemistry minors.
- ✓ Improvement of group skills migrating to upper level classes.
- ✓ Increase in participation in an active ACS chapter.
- ✓ Larger/stronger population of student tutors.
- ✓ Anecdotal comments of success and excitement about Discovery Learning.

THE GREATEST COMPLIMENT OF ALL

Debunking the myths of Chem. 101

Ariane Szu-Tu
EDITORIAL STAFF

At UMBC, horror stories abound about Chemistry 101, often dubbed a 'weed-out course' by students. Chemistry 101, contrary to popular belief, does not have an aim to 'weed-out' students who are not destined to become Chemistry majors. In fact, Chair of the Chemistry Department Dr. William LaCourse said, "We don't expect the majority of the people in Chem 101 to be Chem or BioChem majors."

Less than five percent of Chemistry 101 students have dropped out of the course during this past semester. Classes are getting larger and standards are getting higher. In the past, students have been passed on to the next level of chemistry when their average exam score was less than a 70 percent without the aid of a curve.

Although that is changing with increasingly high exam scores, Dr. LaCourse said, "When we give a C, no matter how that C comes about, the students should know enough of the material." General chemistry coordinator, Dr. Tara Carpenter added, "We won't pass someone if we know they'll fail 102. That won't help anyone."

Pass rates have risen by roughly 10 to 15 percent from fall of 2003 to fall of 2006, correlating with the implementation of the Discovery Center as part of the Chemistry 101 course. This year alone the averages of exam scores for Chemistry 101 have reached 70 percent and above.

Despite the daunting horror stories regarding Chemistry 101, the exams, lectures, and expectations for the course have stayed the same. Students have risen to the challenge with higher exam averages.

Lectures are supposed to inspire students to crack open their textbooks and read on their own. However, with the knowledge that students learn differently, faculty have expanded beyond the limitations of the crowded lecture hall to give students the intimacy of working in small groups during discussion in the Discovery Center. Dr. Carpenter and Dr. LaCourse designed the Discovery component of Chemistry 101 to add yet another medium for conveying course material to students.

The Discovery Center, located on the second floor of the University Center, houses a number of small round tables, each complete with a whiteboard and computer. UMBC is pioneering the field of intro-level chemistry by creating a discussion with its own unique set of rules. "We're doing it the UMBC way," said Dr. LaCourse.

It was discovered that, as the number of absences from discussion rises, the student's exam score decreases. By forcing students to remain in discussion for two hours without distraction, the professors are making sure students devote at least two hours a week out of their busy schedules to chemistry.

Beyond just chemistry, the Discovery Center aims to teach students lessons in problem-solving and forces students to get involved through active learning. Students now have to use their two-hour discussion time to work through chemistry problems together. Students are given the role of manager, blogger, researcher or whiteboard scribe and remain in character throughout discussion. Relying on each other and working together, students attempt to complete the complex problems presented to them. Discussion teaches students the important skills of communication and problem solving that can be applied throughout their college careers and, even further, to the workforce.

With the Tutorial Center, lectures, the Discovery Center, online quizzes, and office hours, professors are providing resources for students and hoping that students will take responsibility for their education. Faculty members are also looking at every student entering Chemistry 101, trying to assess difficulties and problem areas. If a student needs to retake Chemistry 101, the professors try to pinpoint the problems the students had with the course and mandate additional courses or help so the student can be successful. "We are going to take responsibility for students in this course," said Dr. LaCourse.

Ultimately, success in chemistry, or perhaps in life in general, comes down to, as Dr. LaCourse said,"learning, responsibility, and commitment." Doing well in Chemistry 101 does not depend on how big the curve is. It depends on the dedication and commitment of the student and whether the student is willing to utilize the tools to become a lifelong learner.

If more students are passing Chemistry 101 and going on to the next level of chemistry, that means more students will be in need of lab materials, additional teaching assistants, and time from professors, which is a cumulative side effect of everyone's success. The professors at UMBC are willing to make the commitment and students are demonstrating their willingness to make their education a top priority.

The Retriever Weekly, UMBC, 12/4/07

College Active Science Teaching and Learning Environment

CASTLE – The Next Generation

ADAPTABLE SPACE

It’s the little things that make a room a CASTLE.

It's the little things that make a room a CASTLE."

THE RETRIEVER LEARNING CENTER

- **Provide Distinctive Undergraduate Experience:** convivial social learning space – a socially connected learning environment - in proximity to co-located library services, tutoring, information resources and information technology.

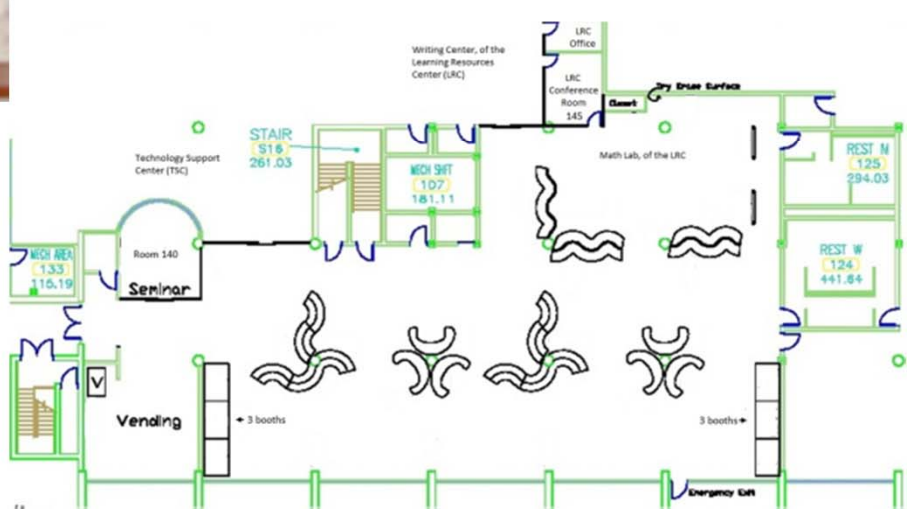
- **Improve Student Retention and Graduation Rates:** encouragement of peer to peer learning, group learning, informal student/faculty interactions; tutoring, library research assistance, and tech support in convenient proximity and integrated with learning activities; environmental positive reinforcement of a sustained study regime.

- **Environmental Sustainability:** consolidates in one location activities which are now distributed, inefficiently and ad hoc, throughout the campus, in spaces not designed for study and difficult to service and secure.

- **Campus Safety and Security:** card access, video monitoring, and other features conducive to improved safety and security for late night study.

The RLC is UMBC's best place for lively group study, scholarly discussion, collaboration, and academic coaching.

THE RETRIEVER LEARNING CENTER



Interdisciplinary Life Sciences Building

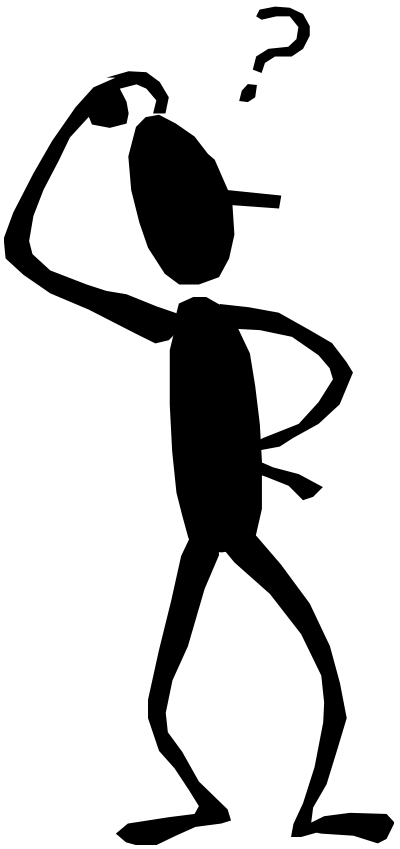
- Planned for 2016
- A suite of “active” learning spaces
- No departmental ownership
- Collaboration requirement for research
- Innovation incubator
- Student interaction design criteria

THERE'S ALWAYS A BETTER WAY!

TAKE AWAYS!

- Pedagogy drives *Learning Space* design!
- Values can be reinforced through proper *Learning Space* design!
- Assessment of *Learning Space* effectiveness can catalyze a culture change!

Questions? Comments?



LEARNING SPACES COLLABORATORY

Visit the Learning Spaces Collaboratory website at

www.pkallsc.org

The LSC Vision

Organized in 2010, the LSC vision is that all 21st century undergraduates, no matter their background or career aspiration, have ready access to physical learning environments that enable them to become engaged learners:

- Constructing their own learning, actively involved with cooperative, problem-driven teams
- Communicating and collaborating with peers and colleagues, formally and informally, face-to-face and virtually
- Connecting their campus-based learning experiences to real-world opportunities and challenges
- Celebrating as members of a robust 21st century community of learners.

The LSC Community of Practice

This emerging community of practice is collaborating in translating contemporary findings from research and practice in the field into roadmaps for shaping and assessing built environments for learning in the undergraduate setting. The case made will be constructed collaboratively by a diverse cadre of stakeholders, each of whom brings to the table requisite experience and expertise in one or more dimensions of shaping undergraduate learning environments.

All involved, including academics, architects, leaders of national societies, share a passion for integrating attention to how and why spaces matter into discussions and decisions about shaping the future of undergraduate learning—on an individual campus and across the nation. It is a collaborating community of researchers, practitioners, and stakeholders working to develop resources, grounded in research and validated in the field, that will inform the process of planning, experiencing, and assessing 21st century learning spaces on campuses across the country.

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Upcoming LSC Activities

- **February 8, 2012** (Boston, MA); **February 29, 2012** (Chicago, IL); **April 4, 2012** (Denver, CO): *LSC/Herman Miller Regional Seminars* (Invitational)
- **February 9, 2012:** *LSC D.C. Leadership Discussion*
- **February 14, 2012:** LSC Webinar: *The Chemistry Discovery Center at UMBC*. Presenter: William La Course, University of Maryland Baltimore County
- **February 24, 2012:** LSC/SCUP Workshop: *Planning and Executing Active Learning Spaces Seminar at Minneapolis Community Technical College*. Organized by: Sally Grans-Korsh, Minnesota State Colleges and Universities
- **March 21, 2012:** LSC Webinar: *The Athenaeum at Goucher College*. Facilitators: Sanford J. Ungar, President; Marc Roy, Provost
- **April 21, 2012:** LSC Webinar: *Anticipating Renovating and Renewing Learning Spaces*. Facilitator: Jeanne L. Narum, Principal, LSC
- **May 17–19, 2012:** *LSC Session at The AIA 2011 National Convention and Design Exposition.* Presenters: Amy Christmas, The S/L/A/M Collaborative, Inc.; Kent Duffy, SRG Partnership, Inc.; Jeanne Narum, LSC; Wendy Newstetter, Georgia Tech
- **May 31–June 2, 2012:** Session at *MARM 2012: Chemistry on the Chesapeake.* Presenter: William La Course, University of Maryland Baltimore County
- **June 23–26, 2012:** Session at CUR National Conference (Collaborating Partner Event). Presenters: Mary L. Crowe, Director, Office of Undergraduate Research, University of North Carolina at Greensboro; Melissa Terlicki, Associate Professor of Psychology, Cabrini College
- **July 7–11, 2012:** LSC Session at *SCUP–47* (Collaborating Partner Event). Presenters: Jeanne L. Narum, LSC; Phil Long, The University of Queensland
- **July 29–August 2, 2012:** LSC Session at BCCE: *Linking the Planning and Assessing of Learning Spaces and Learning Outcomes for Undergraduate Chemists.* Presenters: William La Course, University of Maryland Baltimore County; Mary Walczak, Professor of Chemistry, St. Olaf College