

**SYLLABUS**  
**CHEMISTRY 101 (COLLEGE 200)**  
**Fall, 2016**  
**Chemistry, Energy, and Environment**

**Instructor:** Robert D. Pike  
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*Office Hours:*  
Wednesday 10:00–11:30 am  
Thursday 1:30–3:00 pm  
(and by appointment)

**Text:** R. D. Pike, Elements of Chemistry and Technology. Draft versions of the book chapters are available free-of-charge through Blackboard.

**Scope of the Course:** Our goals in this course are to examine (1) the basic chemical molecular principles of the physical world, (2) the relationship between matter and energy in the chemical world, (3) the impact of industry and consumer society on the environment, (4) the public policy debate on balancing energy needs and environmental stewardship. There will also be numerous scientific demonstrations intended to enhance your education and amusement.

**Intended Audience:** This course is intended for those students who have had little or no previous experience in chemistry (*i.e.* those who have had one year of high school chemistry or less). It is not intended for science majors or premedical students and does not satisfy any science major requirements. The course satisfies COLL 200 and GER 2A.

**Lectures:** Tuesday, Thursday, 9:30–10:50 am, Integrated Science Center room 1127. I do not take attendance. However, I strongly encourage you not to miss lectures since the quiz and exam material will come directly from the lectures. Also, I will have some sense of your attendance based on the quizzes.

**Quizzes:** (20%) A very short quiz will be given each Thursday class period, except 8/25, 9/29, 10/13, and 11/3. Each quiz will cover material contained in the preceding two lectures. Your lowest two quiz scores are dropped, so you can miss two quizzes without penalty.

**Practice Problems:** There are no graded homework sets, but practice problems and solutions will be posted on Blackboard.

**Examinations:** (15% for the lower score, 25% for the higher score) 9/29, 11/3.

Make-up tests are not typically permitted. If you must miss an exam, please let me know your reason at least one week in advance. If your reason is valid, we will arrange for you to take the exam early. All questions regarding grading of exams and quizzes must be raised within one week following return of the material. No scores will be changed thereafter.

**Final Examination:** (25%) Partly cumulative. December 7, 9:00 am, ISC 1127.

**Group Projects:** (15%): Student groups, consisting of four or five members each, will research and prepare a presentation on a topic in chemistry, energy, or the environment. Topics may be chosen from a list of suggestions which will be distributed and must be approved by the instructor. The groups' work will be presented to the class via Blackboard at the end of the semester.

## Chemistry 101 Course Outline (text chapters in parenthesis):

*Course Introductory Topic: "Four Sources of Energy and Three Types of Pollution"*

### I. Observation and Measurement in Chemistry (Chapter 1)

#### A. The History of Matter Science

1. The ancient Greeks
2. Aristotle and alchemy
3. The enlightenment
4. The rise of atomic theory
5. Avogadro and chemical analysis

#### B. The Scientific Method

1. Assumptions in the scientific method
2. Applying the scientific method

#### C. Quantitative and Mathematical Tools in Science

1. Units of measurement
2. Significant figures and exponential notation
3. Units Cancellation Calculations

### II. The Nature of Matter (Chapter 2)

*Introductory Topic: "Natural = Safe, Chemical = Toxic?"*

#### A. Structure of the Atom

1. Subatomic particles
2. Atoms and isotopes
3. Nuclear fusion and stars
4. Atomic force microscopy

#### B. The Periodic Table

1. Spectroscopy and the elements
2. Electron shell and subshell filling
3. The periodic table: metals, semimetals, and non-metals
4. The periodic table: prediction of ion formation and valence

#### C. Gases: Particles Moving in a Vacuum

1. Atomic mass, molecular mass and the mole
2. Density
3. Kinetic molecular theory
4. Pressure, volume, temperature, amount

### III. Ions, Redox Reactions, and Batteries (Chapter 3)

*Introductory Topic: "Energy Delivery: The Grid, Batteries, and (maybe) Hydrogen"*

#### A. Chemical Bonds and Energy Storage

#### B. Ions and Ionic Bonding

1. Electronegativity
2. Ion formation: behavior of electrons
3. Ionic compounds: microscopic structure and macroscopic properties
4. Ionic compounds: formulas and nomenclature

***What's in that stuff? Soil***

C. Oxidation-Reduction Chemistry

1. Reactions involving electron transfer
2. Voltaic and electrolytic reactions
3. Some examples of batteries and electrolysis

IV. Covalent Chemistry (Chapters 4, 5, and 6)

*Introductory Topic: "Agriculture, War, and Marine Dead Zones"*

A. Covalent Bonding

1. Electron sharing
2. Covalent compounds: formulas and nomenclature
3. Lewis dot structures and the octet rule
4. Lone pairs of electrons, molecular shape, and polarity
5. Multiple bonds and resonance
6. Polyatomic ions and solubility

***What's in that stuff? Organic Compounds & Plastics***

B. Covalent Reactions

1. Stoichiometry
2. Limiting reactant and percent yield

C. Chemical Energetics

1. Heat flow: "enthalpy"
2. Chemical storage of energy: "bond dissociation energy"
3. Disorder: "entropy"
4. The big picture: "free energy" and spontaneity
5. Reaction rates and catalysis

D. Combustion, Explosion, and Cancer

V. Water (Chapter 7)

*Introductory Topic: "Chemistry, Energy, and Pollution Revisited"*

A. Solutions

1. Solutions, suspensions, and colloids
2. Units of concentration
3. Ion concentrations in solution

B. Chemical Equilibrium

1. Equilibrium between states of matter
2. Reversibility in chemical reactions
3. Equilibrium constants
4. LeChâtelier's principle

C. Acids and Bases

1. What makes substances acidic or basic?
2. Conjugate acids & bases and dissociation constants
3. Water: amphoteric, autoionizing, and leveling
4. The pH scale
5. Neutralization reactions, titrations and buffers

## VI. The Environment (Chapter 8)

*Introductory Topic: "Risks and Benefits"*

### A. Environmental Chemistry

1. Water pollution: metals
2. Water pollution: organics

***What's in that stuff? Wood & Biomass***

3. Water treatment
4. Air pollution: smog, the ozone layer, acid rain, and global warming

### B. Environmental Policy

1. Refrigerants and the ozone layer
2. Fossil fuels and acid rain
3. Fossil carbon and global climate change

## VII. Energy (Chapters 10 and 11)

*Introductory Topic: "The Dangers of Radiation"*

### A. Metals and Semimetals

1. Types of solids: amorphous and crystalline
2. Types of crystalline solids: ionic, network covalent, molecular covalent, metallic
3. Conduction and semiconduction

***What's in that stuff? Glass***

### B. Our Energy Options

1. Our energy needs
2. Petroleum: chemical energy
3. Mechanical energy: wind, water, and geothermal
4. Solar energy
5. Nuclear energy

### C. Energy Policy for the Future