



# ILLINOIS VALLEY COMMUNITY COLLEGE

## COURSE OUTLINE

**DIVISION: Natural Sciences and Business**

**COURSE: CHM 1000 Introduction to Chemistry**

Date: Spring 2023

Credit Hours: 3

*Complete all that apply or mark "None" where appropriate:*

Prerequisite(s): None

Enrollment by assessment or other measure?  Yes  No

If yes, please describe:

Corequisite(s): None

Pre- or Corequisite(s): None

Consent of Instructor:  Yes  No

Delivery Method:  **Lecture**      **3 Contact Hours** (1 contact = 1 credit hour)  
 **Seminar**      **0 Contact Hours** (1 contact = 1 credit hour)  
 **Lab**      **0 Contact Hours** (2-3 contact = 1 credit hour)  
 **Clinical**      **0 Contact Hours** (3 contact = 1 credit hour)

Offered:  **Fall**     **Spring**     **Summer**

**CATALOG DESCRIPTION and IAI NUMBER (if applicable):**

This course surveys the fundamental concepts of chemistry as these topics apply to personal and societal issues such as the environment, energy production, technology and medicine. A nonmathematical approach is used where possible. The course is intended for nonscience majors or as a background for science majors but does not serve as a prerequisite for any advanced chemistry course. **IAI Equivalent: P1 902**

## ACCREDITATION STATEMENTS AND COURSE NOTES:

None

### COURSE TOPICS AND CONTENT REQUIREMENTS:

#### 1. Science, Technology and the Atom (4 days)

- Science, chemistry: Definitions, technology and Scientific Method
- Matter: Definitions, classes and properties and types of changes
- Terminology: atom, molecules, symbols, formulas, equations
- Atomic theory: history, classic experiments, subatomic particles, atomic number, mass number and isotopes

#### 2. Structure of Matter - Atomic/Molecular Level (6 days) vs. Macroscopic (4 days)

- Atomic/molecular level: electron energy levels, modern atomic structure
  - Bonding: Ionic, covalent, formulas, reactions, energy changes, endothermic, exothermic,
  - Ionic bonds: electrostatic attraction, predicting charges, formulas, polyatomic ions, transition metal ions and nomenclature.
  - Covalent bonds: sharing electrons, Lewis symbols, formulas, nomenclature
- Macroscopic level
  - Gases: Kinetic Molecular Theory, pressure, gas laws
  - Liquids: Change of states, vapor pressure, evaporation, boiling point, intermolecular forces.
  - Solids: Types of solids - ionic, molecular, covalent, metallic

#### 3. Energy and Combustion (3 days)

- Energy: Definitions, units, forms, and change.
- Fossil fuels: Types, combustion, pollution types and sources.
- Alternative energy sources (except nuclear): Wind, solar, biofuels, geothermal, etc.
- Societal benefits and costs of fossil fuel use and alternative energy sources.

#### 4. Nuclear Change (5 days)

- Natural: Discovery, radioactivity, nuclear equations, terminology, and types, ionization ability, penetrating ability, half-life.
- Detection: Geiger tubes, dosimeters, and film.
- Effects of radiation: dose and regulations
- Safeguards: shielding, distance, time
- Military and medical uses of radioisotopes.]
- Nuclear power: Present – fission, Future – fusion, Problems and accidents.

#### 5. Water and Solution Chemistry (6 days)

- Define terms: solute, solvent, solution, saturated, unsaturated, and supersaturated.
- Solubility guidelines, polar vs. nonpolar, types of electrolytes,
- Properties: freezing point and boiling points
- Acid-Base terms: strong, weak, pH scale, buffers
- Common consumer use of acids and bases
- Water: Natural waters, treatment, hard water, water pollution, availability and population density.

## 6. Organic Chemistry (8 days)

- Definition, pharmaceutical, narcotic, biological examples
- Carbon bonding
- Molecular formula, structural formula, condensed structural formula, line structures.
- Classes of compounds: alkanes, alkenes, alkynes, aromatics branched isomers
- Function groups (structures, naming, common uses: alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines.
- Polymers, examples, types (thermosetting vs. thermoplastic) biopolymers, biodegradable polymers.

## 7. Biochemistry (4 days)

- Carbohydrates: starches, sugars, cellulose, dextrose, dietary considerations.
- Lipids: fats vs. oils vs. waxes, saturated vs. unsaturated, fatty acids, glycerol, trans-fats, hydrogenation, dietary considerations
- Proteins: amino acids, essential amino acids, protein structures, uses in the body, dietary considerations.
- Vitamins and minerals: functions, fat vs. water soluble, megadose, dietary considerations, causes of deficiency and associated diseases.
- Enzymes: uses, structure, denaturization.
- Nucleic acids: components, locations and function.

### INSTRUCTIONAL METHODS:

Lecture (primary)

Lecture demonstrations

YouTube videos (animations and demonstrations)

Online homework and quizzing system

Examinations

Peer learning

### EVALUATION OF STUDENT ACHIEVEMENT:

Regular attendance in lecture.

Reading assignments

Quizzes (1 per week)

Exams (4 total)

Participation in class room discussion

Term Paper "The role of chemistry in my future career"

PowerPoint Presentation "The role of chemistry in my future career"

A = 100-90

B = 89-80

C = 79-70

D = 69-60

F = 59 and below

### INSTRUCTIONAL MATERIALS:

#### Textbooks:

Investigating Chemistry by Matthew Johll, W.H. Freeman Publishing, New York.

Online eBook, homework and quizzing system.

## Resources

Exploring Chemistry, 1st edition, 2012 WH Freeman Publishing

Journal Chemical Education

Chemical and Engineering News

## LEARNING OUTCOMES AND GOALS:

### Institutional Learning Outcomes

- 1) Communication – to communicate effectively;
- 2) Inquiry – to apply critical, logical, creative, aesthetic, or quantitative analytical reasoning to formulate a judgement or conclusion;
- 3) Social Consciousness – to understand what it means to be a socially conscious person, locally and globally;
- 4) Responsibility – to recognize how personal choices affect self and society.

### Course Outcomes and Competencies

#### Outcome 1 - Students will be able to demonstrate a basic understanding of how science and technology impacts the world in which we live.

Competency 1.1 Students will be able to distinguish basic science, applied science and technology.

Competency 1.2 Students will be able to discuss some positive contributions as well as some problems caused by science and technology and discuss whether the problems are hopeless.

Competency 1.3 Students will be able to discuss some things which might be necessary to help alleviate some of the problem(s).

Competency 1.4 Students will be able to correctly use the terminology: science, basic science, applied science, technology, chemistry, atom, molecule, compound, element, mixture.

Competency 1.5 Students will be able to describe the steps in the scientific method.

Competency 1.6 Students will be able to classify matter as elements, compounds or mixtures.

Competency 1.7 Students will be able to distinguish physical and chemical properties.

Competency 1.8 Students will be able to distinguish physical, chemical and nuclear changes.

#### Outcome 2 - Students will be able to demonstrate a knowledge of the basic structures of matter.

Competency 2.1 Students will be able to explain three different models of the atom including the present model.

Competency 2.2 Students will be able to enumerate the three principal subatomic particles and where in the atom they are located.

Competency 2.3 Students using a periodic chart will be able to determine an element's atomic number and mass.

Competency 2.4 Given the symbol of an isotope students will be able to determine the atomic number, mass number, number of protons, electrons and neutrons.

Competency 2.5 Using the periodic table students will be able to give the name of each family of the representative elements, name the diatomic elements, the two elements which are liquids at room temperatures, which are metals, which are nonmetals and which elements are metalloids.

Competency 2.6 Students will be able to correctly write the symbols of at least 30 of the most common elements

Competency 2.7 Students will be able to draw electron dot symbols for elements of the main/representative groups.

Competency 2.8 Students will be able to explain why chemical bonds form.

Competency 2.9 Using a periodic chart, students will be able to determine the charge of the usual ion of the representative elements.

Competency 2.10 Students will be able to predict formulas of simple ionic compounds.

Competency 2.11 Students will be able to predict formulas of simple covalent compounds.

Competency 2.12 Students will be able to name simple binary compounds and compounds containing specific polyatomic ions.

Competency 2.13 Students will be able to balance simple chemical equations.

Competency 2.14 Students will be able to demonstrate a knowledge of four or five basic types of chemical reactions.

Competency 2.15 Students will be able to distinguish between chemical reactions and nuclear reactions

### **Outcome 3 - Students will be able to demonstrate a knowledge of the three states of matter and the changes from one state to another.**

Competency 3.1 Students will be able to describe the characteristics and properties of each phase in terms of motion and particles.

Competency 3.2 Students will be able to correctly use terms that describe phase change and phase transition temperature.

Competency 3.3 Students will be able to explain the behavior of gases in terms of Kinetic Molecular Theory (pressure, diffusion compression, etc.).

Competency 3.4 Students will be able to explain the relation between boiling point of a liquid and the attractions between molecules.

Competency 3.5 Students will be able to explain the effect of air pressure on boiling point.

### **Outcome 4 - Students will be able to demonstrate understanding the basic concepts of energy and discuss societal need for power and the environmental consequences for how that energy is obtained.**

Competency 4.1 Students will be able to define energy and distinguish between potential and kinetic energy.

Competency 4.2 Students will be able to explain what is meant by complete and incomplete combustion.

Competency 4.3 Students will be able to explain what is meant by fossil fuels and give several examples, as well as list several sources of energy which are not fossil fuel.

Competency 4.4 Students will be able to discuss possible sources of future energy.

**Outcome 5 - Students will be able to demonstrate an understanding of the basic concepts of nuclear chemistry with attention to nuclear power generation, medical and military applications.**

Competency 5.1 Students will be able to list and explain the three types of nuclear change: radioactivity, fission and fusion.

Competency 5.2 Students will be able to define and correctly use the terms ion, fallout and half-life.

Competency 5.3 Students will be able to complete simple nuclear equations, using symbols for alpha, beta and gamma radiation.

Competency 5.4 Students will be able to recognize the type of nuclear change, given an equation.

Competency 5.5 Students will be able to state the major use of radioactivity and of the major use of fission.

Competency 5.6 Students will be able to discuss the problems of nuclear power.

Competency 5.7 Students will be able to describe two methods of detection of nuclear radiation.

Competency 5.8 Students will be able to describe three safeguards against nuclear radiation.

**Outcome 6 – Students will be able to demonstrate a knowledge of aqueous solutions and how these concepts relate to providing clean water.**

Competency 6.1 Students will be able to correctly use the terms: solute, solvent, solution, suspension, concentrated, dilute and electrolytes.

Competency 6.2 Students will be able to list two properties of solutions and give examples of uses of them.

Competency 6.3 Students will be able to define acid, base, salt, neutral solution, weak and strong acids and bases.

Competency 6.4 Students will be able to interpret the meaning of a pH value.

Competency 6.5 Students will be able to explain what potable water is and distinguish it from pure water.

Competency 6.6 Students will be able to state what is commonly in natural water and explain how water is treated for consumption.

Competency 6.7 Students will be able to discuss some problems in keeping our waterways clean and life supporting and some possible solutions to the various problems.

**Outcome 7 - Students will be able to demonstrate a knowledge of organic chemistry and with attention consumer use of pharmaceuticals and polymers.**

Competency 7.1 From formulas students will be able to recognize basic compounds, the type of organic compound, the functional group and the structure.

Competency 7.2 Students will be able to illustrate the meaning of the word isomer.

Competency 7.3 Students will be able to correctly use the terms: hydrocarbon, saturated and unsaturated, polymer, thermosetting, thermoplastic.

Competency 7.4 Students will be able to list the first eight straight chain alkanes.

Competency 7.5 Students will be able to give specific names to two polymers and tell how each is used.

Competency 7.6 Students will be able to briefly describe some problems associated with polymers and what might help overcome the problems.

Competency 7.7 Students will be able to explain the difference between addition and condensation polymers.

Competency 7.8 Students will be able to discuss some of the advantages of having polymers.

**Outcome 8 - Students will be able to demonstrate a knowledge of some of the basic terminology of biochemistry with attention to nutritional aspects.**

Competency 8.1 Students will be able to correctly use the terms: monosaccharide, disaccharide, polyunsaturated fats and oils, saturated fats and oils, amino acids, proteins, essential amino acids, vitamins, minerals, enzymes, nucleic acids, carbohydrates, lipids.

Competency 8.2 Students will be able to explain the difference to our bodies, between starch and cellulose and what value each has to our bodies.

Competency 8.3 Students will be able to recognize from a structural formula whether a substance is a fat or an oil.

Competency 8.4 Students will be able to explain why polyunsaturated lipids are better for us.

Competency 8.5 Students will be able to explain what essential amino acids are and how they are obtained.

Competency 8.6 Students will be able to list several uses of protein in the body.

Competency 8.7 Students will be able to explain how vitamins and minerals are used by the body.

Competency 8.8 Students will be able to state the important difference between fat soluble and water soluble vitamins.

Competency 8.9 Students will be able to explain several purposes of food additives and be able to discuss one problem associated with food additives.

Competency 8.10 Students will be able to give a specific example of an enzyme and discuss the function of enzymes in the body.

Competency 8.11 Students will be able to explain the major functions of nucleic acids in our bodies.