CHEM 100: People and Chemistry
Section 4 Fall 2026

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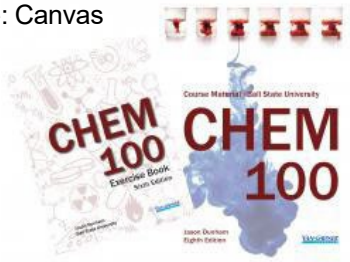

Required Materials:

- Course Materials 8th Edition, Dunham, Van-Griner, 2019
- Exercises Book 6th Edition, Dunham Van-Griner, 2019
- Calculator (non-scientific fine, not programmable)

Course Description:

Chemistry 100 is an elective in the University Core Curriculum that focuses on the practical applications of chemistry in modern society. The objective of this course is to introduce students to the fundamental concepts of chemistry such as the language of chemistry, the nature and classification of matter, and atomic and molecular structure. More specific content objectives will be distributed separately in class. The primary goal is to make relevant the application of these topics to everyday living in order to instill an appreciation for chemistry in students.

The University Core Curriculum:

The central purpose of the University Core Curriculum is to enable individuals to live rich, satisfying lives and to undertake the broad responsibilities of citizenship in a free society. Although it seeks to discover and nurture individual talents, the core curriculum's primary emphasis is on preparation for roles that people share in common as human beings as well as members of family and community groups. The spirit of the core curriculum emerges from the kinds of intellectual attitudes the university strives to develop in students. Through their core curriculum courses, students will be able to:

- engage in lifelong education by learning to acquire knowledge and to use it for intelligent ends.
- communicate at a level acceptable for college graduates.
- clarify their personal values and be sensitive to those held by others.
- recognize and seek solutions for the common problems of living by drawing on a knowledge of historical and contemporary events and elements of the cultural heritage surrounding those events.
- work with others to solve life's common problems.
- assess their unique interests, talents, and goals and choose specialized learning experiences that will foster their fulfillment.

University Attendance Policy:

A student's official course program is regarded as a contract with the university. Because full performance requires, in part, regular and punctual class attendance, students are expected to attend all classes for which they are registered. ...

Students who know they must be absent from a class should notify the instructor or department office. Courtesy requires that students speak to the instructor and preferably present a signed and dated memo briefly stating the reasons for absence.

Faculty members are responsible for keeping records of attendance of all students registered in each class. Students are responsible for completing any work they have missed. The faculty member is not required to do extra teaching or help students "catch up."

I have collected data and correlated exam scores to attendance and found a strong relationship. Attending class is the best way to succeed in this course.

<u>Students Missing 4 or more classes will lose 10% off their final grade with each absence. Meaning 8 absences leads to automatic failure.</u>

Lectures / Class Participation:

Lectures will begin promptly at 11 AM. The student is expected to be present and on time for each class day. The student is further expected to be courteous and respectful of others in class; therefore, laptop computers, cell phones, and other devices should be turned off or silenced and stowed beneath your chair. The student is responsible for actively learning the lecture material presented by the instructor and is expected to participate in class activities.

Course Material Book:

As a hybrid course, there is a significant amount of required work done through online delivery of materials. This includes the lecture material for which links will be posted to Canvas. It is the student's responsibility to watch and engage with this material. These lecture correlate to the course materials book and the student is responsible for filling out this material. The course materials book will be checked during each Unit Exam and points given for its completion.

On-line Exercises:

As a means of self-assessment and to help students prepare for examinations, students will be expected to complete on-line exercises delivered through Canvas assessments. These online problems are located in the exercises book to allow for students to either work before answering the online questions, or use the online quizzes to complete the exercises book. Announcements will be made in class indicating when each unit will open and close. Ample time will be given for students to complete each unit, and **all problems can be tried as many times as needed to earn credit**. A maximum of 195 points can be earned by completing all exercises. These assignments are all or nothing, so a student needs to get a perfect score in order to earn credit.

Homework Assignments:

Homework will be assigned, collected, graded for completion and correctness, and returned in class. Working these problems is a necessary step toward understanding the lecture material and toward exam preparation. Solutions will be posted on the course website following their due date. A student's score will be determined based on a percentage of total points earned on completed assignments. A maximum of 70 points can be earned from homework assignments.

Online Lecture Quizzes:

In order to maintain course engagement, as well as measure student understanding, online lectures will be accompanied by lecture quizzes to be submitted through Canvas at the end of the week the lectures are assigned. Each will be worth up to 5 pts., with a total of 115 points for the semester.

Lab Activities:

A number of experiments will be performed and presented throughout the semester. The student will be expected to record observations, data, and other important information related to demonstrations and other in-class presentations. The objective of recording observations is to help the student gain experience to become an independent and creative learner. The student will be exposed to some of the experimental tools that chemists use to study the world around them and will be required to make the type of assumptions and conclusions that scientists must make in their daily lives.

The student will report observations, data, results, and conclusions on the lab exercises. (Hopefully, you will discover that you gain a better understanding of an experiment as you analyze the data and observations.) Lab exercise reports will be assessed based on the following criteria:

- observations, results, and/or conclusions are recorded using precise scientific language
- numerical results are reported using correct precision and units
- data and results are interpreted using scientific models/knowledge
- questions are answered correctly

A maximum of 115 points can be earned by completing the lab assignments.

Examinations:

Three one-hour Units exams (150 pts each) and a comprehensive final exam (100 pts) will be given to assess student comprehension of the course material. These dates are tentative and subject to change. Any changes will be announced in class.

Exam Schedule:

Exam	Available Date	Coverage	Value
Exam 1	Thur. Oct. 1st	Unit 1: Atoms	150 pts
Exam 2	Thur. Nov. 5th	Unit 2: Molecules	150 pts
Exam 3	Thur. Dec. 3rd	Unit 3: Reactions	150 pts
Final Exam	Dec. 8th-Dec. 11th (online)	Cumulative Portion	100 pts

Students must take all one-hour unit exams and the final exam to earn a passing grade in CHEM 100. The exams mostly will consist of problem-solving questions; however, there also may be essay, short answer, true-false, matching, and / or fill-in-the-blank problems.

Grading

A total of 1200 points are possible in CHEM 100. The points will be distributed as follows:

Online Exercises	195
Course Materials Book	60
Homework	70
Online Lecture Quizzes	115
Lab Activities	115
Unit Exams	450
IC Problems	95
Cumulative Final MC Exam	100
Total points possible	1200

The grade that a student receives in CHEM 100 will be based on the following earned points:

Above 95%	A	73-76.99%	C
90-94.99%	A−	70-72.99%	C−
87-89.99%	B+	67-69.99%	D+
83-86.99%	B	63-66.99%	D
80-82.99%	B−	60-62.99%	D−
77-79.99%	C+	Less than 60%	F

University Statement:

We are committed to ensuring that all members of the community are welcome, through valuing the various experiences and worldviews represented at Ball State and among those we serve. We promote a culture of respect and civil discourse. If you need course adaptations or accommodations because of a disability, please contact the instructor of record as soon as possible. Ball State's Disability Services Office coordinates services for students with disabilities; documentation of a disability needs to be on file in that office before any accommodations can be provided. Disability Services can be contacted at 765-285-5293 or dsd@bsu.edu.

CHEM 100 Topics

Unit 1: Atoms

1.1 Classification of Matter
1.2 Elemental Composition
1.3 Organization of the Elements
1.4 Nuclear Chemistry Part I-Natural Decay
1.5 Nuclear Chemistry Part II-Fission/Fusion
1.6 Electron Structure
1.7 Valence Electrons and Periodic Properties

Unit 2: Compounds

2.1 Formation of Compounds
2.2 Ionic Compounds
2.3 Molecular Compounds
2.4 Lewis Structures
2.5 Valence Shell Electron Pair Repulsion (VSEPR) Theory
2.6 Intermolecular Forces
2.7 Intermolecular Forces and Phases

Unit 3: Reactions

3.1 Balancing and Classifying Chemical Reactions
3.2 Energy in Chemical Reactions
3.3 Thermodynamics
3.4 Mass Balance in Chemical Reactions
3.5 Acids and Bases

CHEM 100 LEARNING OBJECTIVES:

CHEM 100
Unit 1 Objectives upon completion of this material, you should be able to do the following:

Classification of Matter

- Define science, chemistry, and matter
- Know the different classifications of matter and how they can be separated
- Classify matter as either
  - pure substance or mixture
  - element or compound
  - homogenous or heterogeneous mixture
- Explain the differences between
  - physical and chemical properties
  - physical and chemical changes
- Be able to classify properties as chemical or physical
- Be able to classify changes as chemical or physical

Elemental Composition

- Outline the steps of the Scientific method
  - explain what each step means
- Define fact, hypothesis, theory, and law
- State the 4 postulates of Dalton's Atomic Theory and explain how the following laws confirm this theory:
  - Law of Constant Composition
  - Law of Multiple Proportions
  - Law of Conservation of Mass

- Identify two limitations of Dalton's Atomic Theory
- Define atom, isotope, ion, and molecule
- Identify the characteristics of protons, neutrons, and electrons (atomic weight in amu, charge, location)
- Identify the 4 fundamental forces
- Describe the interactions of charged particles
- Define: atomic number, mass number, and atomic weight; and know how to determine them
- Determine the number of protons, neutrons, and electrons of an isotope from either the symbol or name
- Define cation and anion
- Determine number of protons, neutrons, and electrons within an ion

Organization of the Elements

- Locate elements on the periodic table based on group and periodic designations
  - Example: period 3, group VA would be phosphorus
- Identify the location on the periodic table of:
  - Groups IA−VIIIA (the main group elements)
  - transition and inner transition elements
  - metals, nonmetals, and metalloids
- Give the names for Groups IA, IIA, VIIA, and VIIIA
- Use the periodic table to classify an element as
  - a main group, transition, or inner transition element
  - a metal, nonmetal, or metalloid
  - an alkali metal, alkaline earth metal, halogen, or noble gas
- Identify the 7 diatomic elements and 3 polyatomic elements
- Describe the difference between heteroatomic and homoatomic molecules

Nuclear Chemistry

- Identify the underlying cause of radiation
- Use the graph of the belt of stability to predict the stability of a given nuclide
- Describe and characterize the common forms of radioactivity
  - Identify and write the symbols for emitted radioactivity
- Predict type of decay for a given radioisotope
- Write a balanced equation describing any nuclear reaction
  - Identify missing particles
  - Identify the type of nuclear reaction an equation represents
- Define half-life and be able to work problems using half-life
- Describe the processes of fission and fusion
- Identify the fundamental parts of a nuclear power plant
  - Describe how the fission chain reaction is controlled
- Identify four applications for radioisotopes
  - Describe how radioactivity affects the health of humans

Electron Structure

- Describe the Bohr model of the atom and identify its limitations
- Describe what is meant by the phrase "The energy of electrons in atoms is quantized."
- Identify and describe the three levels of structure that describe the location of an electron in an atom
  - Identify the number of subshells present in a given shell
  - Identify the number of orbitals found in each subshell
  - Describe the general shape of an orbital found in each subshell
  - Identify the maximum number of electrons each subshell can hold
- Describe how the aufbau principle, the Pauli exclusion principle, and Hund's rule apply to electron configurations
- Write the electron configuration of a given element in both extended and abbreviated forms
  - Given an electron configuration, determine the element
- Define valence shell and identify the number of valence electrons in an atom of any main-group element
- Describe property trends within the periodic table and use those trends to predict properties of the elements

Unit 2 Objectives upon completion of this material, you should be able to do the following:

Formation of Compounds

- Define valence shell and identify the number of valence electrons in an atom of any main-group element
- Describe property trends within the periodic table and use those trends to predict properties of the elements
- Use the octet rule to explain why and how atoms of the main group elements form ions/chemical bonds
- Predict ion stability based on the octet rule
- Differentiate between the chemical and physical properties of any monatomic ion and its corresponding atom
- Identify the charge on any monatomic ion formed by a main group element
- Draw the Lewis dot symbol for an atom or ion of any main group element
- Define electronegativity
  - Use periodic trends to rank atoms in terms of their electronegativity
- Predict the type of chemical bond formed between two atoms based on the difference in their electronegativity values (ΔEN)

Ionic Compounds

- Describe the formation of an ionic compound from metal and nonmetal atoms
- Identify the typical structure/shape of an ionic compound
- State three physical properties of ionic compounds
- Predict the chemical formulas of binary ionic compounds formed between main-group metal and nonmetal atoms
- Name any monatomic cation or anion
  - Explain how anion names are formed from element names
- Name an ionic compound from its chemical formula or write the chemical formula from its name
  - Explain why Roman numerals are sometimes needed when naming monatomic cations and ionic compounds
- State the name, charge, and formula of the ten polyatomic ions listed in the notes
- Name an ionic compound that contains one or more polyatomic ions or write its chemical formula from its name

Molecular Compounds

- Identify the number of electrons being shared between two atoms with a single, double, or triple bond
- Explain the difference between nonpolar and polar covalent bonds
- Write the chemical formula of a molecule based on the number of atoms in the molecule or based on its structural formula
- Determine the number of atoms of a particular element in a molecule if given the chemical formula
- Classify a compound as molecular or ionic based on its chemical formula
- Differentiate between the properties of ionic and molecular compounds
- Name a molecular compound from the chemical formula or write the chemical formula from its name

Lewis Structures and Valence Shell Electron Pair Repulsion (VSEPR) Theory

- If given the name or formula of a molecule or polyatomic ion:
  - calculate total number of valence electrons
  - determine the octet number of electrons, the number of bonding electrons and number of bonds
  - calculate the number of nonbonding electrons and lone pairs
  - identify the central atom in the structure
- Draw the Lewis structure for a molecule or polyatomic ion from its name or formula using the information determined above
- Determine number of regions of electron density (R.E.D.s) around a central atom
- Determine the electron geometry of a molecule or polyatomic ion based on the number of R.E.D.s
- Identify the bond angle associated with a given electron geometry
- Determine the molecular geometry (shape) of a molecule or polyatomic ion

- Based on the molecular shape predicted using VSEPR theory, predict whether a molecule is polar or nonpolar

Intermolecular Forces and Phases

- Compare and contrast the three phases of matter based on the strength of the intermolecular forces, space between particles, compressibility, whether the shape is definite or indefinite, and whether the volume is definite or indefinite
- Explain how the strength of the intermolecular forces between particles affects the phase of the substance
- Describe the three intermolecular forces
  - London dispersion forces
  - dipole-dipole interactions
  - hydrogen bonding
- Predict the type(s) of intermolecular forces that exist between molecules
- Identify all six phase changes by name or process (i.e. melting is changing from a solid to a liquid)
  - Identify whether a phase change is endothermic or exothermic
- Define heat of fusion and heat of vaporization
  - describe how they affect a heating curve
- Describe how intermolecular forces affect the following:
  - heat of fusion and heat or vaporization
  - boiling point and vapor pressure
  - surface tension and viscosity
  - solubility

Unit 3 Objectives: upon completion of this material, you should be able to do the following:

Balancing and Classifying Chemical Reactions

- Describe the characteristics of a balanced chemical equation
- Identify the physical state of a reactant or product from parenthetical labels
- Identify reactants and products in an equation by name and chemical formula
- Distinguish a balanced equation from an unbalanced one
- Balance an equation by inspection given the formulas for reactants and products
- Explain why subscripts in chemical formulas are not changed when balancing an equation
- Write a balanced chemical equation if given names of reactants and products
- Classify a chemical reaction as decomposition, combination, single replacement, double replacement, or combustion if given a balanced chemical equation
- Predict the products formed during a reaction if given the reactants and type of chemical reaction

Energy in Chemical Reactions

- Describe the role of energy in a chemical reaction
- Define kinetic and potential energy and list six forms of energy
- State the law of conservation of energy
- Describe the difference between heat and temperature
- Tell what happens to the temperature of the surroundings during an exothermic reaction
- Tell what happens to the temperature of the surroundings during an endothermic reaction
- Define bond energy
- Calculate the change in heat, ΔH, if given bond energies and a balanced chemical equation
- Draw an energy diagram indicating the reactants, the activation energy, the energy given off during bond formation, the products, and the energy of reaction
- Describe a reaction in terms of collisions between molecules
- Identify two factors that can influence the success or failure of a collision
- Identify the origin of the activation energy in a chemical reaction
- State the relationship between activation energy and reaction rate
- Describe how the reaction rate is influenced by temperature, particle size, and concentration
- Describe the effect that a catalyst has on the rate and the activation energy of a chemical reaction

Thermodynamics

- Define entropy and compare the entropy content for solids, liquids, and gases
- Determine whether the entropy increases or decreases for a given chemical reaction
- Tell how a spontaneous reaction differs from a non-spontaneous reaction
- Describe what is meant by 'reversible' reaction
- Using the change in heat and the change in entropy, predict whether a chemical reaction will be spontaneous, non-spontaneous, or reversible

Mass Relationships in Chemical Reactions

- Calculate the formula mass of any compound
- Describe the relationship between the mole and Avogadro's number, 6.022×10^{23}
- Calculate the molar mass for a compound using its chemical formula and the periodic table
- Calculate the mass in grams of a given number of moles of a compound
- Examine a balanced equation and determine the mole ratio for any pair of substances
- Determine the moles of reactant required or the moles of product formed in a reaction
- Calculate the mass in grams of reactant required if given the amount of product for a reaction
- Calculate the mass in grams of product formed if given the amount of reactant for a reaction

Acids and Bases Lecture

- Describe the characteristic properties of acids and bases
- Describe the effect that acids and bases have on litmus paper
- Identify the pH ranges for acidic, basic, and neutral solutions
- Tell whether a solution is acidic, basic, or neutral if given the pH
- Describe what is meant by a neutral solution
- Write the formula of the hydronium ion
- Write a chemical equation showing the reaction of an acid with water
- Explain what is meant by the phrases 'extent of reaction' and 'partially ionized'
- Describe the difference between a strong acid and a weak acid in terms of ionization
- Identify what is produced by the reaction of a nonmetal oxide with water
- Name an acid from its chemical formula; write the chemical formula of an acid from its name
- Write the formula of the hydroxide ion
- Write a chemical equation showing the reaction of a base with water
- Describe the difference between a strong base and a weak base in terms of ionization
- Identify what is produced by the reaction of a metal with water or a metal oxide with water
- Name a base from its chemical formula; write the chemical formula of a base from its name
- Predict the formula of the salt that is produced by the reaction of an acid and a base
- Write a balanced chemical equation illustrating the neutralization of an acid with a base