**CHEMISTRY 1000—CHEMISTRY AND WELL-BEING**

**Text**: Chemistry For Changing Times, by John H. Hill and Doris K. Kolb, 2001, Prentice Hall

**Objective of the course**:

The course is designed for non-science majors and to fulfill the liberal arts core science requirements. No prerequisites required. The course shows the role chemical science plays in shaping, promoting, and maintaining well-being of humans. The principles and factual information on the chemistry of materials, diets and nutrition, drugs and medicine, energy and pollution, our environment biochemistry and genetics will be discussed, and their importance in our well being explored.

The course consists of two major components: lecture and laboratory. The lecture usually would cover a range of relevant topics taken from a carefully chosen textbook. The laboratory consists of a series of take-home projects that include experiments illustrating chemical principles using household items, and literature research papers with appropriate chemistry contents. To obtain a passing grade, a student must complete both components of the course satisfactorily and achieve the minimum standards set forth.

**Lecture Component**:

The lecture covers a range of topics considered to be important in helping students to begin to understand the principles of chemistry and its relevance to well-being. The textbook chosen should cover the topics listed below. Some of these are topics that may be included at the discretion of the instructor, depending on time constraints and current well-being issues.

**Course Outline**:

1. Introduction

-Definition of Terms

-Scientific Method

-Matter, Mixtures and Pure Substances

-Chemical and Physical Properties and Changes

-Energy, Heat and Temperature

2. Atoms and Elements:

-Important Discoveries, Experiments and Laws in Chemistry

-Atomic Theory of Matter

-Elements, Compounds, Molecules

-Subatomic Particles

-Isotopes, Atomic Weight

-Periodic Table of Elements

-Electron Configuration, Energy Levels and the Bohr Model.

3. Chemical Bonding:

-Valency and Valence Electrons

-Stability of Inert Gases and the Rule of Octet

-Ionic Bonding and Binary Compounds

-Covalent Bonding and Lewis Structure

-Polarity, Polar Covalent Bonds, and Molecular Shapes

-Intermolecular Interactions and Forces

-Solutions, Changes of States

-Factors Affecting Rate of Chemical Reactions

4. Nuclear Chemistry:

-Radioactivity and Radioactive Decay

-Alpha, Beta, and Gamma Particles

-Nuclear Reaction and Transmutation

-Half Life and Atomic Dating

-Nuclear Chemistry in Industry and Medicine

5. Simple Chemical Arithmetic and Chemical Reactions:

-Moles and Avogadro's Number

-Molarity and Percent Concentration

-Balancing Chemical Equations

-Simple Stoichiometry

6. Acids and Bases:

-Definition, Arrhenius, and Lowry-Bronsted Concept

-Strength of Acids/Bases and pH, a Measure of Acidity

-Acid/base Indicators

-Acids and Bases in Our Life

7. Oxidation and Reduction Reactions:

-Definition of Oxidation and Reduction

-Examples of Redox Reaction in Daily Life Such as Combustion and Corrosion

-Electrode Potential and Application of Redox Reaction in Batteries

8. Water and Its Unique Properties

-Polarity and Hydrogen Bonding

-High Surface Tension, Specific Heat, Boiling Point, and Others

-Solvent Properties

-Biological and Chemical Pollution of Water Resources

-Clean Water For Everyday Use

9. Air and Atmosphere

-Composition of Air

-Definition of Pollution

-Human Activities and Added Components of Atmosphere

-Industrial and Photochemical Smog

-Acids, Ozone, Volatile Organics and Particulate Pollution of Atmosphere

10. Introductory Organic Chemistry:

-Definition

-Hydrocarbons and Their Names

-Isomerisms

-Functional Groups and Families of Organic compounds

11. Energy and Fossil Fuels:

-Fuels for Civilization

-Fossil Fuels, Coal, Gas and Petroleum

-Petroleum Refining and Reforming

-Automobile and the Gasoline

-Octane Rating, Knocking, Antiknock Agents, and Oxygenate

-Combating Pollution and the Catalytic Converter

-Future Energy Sources

12. Polymers and Plastics:

-Natural Polymers, Age of Plastics and Synthetic Polymers.

-Addition and Condensation Polymers, and Elastomers

-Molecular Structure and Properties of Polymers

-Common Examples of Polymers and Their Uses in Consumer Items

13. Major Food Classes: Carbohydrates, Lipids, and Proteins:

-Types: Monosaccharides, Disaccharides, and Polysaccharides

-Common Examples of Simple Sugars and Disaccharides.

-Polysaccharides: Starch, Glycogen, and Cellulose.

-Fats, Oils, and Cholesterol

-Saturated and Unsaturated Fats, Obesity, Diabetes, and Heart Diseases

-Essential and Nonessential Amino Acids and Peptide Bonds

-Primary, Secondary, Tertiary and Quaternary Structures of Proteins

-Some Examples of Common Important Proteins and Their Functions

14. Foods, Nutrition and Fitness:

-Heat Energy and Measurement of Heat

-Counting Calories and Body Mass Index

-Energy from Carbohydrates, Proteins, Fats, and Oils

-Saturated and Unsaturated Fatty Acids

-Minerals and Vitamins for Health, Their Deficiency and Diseases

-Processed Foods and Food Additives

-Activities, Exercises and Fitness

15. Medicines and Drugs:

-Chemicals from Herbs and Plants

-Aspirin and Other Analgesics and Narcotics

-Antibiotics, Antihistamines, Medicines and Drugs for Colds and Allergies

-Brain Chemicals, Caffeine and Nicotine, And Addictive Compounds

-Placebo and Its Effect

16. Cosmetics and Personal Care:

-Universal Urge for Adornment

-Surfactants and Surface Tension

-Soft and Hard Water, Soap and Detergents, Their Properties and Manufacture -Personal Care Cleansers, Moisturizers, and Anti-aging Cream, Tan and Sunscreen

-Toothpaste and Oral Health

17. Poisons, Toxins and Risks:

-Natural Toxins and Synthetic Toxic Substances, LD50

-Natural Foods versus Synthetic Substances

-Mutagens, Teratogens, Carcinogens

-Ames' Test of Mutagenicity

18 Chemistry of Inheritance:

-The Nucleic Acids

-DNA and RNA

-The Double Helix

-Central Dogma: Replication, Transcription and Translation

-The Genetic Code

**Laboratory Component**

The laboratory component consists of a series of projects designed to acquaint the students with experimental observations and also to expose them to the relevance of chemistry in the daily items they use or encounter.

**List of Experiments**:

1. Electrolytes and nonelectrolytes found at homes

2. Acids and bases found in household items using a red cabbage indicator

3. Producing carbon dioxide gas using household Items and studying its properties.

4. Analysis of hardness of water (tap or commercially bottled water)

5. Electrochemical experiments, for example, electrolysis of water

6. Rate of chemical reactions, for example, decomposition of hydrogen peroxide.

7. Cross-linking a polymer and changing its properties.

8. Chemical content of consumer and household Items of different brands.

9. Research on the reliability and accuracy of health-related information obtained on Web

10. Other appropriate experiments

Besides the take-home assignments, the instructor will conduct demonstrations, and chemistry experiments requiring equipments not found at homes during one of the weekly lecture periods.