Revised May, 1986

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: CHEMISTRY

Code No.: CHM 300-3

Program: FORESTRY TECHNOLOGY (FISH & WILDLIFE)

Semester: FIVE

Date: NOVEMBER, 1985

Author: J. S. KORREY

New: _____ Revision: X

APPROVED: _____ Nov 22/85
Chairperson Date

CHEMISTRY	CHM 300-3
Course Name	Course Number

PHILOSOPHY/GOALS:

CHM 300-3 is a one semester course designed to provide fish and wildlife students with the basic theory and background for a better understanding of work done in other areas such as environmental measurements. Topics covered are: matter, physical and chemical change, density, structure of matter, mole concept, percent composition, chemical formulas, nomenclature, equations, solubility, concentration, and solution problems, acid-base theory and the chemistry of some biological compounds.

METHOD OF ASSESSMENT:

A = 80 - 100%
B = 70 - 79%
C = 60 - 69%
I = 59% or less

WEIGHTING: Theory = 45% - based on average mark obtained on four tests.

Lab = 35% - the lab grade will be based on the performing of five labs and assessment of the five reports submitted.

Project = 20% - research project

Credit standing in CHM 300 may be obtained in one of the following ways:

1. "A" Level: To obtain an "A" grade, completion of the research project is required.

2. "B" or "C" Level: Achievable by those students who may elect not to do project and still pass with a "B" or "C" grade.

Students having Grade 12 or 13 Chemistry may be exempted from attendance of the first three units of work by successfully writing a pre-test on these topics. This exemption applies only to the "theory" portion of the course. The laboratory part of the course is required by all students and 100% attendance in lab is a mandatory requirement.

Students having over 50% but less than 60% will be given the opportunity to obtain a passing grade ("C") by writing a make-up test on the whole semester's work, provided they have attended at least 85% of the lectures, and then only at the discretion of the instructor.

TEXTBOOK(S):

Malone, Leo J., Basic Concepts of Chemistry, John Wiley and Sons, N.Y.

REFERENCES:

Robinson, W. L. and Bolen, E. G., Wildlife Ecology and Management, MacMillan, 1984.

Arms, Karen and Camp, P. J., Biology, 2nd Edition, Holt, Rinehart and Winston, 1982.

CHEMISTRY 300-3

	TIME(HRS)	
UNIT I:	3	Chemistry and Matter REF: Chapter 1 and 3 - Malone

- Chemistry and nature of matter
- Properties of matter
- Physical and chemical changes
- Density (Chapter 2)
- Structure of the elements
- Compounds and formulas
- Ions and ionic compounds
- Structure of the atom
- Atomic no., mass no., atomic mass

UNIT II:	4	Periodic Nature of the Elements REF: Chapters 4 and 5 - Malone

- Periodic table of the elements
- Physical properties of the elements
- Periods
- Groups
- Trends

UNIT III:	6	Chemical Formulas and Nomenclature of Inorganic Compounds REF: Chapter 7 - Malone

- Oxidation states
- Naming binary compounds
- Naming ternary compounds containing oxygen
- Naming common acids

Chemical Equations
REF: Chapter 9 - Malone

The student will be able to write and balance equations representing the 5 types of chemical reactions.

UNIT IV:	8	The Mole Concept REF: Chapters 8 and 9 - Malone

- Molecular mass of compounds
- The number of moles in a given mass of material
- Equivalent weight of acids, bases, salts, elements
- Percent composition

UNIT IV: (Cont'd) Solution Problems
REF: Chapter 11 - Malone

- Solubility of ionic compounds
- Methods of expressing concentration
- Solution Problems
  5 types - A) Preparation of a molar solution
  B) Working from specifications
  - $M = \frac{\% \text{ purity} \times \text{Sp. Gr.} \times 1000}{\text{GMW}}$
  C) Serial dilution problems and use of the formula $C_1V_1 = C_2V_2$
  D) Preparation of a normal solution and relationship between M & N

UNIT V: 7 Acid-Base Equilibria
REF: Chapter 15 - Malone

- Equilibria in water
- Concept of pH and pOH
- Weak acids and bases in water
- Buffers

UNIT VI: 8 Organic Chemistry & Biologically Significant Compounds

- A brief introduction to biologically related compounds
  - proteins (amino acids) †
  - carbohydrates † Relate these to energy
  - lipids - waxes † transfer & nutrition
    - steroids †
  - cellulose †
  - vitamins
  - minerals
  - enzymes

TOTAL 36 HOURS

LABORATORY EXPERIMENTS

A two-hour lab session will be run every other week. The labs are designed to give the student practice in basic lab techniques. Experiments to be conducted are:

(6 weeks x 2 hours) = 12 hours

1. Physical Properties - densities of liquids & solids . . . . 2 hours
2. Serial Dilution . . . . . 2 hours
3. pH Measurements using papers, indicators & meters . . . . . 2 hours
4. Titration for Total Inflection Point Alkalinity . . . . . 2 hours
5. Energy Determinations Using Bomb Calorimeter . . . . . 4 hours

LAB ASSIGNMENTS ARE DUE ONE WEEK AFTER COMPLETION OF LAB WORK. LATE ASSIGNMENTS WILL NOT BE ACCEPTED.

OBJECTIVES FOR CHM 300 - CHEMISTRY FOR FORESTRY TECHNOLOGY

FISH AND WILDLIFE TECHNOLOGY PROGRAM

AUGUST, 1985

UNIT 1: CHEMISTRY, MATTER, CHANGES AND ENERGY

Ref: Chapters 1, 2 and 3. Malone, Leo J. Basic Concepts in Chemistry.

AFTER COMPLETION OF THESE CHAPTERS, THE STUDENT SHOULD BE ABLE TO:

1. Give the definitions of chemistry and matter.
2. Describe the three states of matter and give examples of each.
3. Classify a sample of matter as either heterogeneous or homogeneous.
4. Distinguish between a mixture, a solution and a pure substance.
5. Classify a list of pure substances as either elements or compounds.
6. State the names and symbols of the first 20 common elements.
7. Give examples of physical and chemical properties and physical and chemical changes.
8. Apply the law of conservation of mass to explain observed chemical changes.
9. Classify a physical or chemical change as either endothermic or exothermic.
10. Name and describe the various forms of energy.
11. Distinguish between potential and kinetic energy.
12. Distinguish between density, buoyancy and specific gravity.
13. Calculate density given appropriate experimental data and use it as a conversion factor between mass and volume.
14. Convert temperatures in degrees Celsius to Fahrenheit and Kelvin and vice versa.
15. Describe the nuclear atom, including the name, location, mass (in amu) and electrical charge of the three particles in the atom.

UNIT 1: CHEMISTRY: MATTER, CHANGES AND ENERGY...CONTINUED

16. Give the atomic number and mass number of a specified isotope.

17. Write the number of protons, neutrons and electrons from the representation of a specified isotope.

18. Define atomic weight and describe how it differs from mass number.

19. Distinguish between atoms and molecules.

20. Describe the function of a covalent bond in a molecule.

21. List the elements and the number of atoms of that element in a compound from the formula.

22. Write definitions for the terms ion, cation, anion and electrostatic force.

23. Distinguish between molecular and ionic compounds.

24. List the number of protons, neutrons and electrons present in a specified atom or ion.

UNIT II:

Reference: Chapters 4 & 5 - Malone.

AFTER COMPLETION OF THESE CHAPTERS, THE STUDENT SHOULD BE ABLE TO:

1. Describe how to locate elements with similar chemical properties in the periodic table.

2. Give brief discussion of the origin of the periodic table and describe how it was first constructed.

3. Locate on the periodic table those elements existing as gases, liquids and solids.

4. Locate on the periodic table those elements that are metals, nonmetals and metalloids.

5. Explain what is meant by a period and a group.

6. Locate on the periodic table the elements in the first seven periods.

UNIT II: CONTINUED..

7. Give the characteristics of the electron configuration of the four general categories of elements.

8. Predict the general trend of the atomic radii of the representative elements.

UNIT III: CHEMICAL FORMULAS AND NOMENCLATURE OF INORGANIC COMPOUNDS

Ref: Chapters 7 & 8 - Malone.

AFTER COMPLETION OF THESE CHAPTERS, THE STUDENT SHOULD BE ABLE TO:

1. Determine the oxidation state of an element in a compound.

2. List the metals which have only one oxidation state.

3. Name metal-nonmetal binary compounds and write formulas given a name.

4. Apply the Stock method for naming compounds with metals that have variable oxidation states.

5. Write the names and formulas for the polyatomic ions listed in Table 7-3 (the charge must be correct).

6. Name metal-nonmetal binary compounds by use of Greek prefixes listed in Table 7-4.

7. Name binary oxyacids and write formulas given a name.

8. Describe the information represented by a balanced equation.

9. Write and balance simple equations.

10. Classify chemical reactions among the five types listed in the text.

UNIT IV: THE MOLE CONCEPT

Ref: Chapters 8 & 9 - Malone.

1. Describe the unit known as the mole and tell why it is needed in chemistry.

UNIT IV: THE MOLE CONCEPT...CONTINUED

2. Write the molar mass of any element from the periodic table.

3. Calculate the mass of the same number of atoms of one element given the mass of a different element.

4. Convert between moles, mass, and number of atoms of any element.

5. Calculate the formula mass of a specified compound.

6. Convert between moles, mass and number of molecules of formula units of a compound.

7. Calculate the percent composition of the elements in a compound.

8. Distinguish between an empirical and a molecular formula.

9. Calculate the empirical formula of a compound from its present composition or weight composition.

10. Use the data from chemical analysis to establish the molecular formula of a compound.

11. Use the balanced equation to obtain mole relationships among reactants and products.

12. Make the following stoichiometric conversions:
    a) Mole to mole
    b) Mole to weight (mass)
    c) Mass to mass

13. Calculate the percent yield from the actual yield and the theoretical yield.

14. Calculate the percent purity of a sample from the yield of a product.

UNIT IV: AQUEOUS SOLUTIONS

Ref: Chapter 12 - Malone.

15. Describe the conductivity properties and compositions of nonelectrolytes, strong electrolytes and weak electrolytes in water solution.

16. Write equations illustrating the solution of various ionic compounds in water.

UNIT IV: AQUEOUS SOLUTIONS...CONTINUED

17. Determine whether a specific ionic compound is soluble in water given a table of solubilities.

18. Solve problems involving percent composition of a solute.

19. Apply the definition of Molarity to solve the following types of problems:

    a) Preparation of a specified quantity and concentration of a solution.
    b) Calculation of the quantity of solute in a given quantity of solution.
    c) Dilution of a concentrated solution to make a specified dilute solution. Serial dilution using the formula

$$C_1V_1 = C_2V_2$$

20. Determine the Equivalent Weight of acids, bases, salts, and elements.

21. Calculate the amount of solute required to prepare solutions of varying normalities.

22. Convert normalities to molarities and vice versa.

23. Mix solutions of different concentrations and calculate the resulting concentrations.

UNIT V: ACID-BASE EQUILIBRIA

Ref: Chapter 13 - Malone.

1. Apply the Arrhenius definition to identify compounds as acids or bases and to write equations illustrating this behaviour.

2. Give the names and formulas of some common acids and bases derived from specified anions or cations.

3. Distinguish between behaviour of a strong and a weak acid in water.

4. Describe the dynamic equilibrium involved in the partial ionization of a weak acid or base in water.

5. Calculate $[OH^-]$ from a specified $[H_3O^+]$ and vice versa by use of K_w.

CHM 300 OBJECTIVES...6

UNIT V: ACID-BASE EQUILIBRIA...CONTINUED

6. Distinguish between acidic, basic, or neutral solutions in terms of $[H_3O^+]$ and $[OH^-]$.
7. Convert $[H_3O^+]$ to pH and vice versa.
8. Distinguish between acidic, basic or neutral solutions in terms of pH.
9. Determine whether a specified solution acts as a buffer.

UNIT VI: ORGANIC CHEMISTRY AND BIOLOGICALLY SIGNIFICANT COMPOUNDS

1. Define and give examples of the term Isomers.
2. Distinguish between the three homologous series, alkanes, alkenes, and alkynes.
3. Identify Aromatic Compounds.
4. Identify the functional group in the eight classes of compounds listed below:

   Alcohols, ethers, acids, esters, amines, aldehydes and ketones.
5. Define nutrient and essential nutrient.
6. Describe the general characteristics of carbohydrates, lipids and proteins.
7. Distinguish between simple and complex carbohydrates.
8. Distinguish between saturated and unsaturated fats.
9. Define "enzyme".
10. Explain how protein molecules become denatured.
11. List some common sources of carbohydrates, lipids and proteins.
12. Explain the role of the liver in fat metabolism.
13. Distinguish between essential and non-essential amino acids.
14. Distinguish between complete and incomplete proteins.

15. Describe the major functions of amino acids.

16. Define "calorie".

17. Define "energy balance".

20. Distinguish between a vitamin and a mineral.

21. Explain what is meant by Vitamin B complex.

22. Discuss the general characteristics of fat-soluble vitamins.

23. Discuss the general characteristics of the mineral nutrients.

24. Define "enzyme".

25. Describe how an enzyme is thought to interact with its substrate.

26. Explain how an enzyme can be denatured.