Western Technical College

77856761 Developmental Chemistry

Course Outcome Summary

Course Information

Description	A general chemistry course in which the student learns about the nature of matter and energy, and how chemistry affects everyday life and the workplace. Topics include measurements and calculations; atomic structure; chemical bonding; chemical formulas, chemical equations and reactions; stoichiometry; gases; solutions; acids and bases; organic compounds; and biochemistry.
Total Credits	3
Total Hours	108

Textbooks

Open Educational Resource: *Chemistry: Atoms First*. 2nd Edition. Copyright 2021. Publisher: Open Stax. **ISBN-13:** 978-1-947172-63-0. https://openstax.org/details/books/chemistry-atoms-first-2e. Required.

Learner Supplies

Scientific calculator - $10-20. **Vendor:** Campus Shop. Required.

Course Competencies

1. Analyze the properties of matter.

Assessment Strategies

1.1. Classroom assessment - (70% or higher)

Criteria

You will know you are successful when

1.1. you identify physical properties of matter.
1.2. you identify chemical properties of matter.
1.3. you relate the properties of matter to the periodic table of elements.
1.4. you identify a property of matter as an intensive or extensive property.

Learning Objectives

1.a. Distinguish between the physical properties and chemical properties of matter
1.b. Classify changes of matter as physical or chemical
1.c. Explain the gas, liquid, and solid states in terms of particles
1.d. Distinguish between a mixture and a pure substance
1.e. Use a periodic table to name elements, given their symbols

1.f. Use a periodic table to write the symbols of elements, given their names
1.g. Describe the arrangement of the periodic table
1.h. List the characteristics that distinguish metals, nonmetals, and metalloids

2. Apply mathematical principles to solve application problems.

Assessment Strategies

2.1. Classroom Assessment (score 70% or higher)

Criteria

You will know you are successful when

2.1. you perform calculations with signed numbers.
2.2. you convert numbers from scientific notation to standard notation and back.
2.3. you perform calculations on numbers in scientific notation.
2.4. you apply measurement concepts of precision and significant digits.
2.5. you convert units of measure from standard to nonstandard measures.
2.6. you use dimentional analysis to solve problems.
2.7. you use SI system for measurement and calculations.
2.8. you perform calculations with significant digits.

Learning Objectives

2.a. Describe the purpose of the scientific method
2.b. Distinguish between qualitative and quantitative observations
2.c. Distinguish between a quantity, a unit, and a measurement standard
2.d. Name SI units for length, mass, time, volume, and density
2.e. Perform density calculations
2.f. Transform a statement of equality to a conversion factor
2.g. Distinguish between accuracy and precision
2.h. Determine the number of significant figures in measurements
2.i. Perform mathematical operations involving significant figures
2.j. Convert measurements into scientific notation
2.k. Derive conversion factors and apply unit (dimensional) analysis
2.l. Perform English unit - metric unit conversions

3. Analyze types of chemical bonding.

Assessment Strategies

3.1. Classroom assessment (score 70% or higher)

Learning Objectives

3.a. Define chemical bond
3.b. Explain why most atoms form chemical bonds
3.c. Describe ionic and covalent bonding
3.d. Explain why most chemical bonding is neither purely ionic nor purely covalent
3.e. Classify bonding type according to electronegativity differences
3.f. Define molecule and molecular formula
3.g. State the octet rule
3.h. Compare and contrast a chemical formula for a molecular compound with one for an ionic compound
3.i. Discuss the arrangements of ions in crystals
3.j. Define lattice energy and explain its significance
3.k. List and compare the distinctive properties of ionic and molecular compounds
3.l. Describe the electron-sea model of metallic bonding and explain why metals are good electrical conductors
3.m. Explain how the shpaes of molecules are accounted for by hybridization theory

4. Identify the fundamentals of atomic structure.

Assessment Strategies

4.1. Classroom assessment (70% or higher)

Criteria

You will know you are successful when

4.1. you define components of atoms.

4.2. you use atomic models to understand structure of atoms.
4.3. you construct and identify electron configurations.
4.4. you describe the structure of the periodic table of elements.

Learning Objectives

4.a. Explain the law of conservation of mass, the law of definite proportions, and the law of multiple proportions
4.b. Summarize the five essential points of Dalton's atomic theory
4.c. Explain the realtionship between Dalton's atomic theory and the law of conservation of mass, the law of definite proportions, and the law of multiple proportions
4.d. Summarize the observed properties of cathode rays that led to the discovery of the electron
4.e. Summarize the experiment carried out by Rutherford and his co-workers that led to the discovery of the nucleus
4.f. List the properties of protons, neutrons, and electrons
4.g. Define atom
4.h. Explain what isotopes are
4.i. Define atomic number and mass number, and describe how they apply to isotopes
4.j. Given the identity of a nuclide, determine its number of protons, neutrons, and electrons
4.k. Define mole in terms of Avogadro's number, and define molar mass
4.l. Solve problems involving mass in grams, amount in moles, and number of atoms of an element

5. Represent the arrangement of electrons in atoms.

Assessment Strategies

5.1. classroom assessments (score 70% or higher)

Learning Objectives

5.a. Discuss the dual wave-particle nature of light
5.b. Describe the Bohr model of the hydrogen atom
5.c. Compare and contrast the Bohr model and the quantum model of the atom
5.d. List the four quantum numbers, and describe their significance
5.e. Relate the number of sublevels corresponding to each of an atom's main energy levels, the number of orbitals per sublevel, and the number of orbitals per main energy level
5.f. List the total number of electrons needed to fully occupy each main energy level
5.g. State the Aufbau principle, the Pauli exclusion principle, and Hund's rule
5.h. Describe the electron configurations for the atoms of any element using orbital notation, electron-configuration notation, and when appropriate, noble-gas notation

6. Use stoichiometry to balance chemical equations.

Assessment Strategies

6.1. Classroom Assessment (score 70% or higher)

Learning Objectives

6.a. Define stoichiometry
6.b. Describe the importance of the mole ratio in stoichometric calculations
6.c. Write a mole ratio relating two substances in a chemical equation
6.d. Calculate the amount in moles of a reactant or product from the amount in moles of a different reactant or product
6.e. Calculate the mass of a reactant or product from the amount in moles of a different reactant or product
6.f. Calculate the amount in moles of a reactant or product from the mass of a different reactant or product
6.g. Calculate the mass of a reactant or product from the mass of a different reactant or product
6.h. Calculate the amount in moles or mass in grams of a product, given the amounts in moles or masses in grams of two reactants, one of which is in excess
6.i. Distinguish between theoretical yield, actual yield, and percent yield
6.j. Calculate percent yield, given the actual yield and quantity of a reactant

7. Explore the development and application of the Periodic Law.

Assessment Strategies

7.1. Classroom assessments (score 70% or higher)

Learning Objectives

7.a. Explain the roles of Mendeleev and Moseley in the development of the periodic table

7.b. Describe the modern periodic table
7.c. Explain how the periodic law can be used to predict the physical and chemical properties of elements
7.d. Describe how the elements belonging to a group of the periodic table are interrelated in terms of atomic number
7.e. Describe the relationship between electrons in sublevels and the length of each period of the periodic table
7.f. Locate and name the four blocks of the periodic table and explain the reasons for these names
7.g. Discuss the relationship between group configurations and group numbers
7.h. Describe the locations in the periodic table and the general properties fo the alkali metals, the alkaline-earth metals, the halogens, and the noble gases
7.i. Define valence electrons and state how many are present in atoms of each main-group element

8. Represent chemical compounds using chemical formulas.

Assessment Strategies

8.1. Classroom assessment (score 70% or higher)

Learning Objectives

8.a. Explain the significance of a chemical formula
8.b. Determine the formula of an ionic compound formed between two given ions
8.c. Name an ionic compound given its formula
8.d. Using prefixes, name a binary molecular compound from its formula
8.e. Write the formula of a binary molecular compound given its name
8.f. List the rules for assigning oxidation numbers
8.g. Give the oxidation number for each element in the formula of a chemical compound
8.h. Name the binary molecular compounds using oxidation numbers and the Stock system
8.i. Calculate the formula mass or molar mass of any given compound
8.j. Use molar mass to convert between mass in grams and amount in moles of a chemical compound
8.k. Calculate the number of molecules, formula units, or ions in a given molar amount of a chemical compound
8.l. Calculate the percentage composition of a given chemical compound
8.m. Define empirical formula and explain how the term applies to ionic and molecular compounds
8.n. Determine an empirical formula from either a percentage or a mass composition
8.o. Explain the relationship between the empirical formula and the molecular formula of a given compound
8.p. Determine a molecular formula from an empirical formula

9. Examine the relationship between products and reactants in chemical reactions.

Assessment Strategies

9.1. Classroom Assessment (score 70% or higher)

Learning Objectives

9.a. List three observations that suggest that a chemical reaction has taken place
9.b. List three requirements for a correctly written chemical equation
9.c. Write a word equation and a formula equation for a given chemical reaction
9.d. Balance a formula equation by inspection
9.e. Define and give general equations for synthesis, decomposition, single-replacement, and double-replacement reactions
9.f. Classify a reaction as synthesis, decomposition, single-replacement, double-replacement, or combustion
9.g. List three types of synthesis reactions and six types of decomposition reactions
9.h. List four types of single-replacement reactions and three types of double-replacement reactions
9.i. Predict the products of simple reactions given the reactants
9.j. Explain the significance of an activity series
9.k. Use an activity series to predict whether a given reaction will occur and what the products will be

10. Examine types of solutions in chemistry.

Assessment Strategies

10.1. Classroom assessments (score 70% or higher)

Learning Objectives

10.a. Distinguish between heterogeneous and homogeneous mixtures
10.b. List three different solute-solvent combinations

10.c. Compare the properties of suspensions, colloids, and solutions
10.d. Distinguish between electrolytes and nonelectrolytes
10.e. List and explain three factors that affect the rate at which a solid solute dissolves in a liquid solvent
10.f. Explain solution equilibrium, and distinguish among saturated, unsaturated, and supersaturated solutions

11. Examine the importance of carbon and hydrocarbons.

Assessment Strategies

11.1. Classroom assessment (score 70% or higher)

Learning Objectives

11.a. Relate the ability of a carbon atom to form covalent bonds to its atomic structure and hybrid orbitals
11.b. Identify the different allotropes of carbon and their structural differences
11.c. Explain how the different structures of carbon allotropes affect their properties
11.d. Explain how the structure and bonding of carbon lead to the diversity and number of organic compounds
11.e. Explain the importance and limitations of molecular and structural formulas
11.f. Compare structural and geometric isomers
11.g. Recognize the important structural feature of saturated hydrocarbons, alkanes
11.h. Be able to name and write structural formulas for alkanes
11.i. Explain how structures of alkanes relate to their properties and how those properties affect the uses of specific alkanes
11.j. Distinguish between the structures of alkenes, alkynes, an daromatic hydrocarbons
11.k. Be able to name and write structural formulas for unsaturated hydrocarbons
11.l. Explain how structures of unsaturated hydrocarbons relate to their properties and how those properties affect the uses of specific hydrocarbons

12. Explore acids and bases.

Assessment Strategies

12.1. Classroom Assessment (score 70% or higher)

Learning Objectives

12.a. List five general properties of aqueous acids and bases
12.b. Name common binary acids and oxyacids, given their chemical formulas
12.c. List five acids commonly used in industry and the laboratory, and give two properties of each
12.d. Define acid and base according to Arrhenius' theory of ionization
12.e. Explain the differences between strong and weak acids and bases
12.f. Explain the process of neutralization
12.g. Describe the self-ionization of water.
12.h. Define pH, and give the pH of a neutral solution at 25° C
12.i. Explain and use the pH scale
12.j. Given [H3O+] or [OH-], find pH
12.k. Given pH, find [H3O+] or [OH-]
12.l. Describe how an acid-base indicator functions

13. Identify organic compounds.

Assessment Strategies

13.1. Classroom assessment (score 70% or higher)

Learning Objectives

13.a. Define functional group, and explain why functional groups are important
13.b. Identify alcohols, alkyl halides, and ethers based on the functional group present in each
13.c. Classify alcohols, alkyl halides, and ethers from names and structural formulas
13.d. Identify aldehydes, ketones, carboxylic acids, esters, and amines based on the functional group present in each
13.e. Classify aldehydes, ketones, carboxylic acids, esters, and amines from names and structural formulas

14. Explore the fundamentals of biochemistry.

Assessment Strategies

14.1. Classroom Assessments (score 70% or higher)

Learning Objectives

14.a. Identify carbohydrates (mono-, di-, polysaccharides) and give their structure, function, characteristics and properties

14.b. Identify lipids (fats, phospholipids, steroids) and give their structure, function, characteristics and properties

14.c. Identify proteins and give their structure, function, characteristics and properties

14.d. Identify nucleic acids (DNA, RNA) and give their structure, function, characteristics and properties