Course Information
Division: Science
Course Number: CHM 130 (SUN# CHM 1130)
Title: Fundamental Chemistry
Credits: 4
Developed by: Joel Shelton
Lecture/Lab Ratio: 3 Lecture/3 Lab
Transfer Status:

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<td>CHM 101, Natural Science - Quantitative (SQ)</td>
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<td>CHM 130L also satisfies: Lab Science [LAB] --and-- CHM 130 also satisfies: Science &amp; Applied Science [SAS]</td>
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Activity Course: No
CIP Code: 40.0500
Assessment Mode: Pre/Post Test (50 Questions/100 Points)
Semester Taught: Fall and Spring
GE Category: Lab Science
Separate Lab: Yes
Awareness Course: No
Intensive Writing Course: No

Prerequisites
ENG 091 with a grade of "C" or higher or reading placement test score as established by District policy

Educational Value
Students will develop an understanding of how chemical concepts and problem-solving skills are relevant to other courses and their daily lives. This course is designed primarily for students seeking a physical science elective. It is also for science majors who may require additional preparation before taking general chemistry.

Description
This course is designed to help students understand basic chemical principles and master problem-solving skills. Students will develop an understanding of how those concepts and skills are relevant to other courses and their daily lives. Chemical topics covered in the course include basic science concepts, measurements, atomic theory, bonding, stoichiometry, states of matter, solutions, acids and bases, and nuclear chemistry.
**Supplies**
Scientific Calculator

**Competencies and Performance Standards**

1. **Classify examples of matter according to their composition.**
   
   **Learning objectives**
   
   What you will learn as you master the competency:
   
   a. Characterize the three main states of matter.
   b. Classify a sample as a pure substance or a mixture.
   c. Distinguish between an element and a compound.
   d. Distinguish between a homogeneous and heterogeneous sample.
   e. Identify an element from its symbol or provide a symbol for a given element.
   f. Define matter and its chief characteristics.
   
   **Performance Standards**
   
   Competence will be demonstrated:
   
   o on written exams, homework, and lab reports
   o without the use of personal notes
   
   Criteria – Performance will be satisfactory when:
   
   o given samples of matter have been placed in their correct categories
   o any element symbol is written in the correct format

2. **Calculate answers to unit conversion problems using the method of dimensional analysis.**
   
   **Learning objectives**
   
   What you will learn as you master the competency:
   
   a. Write unit conversion factors that will convert from one metric unit to another.
   b. Write unit conversion factors that will convert from metric to US customary units and vice-versa.
   c. Arrange unit conversion factors together in setups with one or more conversion steps.
   d. Show how to cancel units in a conversion setup.
   e. Use a unit conversion setup to carry out the calculations with a calculator.
   f. Calculate the density of a sample when given mass and volume.
   g. Calculate an unknown mass or volume using density as a conversion factor.
   
   **Performance Standards**
   
   Competence will be demonstrated:
   
   o in written exams, homework, and lab reports
   o without the use of personal notes
   o with the use of a personal calculator permitted
   o with some metric to US customary conversions provided
   
   Criteria – Performance will be satisfactory when:
   
   o written answers are numerically correct
   o written answers have correct unit labels
3. **Determine the correct number of significant figures in a numerical answer.**

*Learning objectives*

*What you will learn as you master the competency:*

a. Determine the number of significant figures yielded by a measuring device.

b. Determine if a zero digit is significant.

c. Determine the number of significant figures in a quantity obtained by multiplication or division.

d. Determine the number of significant figures in a quantity obtained by addition or subtraction.

*Performance Standards*

*Competence will be demonstrated:*

- in written exams, homework, and lab reports
- without the use of personal notes

*Criteria – Performance will be satisfactory when:*

- a written numerical answer has the correct number of significant figures

4. **Classify elements according to their position on the periodic table.**

*Learning objectives*

*What you will learn as you master the competency:*

a. Distinguish among metals, nonmetals, and metalloids on a periodic table.

b. Trace the evolution of the modern periodic table.

c. Identify periods and groups on the periodic table.

d. Identify the alkali metals, the alkaline earth metals, the halogens, and the noble gases.

e. Distinguish between transition and representative elements.

f. Predict from a periodic table which of a given pair of elements would have the higher values for ionization energy, electro negativity, or electron affinity.

*Performance Standards*

*Competence will be demonstrated:*

- in written exams, homework, and lab reports
- without the use of personal notes
- with a periodic table provided

*Criteria – Performance will be satisfactory when:*

- an element is classified correctly according to its position in the periodic table
- an element’s ionization energy, electro negativity, or electron affinity is correctly ranked relative to another element

5. **Write examples of how matter and energy are conserved in ordinary physical and chemical changes.**

*Learning objectives*

*What you will learn as you master the competency:*

a. Distinguish between physical and chemical changes.
b. Distinguish between physical and chemical properties.
c. Define the law of conservation of energy and matter.

Performance Standards

Competence will be demonstrated:

- in written exams, homework, and lab reports
- without the use of personal notes

Criteria – Performance will be satisfactory when:

- a process is described that is consistent with the law of conservation of matter and energy

6. Explain how Dalton's atomic theory is supported by the known observations of his time.

Learning objectives

What you will learn as you master the competency:

a. Explain how the laws of definite and multiple proportions support Dalton's atomic theory.
b. Identify the areas of Dalton's theory that are accepted today.
c. Identify the areas of Dalton's theory that are rejected today and how they have been modified.

Performance Standards

Competence will be demonstrated:

- in written exams, homework, and lab reports
- without the use of personal notes

Criteria – Performance will be satisfactory when:

- an area of the atomic theory has been logically supported by experimental observations
- each area of Dalton's atomic theory has been correctly identified as to being accepted today OR rejected and modified today

7. Determine the number of each subatomic particle in a given atom or ion.

Learning objectives

What you will learn as you master the competency:

a. Define proton, neutron, and electron and state each particle’s relative mass and charge.
b. Explain how two isotopes of a single element differ in their structure.
c. Explain how the existence of isotopes affects the atomic mass of elements.
d. Calculate an element's atomic mass from isotope abundance data.
e. Determine the number of protons from an element's atomic number and vice-versa.
f. Determine the number of neutrons from an atom’s atomic and mass number and vice-versa.
g. Determine the number of electrons from an atom’s atomic number and net charge and vice-versa.

Performance Standards

Competence will be demonstrated:

- in written exams, homework, and lab reports
- without the use of personal notes
Criteria – Performance will be satisfactory when:
  o the correct number of each required subatomic particle has been determined

8. Determine the electronic structure of an atom by using the standard order of filling sub-levels.

Learning objectives
What you will learn as you master the competency:

a. Describe the electron principle energy levels in the Quantum Mechanical Model of the atom and how they were discovered
b. Describe how the electron principle energy levels in an atom are filled level by level
c. Describe the electron energy sub-levels in the Quantum Mechanical Model of the atom and how they are filled
d. Determine the electron configuration of an atom using standard subshell and core notation

Performance Standards
Competence will be demonstrated:
  o on written homework, exams, and lab reports.
  o without using personal notes.
  o with a periodic table provided.
Criteria – Performance will be satisfactory when:
  o a written electronic structure shows the correct number of electrons
  o subshells are written with correct numbers and letters
  o the correct number of electrons is shown in each subshell
  o correct noble gas cores are shown

9. Sketch simple diagrams of orbitals when given the shell and subshell.

Learning objectives
What you will learn as you master the competency:

a. Describe the modern theory of orbital placement for electrons.
b. Explain how the principle energy level of an orbital affects its size.
c. Sketch s and p orbitals.
d. Identify s, p, and d orbitals by shape.
e. Identify which orbitals exist in each shell.
f. Give the correct numbers of orbitals in each subshell.

Performance Standards
Competence will be demonstrated:
  o on written exams
  o without using personal notes
Criteria – Performance will be satisfactory when:
  o orbital sketches are correct
  o the correct number of orbitals is specified for each shell number
10. **Classify the basic types of natural radioactivity.**

   **Learning objectives**
   What you will learn as you master the competency:
   a. Name three types of natural radioactivity.
   b. Describe the behavior of each type of radioactivity as it passes through an electric field.
   c. State the materials that will provide personal shielding from each type of radioactivity.

   **Performance Standards**
   Competence will be demonstrated:
   o on written exams, homework, and lab reports
   o without the use of personal notes

   Criteria – Performance will be satisfactory when:
   o each type of radioactivity is correctly classified

11. **Complete nuclear equations.**

   **Learning objectives**
   What you will learn as you master the competency:
   a. Balance nuclear equations involving decay by alpha or beta particle emission.
   b. Explain how synthetic radioactive elements can be created.
   c. Balance nuclear equations involving decay by positron emission or electron capture.

   **Performance Standards**
   Competence will be demonstrated:
   o on written exams, homework, and lab reports
   o without the use of personal notes

   Criteria – Performance will be satisfactory when:
   o the correct type of nuclear decay appears in the equation
   o the mass numbers are balanced
   o the atomic numbers are balanced
   o the correct symbols appear

12. **Solve half-life problems.**

   **Learning objectives**
   What you will learn as you master the competency:
   a. Describe the half-life of an isotope.
   b. Solve quantitative half-life problems.

   **Performance Standards**
   Competence will be demonstrated:
   o on written exams, homework, and lab reports
   o without the use of personal notes

   Criteria – Performance will be satisfactory when:
   o answers to half-life problems are numerically correct
   o answer has correct unit labels
13. **Describe the uses of nuclear chemistry.**

**Learning objectives**

*What you will learn as you master the competency:*

a. Identify four common uses of radioactive isotopes and explain their benefits.
b. Describe a nuclear fission reaction.
c. Describe a nuclear fusion reaction.
d. Describe a nuclear fission power plant generates electrical energy and identify potential problems and solutions associated with these plants.
e. Compare and contrast the generation of electricity using nuclear power and two other sources.

**Performance Standards**

*Competence will be demonstrated:*

- on written exams, homework, and lab reports
- without the use of personal notes

*Criteria – Performance will be satisfactory when:*

- fission and fusion are correctly distinguished
- uses of radioisotopes are correctly stated
- fission plants are correctly described
- potential problems of fission plants are accurately stated
- possible solutions to problems of nuclear plants are stated
- nuclear plants are compared to other power sources

14. **Describe how atoms form bonds.**

**Learning objectives**

*What you will learn as you master the competency:*

a. Explain how ionization energy, electron affinity, and electro negativity influence chemical bonding.
b. Describe how atoms form ionic bonds.
c. Describe how atoms form covalent bonds.
d. Explain how coordinate covalent bonds are formed.

**Performance Standards**

*Competence will be demonstrated:*

- on written exams, homework, and lab reports
- without the use of personal notes

*Criteria – Performance will be satisfactory when:*

- the description of the bonding process is correct and appropriate for the types of atoms involved

15. **Classify a chemical bond according to position of bonded atoms on the periodic table.**

**Learning objectives**

*What you will learn as you master the competency:*

a. Differentiate between covalent and ionic bonds.
b. State whether a bond is polar or nonpolar.

**Performance Standards**

*Competence will be demonstrated:*
- on written exams, homework, and lab reports
- without the use of personal notes

*Criteria – Performance will be satisfactory when:*
- bonds are correctly classified

16. **Sketch the structure of covalent compounds.**

**Learning objectives**

*What you will learn as you master the competency:*

a. Determine the number of valence electrons in a covalent compound.
b. Determine the central atom(s) in a molecule.
c. Sketch a Lewis-dot structure of a compound.

**Performance Standards**

*Competence will be demonstrated:*
- on written exams, homework, and lab reports
- without the use of personal notes

*Criteria – Performance will be satisfactory when:*
- sketches of molecules have the correct number of valence electrons
- the molecule sketch shows the correct central atom
- the sketch obeys the octet rule as appropriate for each element
- the sketch shows the correct number of bonds to each atom

17. **Name compounds when given the formula and vice-versa.**

**Learning objectives**

*What you will learn as you master the competency:*

a. Distinguish between ionic and covalent compound.
b. Distinguish between binary and ternary compounds.
c. Distinguish among acids, bases, and salts.
d. Name binary compounds containing two nonmetals.
e. Name binary compounds containing one nonmetal and one metal.
f. Name compounds containing one metal and two or more nonmetals.
g. Given the name of a compound, write the formula.

**Performance Standards**

*Competence will be demonstrated:*
- on written exams, homework, and lab reports
- without the use of personal notes

A list of ions with names and charges will be provided.

*Criteria – Performance will be satisfactory when:*
- compounds names are correct
18. **Perform calculations pertaining to the chemical formula of a compound.**

**Learning objectives**

*What you will learn as you master the competency:*

a. Calculate the formula or molecular mass of a compound.

b. Convert between mass and moles, number of particles and moles, and liters and moles as well as any combination of these units.

c. Calculate the percent composition of a compound.

d. Determine the empirical formula of a compound from the molecular formula.

e. Determine the empirical formula of a compound from elemental composition data.

f. Given the empirical formula and molecular mass, determine the molecular formula for a compound.

**Performance Standards**

*Competence will be demonstrated:*

- on written exams, homework, and lab reports
- without the use of personal notes
- Personal calculators may be used.

*Criteria – Performance will be satisfactory when:*

- answers are numerically correct with any needed unit labels

19. **Write balanced chemical equations.**

**Learning objectives**

*What you will learn as you master the competency:*

a. Identify the terms and symbols used by chemists in writing chemical equations.

b. Balance chemical equations.

c. Identify combination, decomposition, single replacement, double replacement, neutralization, and combustion reactions.

d. Differentiate between exothermic and endothermic reactions.

**Performance Standards**

*Competence will be demonstrated:*

- on written exams, homework, and lab reports
- without the use of personal notes

*Criteria – Performance will be satisfactory when:*

- chemical equations use correct symbols and terms
- equations show the same number of atoms of each element on each side
- subscripts of correctly written compound formulas have not been altered
- no extraneous atoms or compounds are added to either side of the equation
20. Make reasonable predictions about which chemical reactions will occur.

**Learning objectives**

*What you will learn as you master the competency:*

a. Predict which combination, decomposition, single replacement, double replacement, neutralization, and combustion reactions will occur from given reactants.

b. Use the activity series to determine whether a single replacement reaction will occur.

c. Use solubility rules to determine whether a double replacement reaction will occur.

**Performance Standards**

*Competence will be demonstrated:*

- on written exams, homework, and lab reports
- without the use of personal notes
- charts showing the activity series and solubility rules will be provided

*Criteria – Performance will be satisfactory when:*

- the reaction outcome from a given set of reactants is correctly predicted


**Learning objectives**

*What you will learn as you master the competency:*

a. Extract mole to mole information about a reaction from its balanced equation.

b. Solve stoichiometry problems involving mass-mass relationships.

c. Solve mass-mass stoichiometry problems involving a limiting reactant.

d. Determine the percent yield of a product from a chemical reaction.

**Performance Standards**

*Competence will be demonstrated:*

- on written exams, homework and lab reports
- without the use of personal notes
- a periodic table may be used
- calculators may be used

*Criteria – Performance will be satisfactory when:*

- calculated answers are numerically correct and show correct significant figures and unit labels
- answers follow a logical sequence of steps

22. Describe gases according to the kinetic molecular theory.

**Learning objectives**

*What you will learn as you master the competency:*

a. Describe the kinetic molecular theory.

b. Explain how volume, pressure, and temperature of gases are related at constant volume, constant pressure, and constant temperature.

Performance Standards

Competence will be demonstrated:
- on written exams, homework and lab reports
- without the use of personal notes
- A periodic table may be used

Criteria – Performance will be satisfactory when:
- the behavior of gases is correctly explained according to the kinetic molecular theory


Learning objectives

What you will learn as you master the competency:

a. Combine the gas laws to form the Ideal Gas Equation.
b. Use the Ideal Gas Equation to solve problems.
c. Use the molar volume of a gas to interconvert among volume, density, and quantity of a gaseous compound.
d. Solve problems involving mass-volume relationships.
e. Solve problems involving volume-volume relationships.
f. Use Dalton’s law of partial pressures to solve problems involving mixtures of gases.

Performance Standards

Competence will be demonstrated:
- on written exams, homework and lab reports
- without the use of personal notes
- A periodic table may be used
- Calculators may be used
- A table of physical constants will be provided

Criteria – Performance will be satisfactory when:
- Calculated answers are numerically correct and show correct significant figures and unit labels
- Answers follow a logical sequence of steps

24. Describe the attractions that hold molecules together in liquids and solids.

Learning objectives

What you will learn as you master the competency:

a. Describe dipole-dipole, ion-dipole, and London forces.
b. Determine if a given molecule is polar or nonpolar.
c. Determine which intermolecular attractions exist between molecules of a compound.
d. Explain how the physical properties of liquids and solids are affected by the strength of intermolecular attractions.
e. Compare different compounds as to the strength of intermolecular attractions.
f. Classify solids as ionic, covalent, molecular, or metallic.
25. **Describe the process of solution formation.**

*Learning objectives*

*What you will learn as you master the competency:*

a. Distinguish between solute and solvent in a solution.
b. Distinguish among saturated, unsaturated, and supersaturated solutions.
c. Identify three factors that affect the solubility of various substances in other substances.
d. Identify three factors that affect the rate of solubility.

*Performance Standards*

*Competence will be demonstrated:*

- on written exams, homework and lab reports
- without the use of personal notes
- A periodic table may be used

*Criteria — Performance will be satisfactory when:*

- the process of solution is correctly described
- the terms related to solutions are correctly used

26. **Perform calculations involving solution concentrations.**

*Learning objectives*

*What you will learn as you master the competency:*

a. Calculate the molar concentration (molarity) of a solution.
b. Explain when molarity is a useful concentration.
c. Use a given molarity as a unit conversion in a calculation.

*Performance Standards*

*Competence will be demonstrated:*

- on written exams, homework and lab reports
- without the use of personal notes
- A periodic table may be used

*Criteria — Performance will be satisfactory when:*

- calculations are set up correctly
- answers are numerically correct
- answers have the correct unit labels and significant figures
27. **Describe qualitatively acids and bases.**

*Learning objectives*

*What you will learn as you master the competency:*

a. Identify an acid and a base according to both the Arrhenius and Bronsted-Lowry models.

b. Describe the difference between a strong and weak acid and the difference between a strong and weak base.

c. Explain how acid rain is produced.

d. Explain the effect of acid rain on the earth.

*Performance Standards*

*Competence will be demonstrated:*

- on written exams, homework and lab reports
- without the use of personal notes
- A periodic table may be used

*Criteria – Performance will be satisfactory when:*

- the qualities of given acids or bases are correctly described

28. **Perform calculations relating to acids and bases.**

*Learning objectives*

*What you will learn as you master the competency:*

a. Use the data from a titration experiment to calculate the concentration of an unknown acid or base.

b. Use pH or pOH in calculations involving solutions of acids or bases.

*Performance Standards*

*Competence will be demonstrated:*

- on written exams, homework and lab reports
- without the use of personal notes
- A periodic table may be used
- with the use of a personal calculator

*Criteria – Performance will be satisfactory when:*

- answers are numerically correct
- answers have proper labels and significant figures

29. **Describe dynamic equilibrium.**

*Learning objectives*

*What you will learn as you master the competency:*

a. Explain what is meant for a reaction to be at "equilibrium."

b. Write equilibrium constant expressions in terms of reactant and product concentrations of a given reaction.

c. Use LeChatelier's Principle to explain how a given equilibrium will change in response to a change in concentration, temperature, or pressure.
Performance Standards

Competence will be demonstrated:
- on written exams, homework and lab reports
- without the use of personal notes
- A periodic table may be used

Criteria – Performance will be satisfactory when:
- relationships between concentration and equilibrium are correctly stated
- shifts in equilibrium are correctly predicted according to LeChatelier’s Principle

30. Identify the factors that determine the rate of a chemical reaction.

Learning objectives

What you will learn as you master the competency:
- a. Identify four factors that determine the rate of a reaction.
- b. Discuss how each factor affects the rate by using a reaction coordinate (potential energy) diagram.

Performance Standards

Competence will be demonstrated:
- on written exams, homework and lab reports
- without the use of personal notes
- A periodic table may be used

Criteria – Performance will be satisfactory when:
- the effect of each given factor on the rate of a reaction has been correctly determined
- a potential energy diagram relating to the rate of a reaction is correctly interpreted and labeled

Types of Instruction

Classroom Presentation
Laboratory

Grading Information

Grading Rationale

The lowest exam and lab score will be dropped.
The approximate weight given to each method of evaluation:
Pre-test: 0%
Homework and Quizzes: 15%
Labs: 25%
Exams: 50%
Comprehensive Post-Test: 10%
Grading Scale
A  90%
B  80%
C  70%
D  60%
F  Below 60%