

# Interactive Learning and Assessment Strategies in General Chemistry 2011 Curriculum Reform Project

Rose Theisen, PhD

Assistant Professor in the Department of Chemistry

University of Wisconsin – Eau Claire



# Goals of the curriculum reform project:

To re-design a course that

- makes learning more interactive for students
- makes learning more visible to the instructor.

To engage and retain more students, specifically women and students of diverse cultural and socioeconomic backgrounds, in the physical sciences and chemistry

# Getting Started: Two Sources

- Haak, D.C.; HilleRisLambers, J.; Pitre, E.; Freeman, S. “Increased Structure and Active Learning Reduce the Achievement Gap in Introductory Biology” *Science* **2011**, 333, 1213-1216.
- Angelo, T. A. and Cross, K. P. Classroom Assessment Techniques: A Handbook for College Teachers; Second Edition ed.; Jossey-Bass: San Francisco, **1993**.

# Increased Structure and Active Learning Article

*Science* **2011**, 333, 1213-1216.

A highly structured course design

- improved the performance of all students in a college level introductory biology course
- and reduced the achievement gap between disadvantaged and non-disadvantaged students without increased expenditures.
- based on daily and weekly practice with problem solving, data analysis and other higher-order cognitive skills



# Increased Structure and Active Learning Article

*Science* 2011, 333, 1213-1216.

## Podcast Interview



From the *Science* Podcast: an interview with Scott Freeman on how increased structure and active learning reduces the achievement gap in introductory biology.

Listen:



[Download the interview \[MP3\]](#)

# Classroom Assessment Techniques

by T. A. Angelo and K. P. Cross

- Classroom assessment is an approach designed to help teachers find out **what** students are learning in the classroom and **how well** they are learning it.
- This book gives excellent examples of activities to include and how to implement them into your courses.
- Classroom Assessment aims at providing **early feedback**.
- This approach is learner-centered teacher-directed and firmly rooted in good practice.



# Curriculum Reform Project

## Course Details

- What course:
  - General Chemistry I (CHEM 103) Fall 2012
- Enrollment:
  - 75-150 students, 75% pre-nursing students, >5% chemistry majors, large lecture course with 3-5 lab sections
- Why I selected this course:
  - Introductory chemistry students lack of retention of fundamental concepts and lack of engagement for the subject material.
  - Large intro-level lecture courses present a unique opportunity for chemistry instructors to add inclusive and interactive teaching and learning techniques

# Curriculum Reform Project

## Course Details

- Proposed changes to course
  - Create a highly structured course which included
  - Traditional assessments: monthly exams, cumulative final, weekly quizzes, biweekly homework assignments and lab experiments
  - incorporated a **weekly classroom activity** into the lecture part of the course.

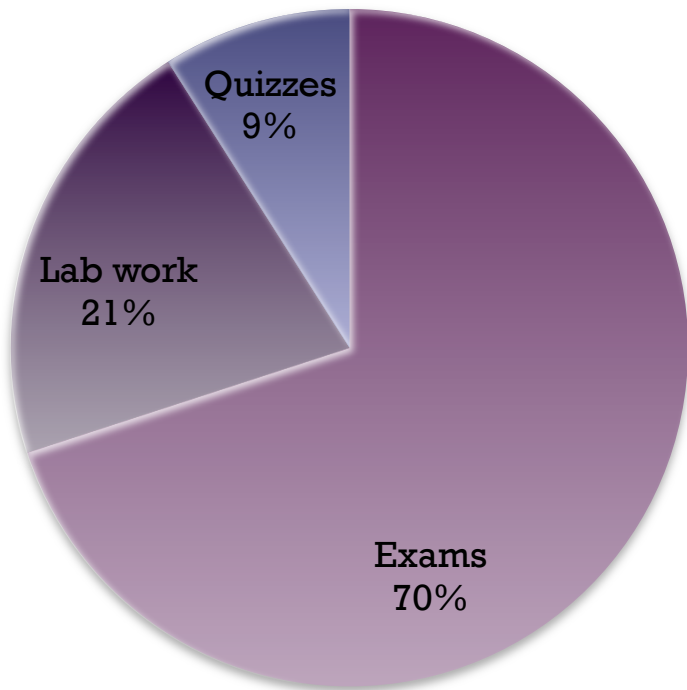


# Curriculum Reform Project

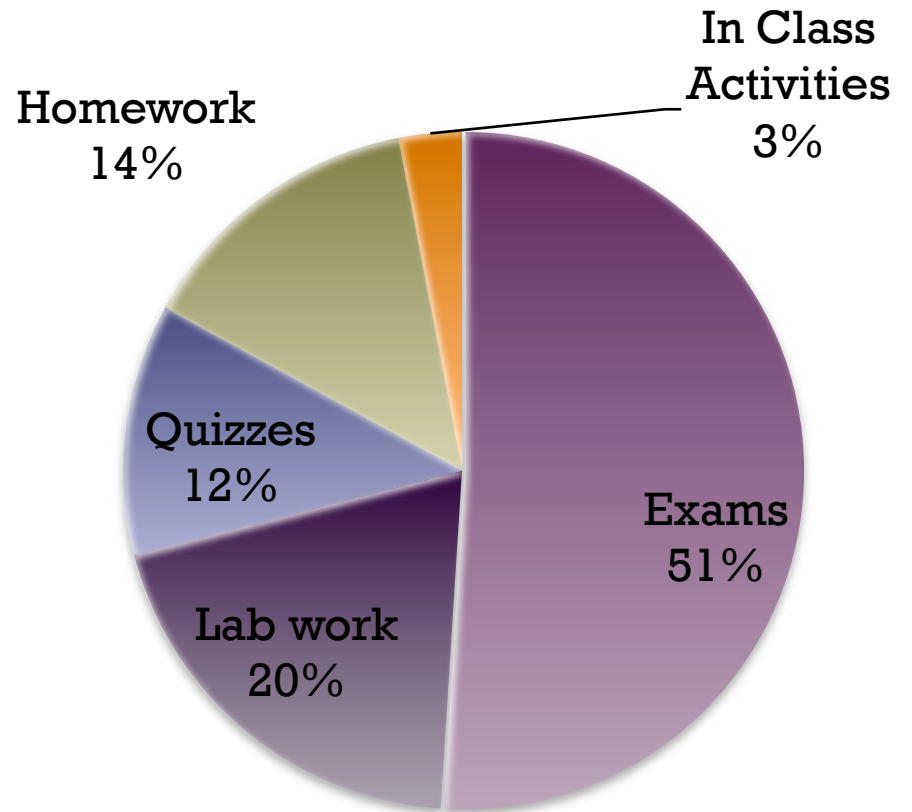
## Proposed Changes to the Course



Traditional Course



Highly Structured Course



# Curriculum Reform Project

## Proposed Changes to the Course

### ■ Weekly Classroom Activity

- Each week – a different activity depending on the material covered
- 2 points a week, 30 total points (3% overall grade)
- With high-frequency, low-risk activities, students should either gain familiarity with material or learn early that they don't understand a topic to seek further assistance
- To ease the burden of grading ~100 weekly assignments – activities were graded 0, 1 or 2 point scale

# Examples of Classroom Activities

CHEM 103 - Fall 2012

- Week 1: Response Notecard on Attitude of Previous Chemistry Experience
- Week 2: ChemActivity on the Nuclear Atom by Moog and Farrell
- Week 3: End of Class Notecard, Minute Paper
- Week 4: Self Assessment of Exam 1
- Week 5: Group Quiz on topics from lecture
- Week 6: Net Ionic Equation practice
- Week 7: Identify Types of Reactions practice
- Week 8: End of class notecard, Minute Paper
- Week 9: Lewis Structure practice
- Week 10: Formal Charge practice
- Week 11: Intermolecular forces practice
- Week 12: Intermolecular forces quiz preparation
- Week 12: Molar masses of gases practice
- Week 13: End of class notecard, Minute paper

# Examples of Classroom Activities

CHEM 103 - Fall 2012

- Week 1: Response Notecard on Attitude of Previous Chemistry Experience
- Week 2: ChemActivity on the Nuclear Atom by Moog and Farrell
- Week 3: End of Class Notecard, Minute Paper
- **Week 4: Self Assessment of Exam 1**
- Week 5: Group Quiz on topics from lecture
- Week 6: Net Ionic Equation practice
- Week 7: Identify Types of Reactions practice
- Week 8: End of class notecard, Minute Paper
- Week 9: Lewis Structure practice
- Week 10: Formal Charge practice
- Week 11: Intermolecular forces practice
- Week 12: Intermolecular forces quiz preparation
- Week 12: Molar masses of gases practice
- Week 13: End of class notecard, Minute paper

# Examples of Classroom Activities

CHEM 103 - Fall 2012

- Week 1: Response Notecard on Attitude of Previous Chemistry Experience
- Week 2: ChemActivity on the Nuclear Atom by Moog and Farrell
- **Week 3: End of Class Notecard, Minute Paper**
- Week 4: Self Assessment of Exam 1
- Week 5: Group Quiz on topics from lecture
- Week 6: Net Ionic Equation practice
- Week 7: Identify Types of Reactions practice
- **Week 8: End of class notecard, Minute Paper**
- Week 9: Lewis Structure practice
- Week 10: Formal Charge practice
- Week 11: Intermolecular forces practice
- Week 12: Intermolecular forces quiz preparation
- Week 12: Molar masses of gases practice
- **Week 13: End of class notecard, Minute paper**

# Classroom Assessment Techniques by Angelo and Cross

## Minute Paper

- A minute paper is a 3-5 minute writing assignment at the beginning of lecture period or a 3-5 minute writing assignment at the end of the lecture.



# Today's Classroom Activity #8

Note card, 2 points

Write your name on your note-card

- What is the most significant thing you learned today?
- What question is uppermost in your mind at the end of this class session?



# Classroom Assessment Techniques by Angelo and Cross

## Minute Paper

- The benefits from using minute papers are
  - that they require more active listening from students
  - improves students writing
  - writing assignments help document **for students** that they are indeed learning something in the course.



# Student's Favorite Classroom Activity

## Self Assessment of Exam #1, 2 points

Chemistry 103

Self Assessment of Exam 1 (2 points)

Fall 2012

Due in class Tuesday Oct 9<sup>th</sup> at 3:30pm

Name \_\_\_\_\_

**Circle** the answer for the following questions on study tips:

|   |                    |                 |
|---|--------------------|-----------------|
| How many <b>days a week</b> do you spend working on chemistry (not counting class)?   | <b>1-3 days</b>    | <b>3-5 days</b> |
| How much <b>time in a day</b> do you spend working chemistry problems (not counting class)?<br><b>Less than 30min 30min</b> | <b>1 hour</b>      | <b>More 1h</b>  |
| Did you use the <b>exam topic</b> list to study for exam #1?  | <b>Yes</b>         | <b>No</b>       |
| How many <b>SI sessions</b> have you attended?  | <b>More than 1</b> | <b>1 or 0</b>   |
| Do you skim/ <b>read</b> the assigned sections of textbook to prepare for lecture?  | <b>Yes</b>         | <b>No</b>       |
| Do you <b>take notes</b> /write down key terms when reading the assigned sections?  | <b>Yes</b>         | <b>No</b>       |
| Do you <b>work the examples</b> in the chapter as you read the chapter?   | <b>Yes</b>         | <b>No</b>       |
| Do you use the back of the book solution answers only to check your answers?  | <b>Yes</b>         | <b>No</b>       |
| Do you take <b>notes</b> in lecture?  | <b>Yes</b>         | <b>No</b>       |
| Do you <b>participate</b> in the calculation-based examples during lecture?   | <b>Yes</b>         | <b>No</b>       |

# Student's Favorite Classroom Activity

## Self Assessment of Exam #1

What is **helping** you learn in this class? (examples: *reading the sections before and after class, coming to lecture, SI sessions, quizzes, working examples in the chapter, working with peers in groups*)

What is **not helping** you learn in this class?

What is **something I can do** to help you learn more?

What **personal action plan** can you put in place to help yourself learn more this semester?

# Curriculum Reform Project

## Advantages of Classroom Activity

- Provided opportunities to describe concepts or reflect on learning
- Written record of students directly participating with the lecture material
- Encouraged group work (could work alone or together)
- Encouraged attendance
  - served as a measure of student attendance (required for UW-EC)

# Curriculum Reform Project

## Disadvantages of Classroom Activity

- Took 5-15 minutes of class time every week
- Some students didn't like working together
- If you are asking students to do something a little different than they are used to, you may have to sell it a bit.



# Curriculum Reform Project

## Student Comments

### ■ Group Work:

- I learned from the activities that we worked together with a partner on, it plays on each persons strengths
- Working with others [on the activities] gave me a different point of view about how I saw the problem

### ■ Self Assessment worksheet

- [I liked the] self assessment worksheet – it was kind of a kick in the butt for me to realize there is more I can do to get better grades

### ■ General

- I liked the activities, they helped me grasp the material better than if we just went over it in class



# Curriculum Reform Project

## Student Comments

### ■ Notecards:

- The end of class notecards was memorable because I like being able to give feedback in the middle of the semester when it will still make a difference to me.
- The notecards were helpful because I found I paid closer attention because I knew I had to write something down at the end of class
- End of class notecards it helped me think about what I understood and what I didn't from the lecture
- I really enjoyed using notecards to share our opinions with you and getting points for coming to class.

# Summary

## Interactive Learning and Assessment Strategies in General Chemistry

- Inclusion of Weekly Classroom Activities to Large Lecture Course in Chemistry
- The classroom activities
  - were a small change that made a big difference to my CHEM 103 course last fall
  - improved critical thinking skills and reflection, fostered group discussion and required instructor intervention
  - helped meet my course goals to makes learning more interactive for students and makes learning more visible to the instructor.
  - were well-received by students



# Acknowledgements

UW System Women & Science Program

Jennifer Mihalick and Amy Hardy

Department of Chemistry at UW-Eau Claire

Bob Eierman – Center for Excellence in Teaching and Learning (CETL)

Wisconsin Teaching Fellows and Scholars Program – UW System OPID

Cyndi Kernahan and Aeron Haynie (co-directors of WTFS program)



Wisconsin Teaching  
Fellows &  
Scholars