Miami Dade College

Course Description

CHM1033 | Chemistry for Health Sciences | 3.00 credits

This course emphasizes chemistry topics related to allied health. Students will learn the essentials of inorganic chemistry, organic chemistry, biochemistry and their applications to physiological functions. Prerequisite: MAT1033; Corequisite: CHM1033L

Course Competencies:

Competency 1: The student will demonstrate comprehension of the basic metric and English units for length, mass, volume, temperature, and energy by:

1. Naming the metric units and their abbreviations for length, mass, volume, temperature, and energy.
2. Identifying the decimal value for a numerical prefix in the metric system and vice versa.
3. Arranging a list of metric units in order from largest to smallest or smallest to largest.
4. Using conversion factors to convert from metric to metric units.
5. Using conversion factors to convert from English to metric units and vice versa.
6. Computing the density of an object from its metric measurements for mass and volume.
7. Distinguishing whether an object sinks or floats in pure water based on the object's specific gravity or density.
8. Inferring the specific gravity of an object from its density and vice versa.
9. Converting a given temperature value to another temperature scale, including the Fahrenheit, Celsius, and Kelvin scales.

Competency 2: The student will demonstrate the ability to use the periodic table to identify elements by names and symbols, as well as atomic numbers and mass numbers by:

1. Stating the symbol and naming the first 20 elements and other selected elements on the Periodic table.
2. Identifying element families and periods in the Periodic table.
3. Identifying elements as metals, non-metals, or metalloids according to their position in the periodic table.
4. Identifying subatomic particles by charge, relative mass, and location within the atom.
5. Predicting elements by symbol or name when any of the following properties of the element are given (i.e., atomic number, mass number, number of protons, number of neutrons, and number of electrons).
6. Predicting whether atoms are isotopes of the same element when given atomic numbers and atomic masses.
7. Generating the electronic configuration of the ground state for the first 20 elements in the Periodic table.
8. Inferring from the Periodic table whether similar chemical properties exist for a given group of elements.
9. Inferring from the periodic table, given an element's symbolic number of protons, neutron electrons, and valence electrons for representative elements, atomic number, and atomic mass,
10. Applying the law of periodicity

Competency 3: The student will demonstrate knowledge of the interaction of elements in the process of forming compounds by

1. Explaining the transfer of one or more electrons in ionic bonding.
2. Predicting valence electrons and oxidation state.
3. Explaining how charges of +1, +2, +3, -1, -2, and -3 can occur in ions of the representative elements.
4. Defining electronegativity and relating it to the position of an element in the Periodic table.
5. Illustrating the sharing of valence electrons in covalent bonding.
6. Explaining the meaning of single, double, and triple covalent bonds.
7. Using a Periodic table to illustrate which of the two binary compounds is more ionic or more covalent.
8. Using a Periodic table, determine the atomic mass and molar mass of elements.
9. Using a Periodic table, determine the molecular mass or formula mass of compounds.
10. Using a periodic table, conversions between the mass and any number of moles of elements and compounds can be performed, and vice versa.
11. Recognizing polar and non-polar covalent bonds and polar and non-polar compounds.

12. Using the Pauling electronegativity scale to determine compounds' relative polarity and distinguish ionic compounds from covalent compounds.
13. Defining Avogadro's number and using it to perform conversions.

Competency 4: The student will demonstrate knowledge of the naming and writing of formulas for selected inorganic compounds by:

1. Predicting and writing formula of binary salts of metals with fixed oxidation numbers and of selected acids and bases from the compound's IUPAC name and vice versa.
2. Predicting and writing the formula of the salts produced by the metals Cu, Fe, Pb, Hg, and Sn, metals with variable oxidation numbers from the compound's IUPAC name and vice versa.
3. Predicting and writing the formula of compounds containing selected polyatomic ions (i.e., CO_3^{-2}, HCO_3^-, NH_4^+, and CN^- in their formula from the compound's IUPAC name and vice versa).
4. Predicting and writing the formula of binary nonmetallic compounds from the compound's IUPAC name and vice versa.
5. Predicting and writing the formula of ternary acids and their corresponding salts from the compound's IUPAC name and vice versa.

Competency 5: The student will be able to balance chemical reactions and relate kinetic and potential energy to chemical reactions by:

1. Distinguishing between reactants and products in a chemical reaction.
2. Explaining the Law of Mass Conservation.
3. Generating balanced chemical reactions.
4. Differentiating between heat and temperature and their units.
5. Relating heat evolved or absorbed during a reaction, whether it is exothermic or endothermic, and illustrate this in the balanced chemical equation for a reaction.
6. Preparing and labeling energy diagrams for exothermic and endothermic reactions.
7. Differentiating between catalyzed and uncatalyzed reactions through energy diagrams.
8. Defining a calorie and predicting the number of calories involved in heating a definite mass of water by a definite number of OC.
9. Defining and giving examples of kinetic energy (KE) and potential energy (PE).
10. Defining and illustrating activation energy.
11. Defining a catalyst and graphically illustrating its properties.
12. Distinguishing between exothermic and endothermic reactions.
13. Defining a large Calorie (the food calorie) and comparing it to a "small" calorie.
14. Performing stoichiometric calculations using balanced reactions.

Competency 6: The student will demonstrate an understanding of solution chemistry and the calculation of concentrations in solutions by:

1. Defining homogeneous and heterogeneous mixtures, solute, solvent, and solution.
2. Defining and calculating solution concentrations as percent mass/mass, percent volume/volume, and molar (M) solutions.
3. Defining mole and molar mass (atomic weight, molecular weight, and formula weight).
4. Solving problems involving conversions of solution concentrations.
5. Defining and identifying solutions as saturated, unsaturated, or supersaturated.
6. Defining diffusion.
7. Identifying solutions as true, colloidal, or suspensions based on their properties.
8. Defining osmosis and osmotic pressure relating these to a living membrane.
9. Predicting the direction in which water diffuses through a semipermeable (selectively permeable) membrane in an osmotic process.
10. Defining dialysis.
11. Defining and distinguishing isotonic, hypotonic, and hypertonic solutions depending on their effect on normal cells.

Competency 7: The student will demonstrate knowledge of bonding and relation to the electrolytic properties of solutions by:

1. Defining electrolytes.
2. Relating electrolytic properties to bonding the compound used in the solution.
3. Naming the electrolytes found in the body.

Competency 8: The student will demonstrate knowledge of acids, bases, and salts and the concept of pH and pOH as related to the composition and mechanism of buffers by:

1. Defining acids, bases, and salts according to the Arrhenius theory.
2. Recognizing acids, bases, and salts from their molecular formulas.
3. Describing the bonding properties of water and explaining self-ionization.
4. Relating strong and weak acids and bases to percent ionization.
5. Defining pH and predicting acidity and basicity from pH values.
6. Defining pOH and predicting acidity and basicity from pOH values.
7. Identifying equations for the reactions of acids with bases.
8. Generating balanced equations when given the reaction of an acid with a base.
9. Listing the components of a buffer and predicting whether a mixture is a buffer.
10. Identifying the chemical properties of buffers in acidic and basic solutions.
11. Illustrating the action of the bicarbonate buffer in the blood related to acidosis and alkalosis.
12. Creating equations for ionizing acids, bases, and salts in water. 13. Listing the properties of acids, bases, and salts

Competency 9: The student will demonstrate an understanding of nuclear chemistry and nuclear emissions, as well as their measurements and applications in medicine by:

1. Predicting the mass number, number of protons, and number of neutrons for the reactants and products in a nuclear reaction
2. Using nuclear symbols to write a nuclear equation for the alpha, beta, and gamma decay of a radioisotope.
3. Identifying a nuclear equation for the artificial production of a radioisotope.
4. Calculating the mass remaining after one or more half-lives have passed, given the mass of a radioisotope and its half-life.
5. Calculating the half-life of a radioisotope given the initial and remaining masses of the radioisotopes after a given time interval.
6. Defining and recognizing the processes of fission and fusion.
7. Describing, discussing, and interpreting the units of radiation measurements.
8. Explaining the process by which a radioisotope in the body is detected.
9. Distinguishing the characteristics of fission and fusion processes.

Competency 10: The student will demonstrate an understanding of the states of matter and of the gas laws by:

1. Identify the three standard states of matter and provide the terminology of state changes (i.e., condensation, evaporation, freezing, melting, deposition).
2. Outlining the properties of shape and volume as related to solids, liquids, and gases.
3. Defining atmospheric pressure and explaining how it is measured with a barometer.
4. Defining and applying pressure-volume relationships, Boyle's Law.
5. Explaining how Boyle's Law relates to the breathing mechanism.
6. Defining and applying volume-temperature relationships, Charles' Law.
7. Defining and applying pressure-temperature relationships, Gay-Lussac's Law.
8. Defining and manipulating partial pressures of gases, Dalton's Law.
9. Interpreting the ideal gas law and manipulating the different variables (pressure, volume, temperature, and moles).
10. Relating the partial pressures of O2 and CO2 to the respiration process in the lungs, arteries, capillaries, cells, and veins and back to the lungs (alveoli).

Competency 11: The student will be able to distinguish organic chemicals from inorganic chemicals by:

1. Comparing organic properties to inorganic properties.
2. Describing the characteristics of the bonds formed by carbon.
3. Listing the six most common elements found inorganic compounds.
4. Differentiating between molecular formulas, structural formulas, and condensed formulas.

Competency 12: The student will demonstrate knowledge of the nomenclature and structures of hydrocarbons by:

1. Naming with the IUPAC system the first ten continuous chain alkanes.
2. Naming, predicting the formulas, and distinguishing branched-chain isomers of organic compounds.
3. Predicting the IUPAC or common name of a compound from its structural formula for alkanes, haloalkanes, cycloalkanes, alkenes, and alkynes.
4. Predicting the molecular, structural, and condensed formulas of a compound when given its name or formula for alkanes, haloalkanes, cycloalkanes, cycloalkenes, alkenes, and alkynes.
5. Defining and distinguishing saturated and unsaturated compounds.
6. Using structural formulas to explain oxidation and dehydrogenation reactions for selected alkanes.
7. Using structural formulas to explain the processes of oxidation, hydrogenation, halogenation, hydrohalogenation, and hydration reactions for selected alkenes and alkynes.
8. Naming and predicting the structures for structural isomers of alkanes, alkenes, and alkynes.
9. Naming and producing drawings of the structures for cis-trans isomers of alkenes.

Competency 13: The student will demonstrate knowledge of nomenclature, structural formulas, and reactivity for alcohols, aldehydes, ketones, and ethers by:

1. Predicting the IUPAC or common name of an alcohol from its structural formula.
2. Predicting whether alcohols are primary, secondary, or tertiary.
3. Producing the general formulas of alcohols, ethers, aldehydes, and ketones.
4. Generating the names of ethers, aldehydes, and ketones from selected structural formulas and vice versa.
5. Predicting and identifying the products of the oxidation and dehydration reactions of primary, secondary, and tertiary alcohols.
6. Predicting and identifying the products of the reduction of aldehydes and ketones.
7. Outlining the preparation of alkenes from alcohols.
8. Outlining the preparation of ethers from alcohol.

Competency 14: The student will apply a comprehension of the structure and nomenclature of selective carbohydrates by:

1. Defining and distinguishing carbohydrates, sugars, and saccharides.
2. Identifying open chain (Fischer) and ring (Haworth) structures for sugars.
3. Identifying aldoses or ketoses.
4. Differentiating trioses, tetrodes, pentoses, and hexoses from their structural formulas.
5. Determining the hemiacetal carbon and numbering all carbons in the ring for mono and disaccharides.
6. Distinguishing α or β bonding from the hemiacetal carbon of a disaccharide or polysaccharide.
7. Explaining the significance of + and – isomers (D and L stereoisomers).
8. Predicting the existence of D and L isomers for selected compounds.
9. Labeling glucose, fructose, galactose, maltose, lactose, sucrose, starch, amylase, amylopectin, glycogen, and cellulose as mono, di, or polysaccharides from their names or structures.
10. Identify the properties of Benedict's solution and produce an equation for its reaction with reducing sugars.
11. Predicting which carbohydrates give positive or negative results with the iodine test and with Benedict's test.
12. Describing the carbon dioxide cycle, including the role of photosynthesis.
13. Relating glucose levels in the blood to normal levels, hypoglycemia, and hyperglycemia.

Competency 15: The student will demonstrate knowledge of the nomenclature and structures of amines, carboxylic acids, esters, and amides by:

1. Predicting the IUPAC and common name of simple carboxylic acid from its structural formula and vice versa.
2. Predicting the name of an ester from its structural formula and vice versa.
3. Predicting and identifying the products of hydrolysis reactions of esters in both acidic and basic media.
4. Predicting and identifying the products of esterification reactions when carboxylic acids and alcohols react.
5. Identify the structure of amines and predict whether they are primary, secondary, or tertiary amines.
6. Explaining that amines are basic and predicting what happens when they are dissolved in water.
7. Predicting and identifying the products of the reactions of amines with carboxylic acids.
8. Identifying the structure of amides.
9. Predicting and identifying the products of the hydrolysis reactions of amides catalyzed by enzymes.
   OPTIONAL: Predicting the name of amines and amides from their structural formula and vice versa.

Competency 16: The student will demonstrate knowledge of fatty acids, lipids, and the relationship among different classes of lipids by:

1. Explaining the functions of lipids.
2. Distinguishing lipids that are fats and oils.
3. Predict the type of lipid based on its origin (animal or vegetable) and its state of matter at room temperature.
4. Defining the concept of saponification and demonstrating its significance.
5. Identify general steroid structures and predict which hormones and vitamins are steroids.
6. Producing equations for the chemical reactions of triglycerides (formation, hydrogenation, and hydrolysis).
7. Identifying the structures and explaining the functions of waxes and glycerophospholipids.
8. Distinguishing between essential and nonessential fatty acids based on dietetic needs and body synthesis.
9. Describing the iodine and acrolein tests for lipids.

Competency 17: The student will demonstrate an understanding of protein structure and function by:

1. Predicting the general structure of an amino acid and identifying its basic and acidic sites.
2. Distinguishing between essential and nonessential amino acids based on dietetic needs and body synthesis.
   Listing biological functions of proteins.
3. Identifying a zwitterion, explaining its use, and diagramming its structural changes in acid and bases.
4. Identifying a peptide bond and showing its significance.
5. Distinguishing between dipeptides, tripeptides, oligopeptides, and polypeptides.
6. Defining what a protein is and differentiating the primary, secondary, tertiary, or quaternary structures of proteins.
7. Discussing reversible and irreversible denaturation of proteins.
8. Showing how chemical structure is affected in the temporary and permanent denaturing of proteins.
9. Listing ways to denature a protein.
10. Illustrating the process of electrophoresis in the separation of proteins.
11. Distinguishing whether the "R" group of an amino acid is polar or nonpolar.
12. Identifying and predicting the products of hydrolysis of proteins.
13. Explaining the importance of protein structure for their function.
14. Comparing complete and incomplete proteins.
15. Describing identification tests for proteins

Competency 18: The student will demonstrate knowledge of enzymes and digestion sites by:

1. Identifying an enzyme as an organic catalyst.
2. Explaining the lock and key model of enzymological catalysis.
3. Relating the pH, temperature, and substrate concentration to the activity of an enzyme.
4. Defining a catalyst and graphically illustrating its effect on activation energy.
5. Differentiating between reversible and irreversible enzyme inhibition.
6. Identifying an enzyme as simple or conjugated.
7. Distinguishing between cofactors and coenzymes.

8. Listing the sites and products of digestion for carbohydrates, lipids, and proteins

Competency 19: The student will demonstrate knowledge of RNA and DNA structures, as well as their physiological functions as related to protein synthesis by:

1. Identifying the location in the cell of DNA, RNA, mRNA, and tRNA, whether in the nucleus or the ribosomes.
2. Differentiating the structures of ribose and deoxyribose, the phosphate group, and nitrogen bases of DNA and RNA.
3. Identifying and naming the five nucleotides of DNA and RNA.
4. Identifying the basic shape of DNA and RNA strands and discuss the rules of base pairing and hydrogen bonding between the bases.
5. Diagramming the replication of a strand of DNA.
6. Listing the steps involved in protein synthesis.

Learning Outcomes:

- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Formulate strategies to locate, evaluate, and apply information