

Using Context and Problem-based Learning to Promote Learning in Introductory Chemistry Courses



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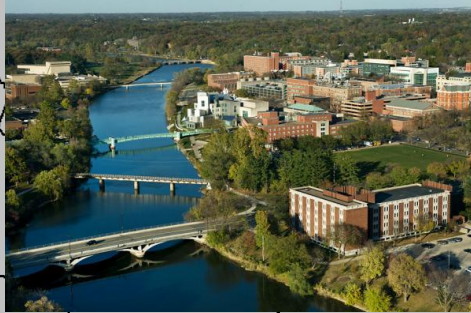
Introductions



Univ. of Iowa



Buffalo, New York

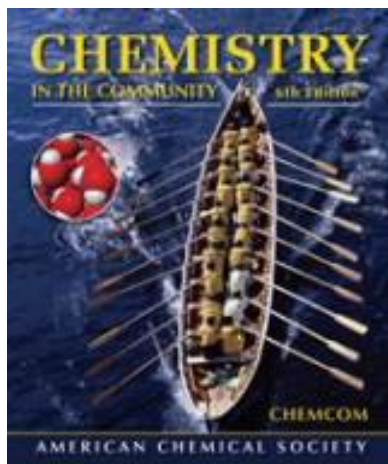


PhD: Univ. of North Carolina, Chapel Hill

Univ. of Georgia

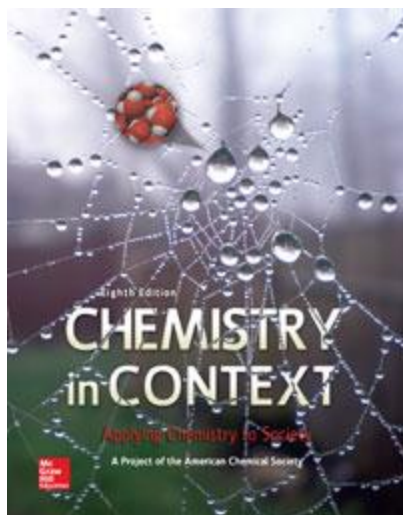


Content that is Accessible



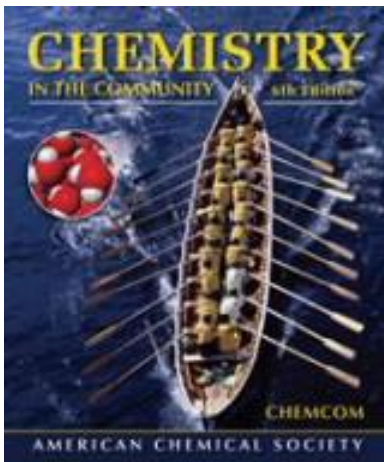
Chemistry in the Community [ChemCom]

- modular curriculum for high school
- 8 units, based on societal issues
- started in 1980; NSF grant w/ ACS support



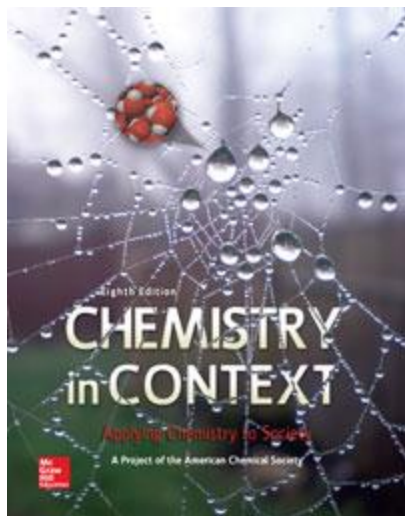
Chemistry in Context

- college level, non-science majors
- societal issues [environmental]



A Chemistry Text for Secondary School Students

1. Getting to know ChemComm
2. Materials: Formulating Matter
3. Air: Designing Scientific Investigations
4. Petroleum: Making and Breaking Bonds
5. Water: Exploring Solutions
6. Industry: Applying Chemical Reactions
7. Atoms: Nuclear Interactions
8. Food: Matter and Energy for Life



Writing A Chemistry Text for Nonscience Majors

1. The Air We Breathe
2. Protecting the Ozone Layer
3. The Chemistry of Global Warming
4. Energy, Chemistry, and Society
5. The Water We Drink
6. Neutralizing the Threat of Acid Rain
7. The Fires of Nuclear Fission
8. Energy from Electron Transfer
9. The World of Plastics and Polymers
10. Manipulating Molecules and Designing Drugs
11. Nutrition: Food for Thought
12. Genetic Engineering and the Molecules of Life

Which has the most calories—alcohol, carbohydrates, or fats?

What radioactive elements are found in my living room?

Are global warming and the ozone hole due to the same cause?

Is transgenic Iowa corn really “Frankenfood”?



How could they tell that the testosterone in the bike rider was synthetic?

Other Audiences— Basics (Prep) & Allied Health Sciences

Basics of Chemistry

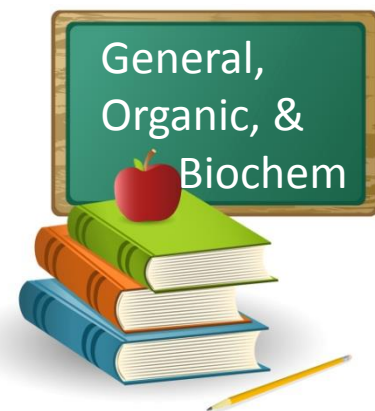
- preparatory course (university level but transitional)
- problem-solving and “habits of mind”

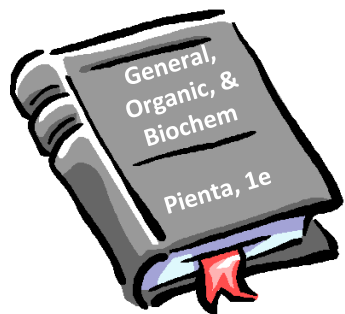
Allied Health Sciences

- required science courses (bio, chem, physics)
- value as prerequisite to subsequent courses

Needs

- prerequisite content
- accommodate math and science anxiety





Working with Curricula & Required Content

General

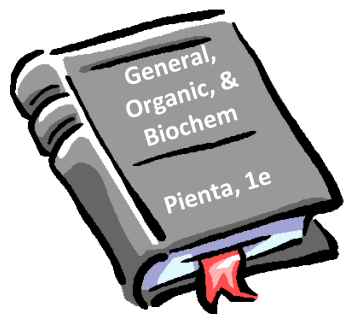
Atoms
Molecules
States of Matter
Solutions
Physical & Chemical Changes
Kinetics and Equilibrium
Acidity and Basicity

Organic / Biochem

Organic Molecular Structure
Physical & Chemical Properties
Reactions
Polymers and Advanced Materials
Chemistry & Nutrition
Drugs and Pharmaceutical Chemistry
Chemical Basis of Disease

Topics...

- Recognizable
- Consolidated
- Reorganized
- Support pedagogy



Challenging Tradition

Atoms
Molecules
States of Matter
Solutions
Physical & Chemical Changes
Kinetics and Equilibrium
Acidity and Basicity

Organic Molecular Structure
Physical & Chemical Properties
Reactions
Polymers and Advanced Materials
Chemistry & Nutrition
Drugs and Pharmaceutical Chemistry
Chemical Basis of Disease

Integrated topics...

- Metabolism & the Disappearance of Alcohol & Drugs
- Enzymes and Substrates

Case studies...

- Biological Timescales & Rates—From Photosynthesis to Trees
- Coagulation and Prothrombin Times
- Radiocarbon Dating
- Catalytic Converters
- Chelation Therapy—Equilibrium in Action



Matching a concept with a case-study

Individuals

- Choose a chemical concept or idea.
 - Particularly challenging
 - Particularly interesting
 - One or more common misconceptions




Matching a concept with a case-study

Individuals

- Choose a chemical concept or idea.
- Match a problem / scenario to illustrate it.

STEREOCHEMISTRY

R: CARBON VALENCY, HYBRID


START: STEERING WHEEL 

⇒ DOUBLE BOND,

ASSESSMENT: TESTING UNDERSTANDING

CIS-TRANS

3D-SHAPE

 THIS IS DIFFICULT

ORGN MECHANISMS

R: WHY IMPORTANT

BASIS OF ORGANIC STRUCTURE

ANIMATIONS

ASSESSMENT: UNKNOWNIS

ORGN

ORGANIC PAD

MELANIE COOPER

ISM!

ACID / BASE

ELECTROCHEM

R: WATER EQUILIBRIUM

R:

COLORED SOLUTIONS: SORT

SHOW CROSS-SECTION OF DRY CELL

COMMON DRINKS

DEMONSTRATION OF H₂ EVOLUTION

ASSESS

↗ GIVE SET OF SOLUTION

ASSESSMENT:

PHET
COLORADO



Matching a concept with a case-study

Groups

- Discuss individual chemical concepts or ideas and matching problem / scenario.
- Help refine each case study
 - Necessary background: What info do students need to know?
 - Demonstration of concept or idea: How do you integrate the original idea?
 - Devise an assessment: What assignment or activity would test their knowledge?



Matching a concept with a case-study

Group Reports

- chemical concepts or ideas with matching problem / scenario.
- case study
 - Necessary background: What info do students need to know?
 - Demonstration of concept or idea: How do you integrate the original idea?
 - Devise an assessment: What assignment or activity would test their knowledge?