JEFFERSON COLLEGE

COURSE SYLLABUS

CHM101

INTRODUCTORY CHEMISTRY

5 Credit Hours

Prepared by:
Vern L. Wolfmeyer

Revised by:
Wesley Whitfield
&
Sean Birke
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Minor Revision or Update by: Fran Moore
Per Curriculum Committee Process Change: April 25, 2018

Ms. Linda Abernathy, Math, Science & Business Division Chair
Ms. Shirley Davenport, Dean, Arts & Science Education
CHM101 Introductory Chemistry

I. CATALOGUE DESCRIPTION

A. Course prerequisites:
   - 3.0+ high school GPA, MTH084 or MTH002 with a grade of “C” or better, ACCUPLACER elementary algebra score of 75 or college level math of at least 20 within the past two years, COMPASS algebra score of at least 42 within the past two years, or ACT math score of at least 18
   - Reading proficiency

B. 5 semester credit hours

C. Introductory Chemistry is designed for the student who has had no prior instruction in chemistry. This course explores the fundamental concepts and laws which deal with the composition, structure, and behavior of matter. The relationship of theory to practical applications will be emphasized. Laboratory time is required. Introductory Chemistry carries no credit toward a major in natural science or engineering fields. This course is not recommended for science or engineering majors unless they have had no previous chemistry. Students cannot apply both CHM101 and CHM102 toward graduation. (F,S,Su)

D. Curricular alignment:
   - Fulfills part of Natural Sciences (Physical Sciences) with lab CORE requirement for AA, AAT, AFA, and select AAS degrees: MOTR CHEM 100L Essentials in Chemistry with Lab
   - Elective course applies toward AA or AAT degree.

II. EXPECTED LEARNING OUTCOMES/CORRESPONDING ASSESSMENT MEASURES

<table>
<thead>
<tr>
<th>Expected Learning Outcomes</th>
<th>Assessment Measures</th>
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<tbody>
<tr>
<td>Understand the basic nature of the science of chemistry</td>
<td>Examinations, quizzes, laboratory exercises, and class discussion</td>
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<td>Convert units within the metric (SI) system</td>
<td>Examinations, quizzes, laboratory exercises, and class discussion</td>
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<tr>
<td>Classify matter as element, compound or mixture</td>
<td>Examinations, quizzes, laboratory exercises, and class discussion</td>
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<td>Perform basic computations using the mole concept</td>
<td>Examinations, quizzes, laboratory exercises, and class discussion</td>
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<tr>
<td>Balance, interpret, and perform basic computations using chemical equations.</td>
<td>Examinations, quizzes, laboratory exercises, and class discussion</td>
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<td>Distinguish between physical and chemical properties</td>
<td>Examinations, quizzes, laboratory exercises, and class discussion</td>
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<tr>
<td>Distinguish between physical and chemical changes</td>
<td>Examinations, quizzes, laboratory exercises, and class discussion</td>
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<tr>
<td>Use the Periodic Table to make predictions about the properties of the element</td>
<td>Examinations, quizzes, laboratory exercises, and class discussion</td>
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<tr>
<td>Gain laboratory and data collection experience</td>
<td>Laboratory exercises and class discussion</td>
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<tr>
<td>Connect chemical knowledge with STEM and health professional fields</td>
<td>Examinations, quizzes, laboratory exercises, and class discussion</td>
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III. OUTLINE OF TOPICS

A. Introduction to chemistry
   1. Scope of chemistry
      a. Definitions of chemistry
      b. Matter
      c. Mass and weight
      d. Properties of matter
   2. Historical perspectives
      a. The ancient arts
      b. The Greeks
      c. Alchemy
      d. Modern chemistry
   3. The scientific method
      a. Science as a process
      b. Fact
      c. Data
      d. Natural laws
      e. Hypotheses
      f. Theories

B. Matter and energy
   1. Properties and changes
      a. Composition and structure
      b. Physical properties
      c. Physical change
      d. Chemical properties
      e. Chemical change
   2. Physical states
      a. Solid state
      b. Liquid state
      c. Gaseous state
      d. Changes in state
   3. Classification
      a. Pure substances
      b. Homogeneous and heterogeneous mixtures
      c. Elements
      d. Compounds
   4. Energy
      a. Definition
      b. Work
      c. Kinetic energy
      d. Potential energy
      e. Forms of energy
      f. Energy transformations
      g. Law of conservation
      h. Units of energy
C. Measurement and problem solving
1. Background
   a. History
   b. Development of units
2. Reliability of measurement
   a. Uncertainty
   b. Accuracy
   c. Precision
   d. Types of errors
3. Exponential notation (scientific notation)
   a. Base ten arithmetic
   b. Calculations
4. International system (SI) of units
   a. Seven base units
   b. Prefixes and their meanings
   c. Metric conversions
   d. Heat and temperature
   e. Derived units
   f. Density and specific gravity
5. Significant figures
   a. Meaning
   b. Rules for determination
   c. Computations
   d. Rounding numbers
6. Approach to problem solving
   a. General principles
   b. Planning
   c. Approximations
   d. Dimensional analysis (bridge method)
   e. Operations
   f. Assessment
7. Types of problems
   a. Calculations with density
   b. Calculations with temperature
   c. Calculations with heat energy

D. Atomic theory
1. Elements
   a. Democritus
   b. Organization of the periodic table
      i. Groups
      ii. Periods
      iii. Family names of elements
   c. Physical properties
      i. Metals
      ii. Non metals
      iii. Metalloids
d. Dalton’s theory  
e. Laws of definite and multiple proportions

2. Structure of atoms  
a. Subatomic particles  
b. Atomic mass unit  
c. The nucleus  
d. Atomic number  
e. Mass number  
f. Atomic symbols  
g. Isotopes

3. Atomic weight  
a. Isotopic mass  
b. Distribution in nature  
c. Relative averages

4. Introduction to the mole concept  
a. Molar mass  
b. Avogadro’s number

5. Chemical formula

E. Electron structure of atoms  
1. Discovery of atomic structure  
a. Thompson and cathode rays  
b. Plum pudding model  
c. Millikan’s oil drop experiment  
d. Rutherford’s alpha particle experiment

2. The electromagnetic spectrum  
a. Visible light  
b. Ultraviolet light  
c. Infrared light  
d. Microwave radiation

3. Excited electrons  
a. Photoelectric effect  
b. Line spectra

4. Electrons in atoms  
a. Ionization  
b. Valence electrons and Lewis symbols  
c. Bohr model

5. Quantum mechanical model  
a. deBroglie  
b. Schrödinger wave equation  
c. Heisenberg uncertainty principle

6. Electronic structure/configurations and energy levels  
a. Aufbau principle  
b. Hund’s rule  
c. Pauli exclusion principle  
d. Electron energy levels and the periodic table
F. Chemical nomenclature
1. Chemical formula
   a. General guidelines
   b. Oxidation numbers
      i. Definition
      ii. Rules for assignment
      iii. Use in writing formulas
2. Names of chemical compounds
   a. Common vs. systematic names
   b. General guidelines
   c. Binary compounds
      i. Ionic compounds of representative elements
      ii. Ionic compounds of transition metals
         a. Stock system
         b. Greek prefixes
      iii. Molecular compounds
      iv. Binary and ternary acids and their salts
      v. Bases
   d. Ternary compounds
      i. Oxidation number of the central atom
      ii. Polyatomic ions
   e. Hydrates

G. Periodic properties
1. Discovery of the elements
2. Modern periodic law
3. Atomic number concept
4. Periodic properties
   a. Atomic size
   b. Ionization energy
   c. Electron affinity
   d. Melting points and boiling points
   e. Density and conductivity
5. Typical elements
   a. Group similarities
   b. Trends in groups
   c. Metals
   d. Transition metals

H. Chemical bonding
1. Bond formation
   a. Energetics and stability
   b. The octet rule
   c. Lewis structures of atoms
2. The ionic bond
   a. Electron transfer
   b. Electrostatic forces
c. Electron dot structures
d. Properties of ionic compounds

3. The covalent bond
   a. Electron sharing
   b. Relative stability
c. Mechanism of formation
d. Lewis electron dot structures
e. Multiple covalent bonds
f. Electronegativity
   i. Polar covalent bonds
   ii. Coordinate covalent bonds
g. VSPER and molecular geometry
h. Properties of covalent compounds

I. The mole concept
   1. The mole
      a. Formula weights vs. molecular weights
      b. Moles and molar masses
   2. Composition calculations
   3. Mass and mole conversions
   4. Calculations involving Avogadro’s number
   5. Calculation of solution concentration
      a. Molarity
      b. Dilution
   6. Moles and chemical formulas
      a. Percent composition
      b. Empirical formulas
      c. Molecular formulas

J. Chemical equations
   1. Basics of chemical equations
      a. Verbal description of chemical change
      b. Symbolic representations
      c. Special symbols
      d. Interpretation
   2. Equation balancing
      a. Law of conservation of mass (atoms)
      b. Use of coefficients
      c. Steps in equation balancing procedure
d. Special note regarding polyatomic ions in balancing procedure
e. Quantitative (molar) interpretation of balanced equations
   3. Classification of reaction types
      a. Synthesis (combination) reactions
      b. Analysis (decomposition) reactions
      c. Substitution (single displacement) reactions
d. Metathesis (double displacement) reactions
e. Combustion reactions
K. Stoichiometry
1. Quantitative interpretation of equations
   a. Information given by balanced equation
   b. The mole revisited
   c. Definition of "stoichiometry"
   d. Molar relationships
2. Computations based on equations
   a. Mole-mass relationships
   b. Mass-mass relationships
   c. Limiting reactant in chemical reactions
   d. Theoretical yield and actual yield

L. Gases
1. The atmosphere
2. Kinetic molecular theory of gases
3. Atmospheric pressure and pressure conversions
4. Gas laws
   a. Boyle’s law
   b. Charles’ law
   c. Gay-Lussac’s law
   d. Combined gas law
   e. Avogadro’s law
   f. Molar volume of a gas and density
   g. Ideal gas law
   h. Dalton’s law of partial pressures
   i. Gas stoichiometry

M. Liquids and solids
1. General properties
2. Intermolecular forces
   a. Dipole forces
   b. Hydrogen bonds
   c. Dispersion forces
   d. Ion – dipole interactions
3. The liquid state
   a. Viscosity
   b. Surface tension
4. Vaporization and condensation
   a. Vapor pressure
   b. Boiling point
   c. Distillation
   d. Heat of vaporization
5. The solid state
   a. Amorphous solids
   b. Crystalline solids
   c. Bonding classifications
     i. Ionic solids
     ii. Molecular solids
iii. Covalent network
iv. Metallic
6. Melting and freezing
7. Heating and cooling curves

N. Solutions
1. General characteristics
2. Solubility
   a. Ionic compounds
   b. Covalent compounds
   c. Temperature and pressure effects
3. Concentration expressions
   a. Molarity
   b. Percent by volume
   c. Percent by mass
   d. Parts per million and billion
4. Colligative properties
   a. Freezing point depression
   b. Boiling point elevation
   c. Osmotic pressure
5. Colloids
6. Osmosis and dialysis

IV. METHODS OF INSTRUCTION

A. Lecture
B. Class discussion and class activities
C. Textbook readings
D. Laboratory experiments

V. REQUIRED TEXTBOOKS


VI. REQUIRED MATERIALS

Writing paper, pencils, pens, laboratory notebook, laboratory safety eyewear, scientific calculator
VII. SUPPLEMENTAL REFERENCES

Numerous textbooks, study guides, and problem solving supplements are available at the reserve desk in the library, laboratory, Jefferson College bookstores, and on the blackboard course page.

VIII. METHODS OF EVALUATION

A. Lecture examinations
B. Lecture quizzes
C. Class activities
D. Laboratory reports
E. Grading scale:
   - 90-100% = A
   - 80-89% = B
   - 70-79% = C
   - 60-69% = D
   - Below 60% = F

IX. ADA AA STATEMENT

Any student requiring special accommodations should inform the instructor and the Coordinator of Disability Support Services (TC 101; phone 636-481-3169)

X. ACADEMIC HONESTY STATEMENT

All students are responsible for complying with campus policies as stated in the Student Handbook (see College website, http://www.jeffco.edu).

XI. ATTENDANCE STATEMENT

Regular and punctual attendance is expected of all students. Any one of these four options may result in the student being removed from the class and an administrative withdrawal being processed: (1) Student fails to begin class; (2) Student ceases participation for at least two consecutive weeks; (3) Student misses 15 percent or more of the coursework; and/or (4) Student misses 15 percent or more of the course as defined by the instructor. Students earn their financial aid by regularly attending and actively participating in their coursework. If a student does not actively participate, he/she may have to return financial aid funds. Consult the College Catalog or a Student Financial Services representative for more details.
XII. OUTSIDE OF CLASS ACADEMICALLY RELATED ACTIVITIES

The U.S. Department of Education mandates that students be made aware of expectations regarding coursework to be completed outside the classroom. Students are expected to spend substantial time outside of class meetings engaging in academically related activities such as reading, studying, and completing assignments. Specifically, time spent on academically related activities outside of class combined with time spent in class meetings is expected to be a minimum of 37.5 hours over the duration of the term for each credit hour.