LSC Use Only **Proposal No:** **LSC Action-Date:** AP-3/22/12	*UWUCC Use Only* Proposal No: 11-125a. UWUCC Action-Date: App-4/3/12 Senate Action Date: App-9/11/12

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person(s) **Sharon Sowa**	Email Address **ssowa@iup.edu**
Proposing Department/Unit **Chemistry**	Phone 74481

Check all appropriate lines and complete all information. Use a separate cover sheet for each course proposal and/or program proposal.

1. Course Proposals (check all that apply)

____ New Course ____ Course Prefix Change ____ Course Deletion

_X_ Course Revision ____ Course Number and/or Title Change _X_ Catalog Description Change

Current course prefix, number and full title: *CHEM 101 College Chemistry I*

Proposed course prefix, number and full title, if changing:

2. Liberal Studies Course Designations, as appropriate

_x_ This course is also proposed as a Liberal Studies Course (please mark the appropriate categories below)

____ Learning Skills _X_ Knowledge Area ____ Global and Multicultural Awareness ____ Writing Intensive (include W cover sheet)

____ Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)

____ Global Citizenship ____ Information Literacy ____ Oral Communication

____ Quantitative Reasoning ____ Scientific Literacy ____ Technological Literacy

3. Other Designations, as appropriate

____ Honors College Course ____ Other: (e.g. Women's Studies, Pan African)

4. Program Proposals

____ Catalog Description Change ____ Program Revision ____ Program Title Change ____ New Track

____ New Degree Program ____ New Minor Program ____ Liberal Studies Requirement Changes ____ Other

Current program name:

Proposed program name, if changing:

5. Approvals	Signature	Date
Department Curriculum Committee Chair(s)	[signature]	2/23/12
Department Chairperson(s)	Dean R Long	2/23/12
College Curriculum Committee Chair	Anne Kondo	3/8/12
College Dean	[signature]	3/12/12
Director of Liberal Studies (as needed)	David H Porter	3/27/12
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	Gail S Sechrist	4/3/12

Received MAR 27 2012 Liberal Studies

Received MAR 12 2012 Liberal Studies

Part II.

New Syllabus of Record

1. Catalog Description

CHEM 101 College Chemistry I (3c-2l-4cr)

Prerequisites: none

Basic principles and concepts of inorganic chemistry are developed using atomic and molecular structure with illustrative examples from descriptive chemistry. The laboratory portion of the course illustrates physical and chemical properties in a qualitative and quantitative manner. Designed for selected majors within the College of Health and Human Services and to fulfill the Liberal Studies Natural Science Laboratory Sequence requirement.

2. Course Outcomes

Objective 1:
The students will understand the basic principles of matter and energy, as they apply to inorganic chemistry.
Expected Student Learning Outcomes 1 and 2:
Informed and empowered learners.
Rationale:
Exams and homework assignments, as well as laboratory investigations will determine whether students understand elements, atomic structure, chemical bonding, energy of physical and chemical changes, chemical reactions and equilibria, acids and bases. Students will also understand the basics of radiation and explain how it is used in medicine.

Objective 2:
The students will analyze chemical processes in a quantitative manner.
Expected Student Learning Outcomes 1 and 2:
Informed and empowered learners.
Rationale:
Students will be able to solve stoichiometry problems and understand quantitative relationships between reactants and products in both theoretical and experimental problem solving activities. Students can apply their understanding of acid-base behavior to the calculation of pH and buffering capacity in aqueous solutions.

Objective 3:
The students will relate chemical principles to practical applications in areas such as health and nutrition.
Expected Student Learning Outcomes 2 and 3:
Empowered and responsible learners.
Rationale:
Students will be able to critically evaluate the pros and cons of using radiation for the diagnosis and treatment of disease. Students will be able to relate chemical concepts such as buffers and solutions to physiology and medications. Students can use their quantitative and measurement skills to evaluate

nutritional needs and medication dosages. In the laboratory, students will gain an understanding of chemical safety and the safe handling of hazardous materials, to prevent damage to themselves and the environment.

3. Detailed Course Outline

College Chemistry I is a multi-section course taught by a team of instructors. However, it is always coordinated so that students receive exposure to the same series of lecture topics and the same experiments. There are special sections of both lecture and laboratory designated for students in Nursing and Allied Health Professions as well as Food and Nutrition.

Lecture Topics

1 hr = one 50 minute lecture or 'academic hour'

1. The Language of Chemistry — 5 hours

Characteristics of elements, compounds, mixtures. Scientific measurements: units, uncertainty, significant figures. Scientific notation. Using the unit-conversion (factor-unit, dimensional analysis) method to solve problems. Concepts/measurements of mass, volume, density, temperature, heat, calorimetry. Applications to health and nutrition.

2. Atomic Structure — 4 hours

Dalton's atomic theory. Laws of constant composition and conservation of mass. Subatomic particles and atomic structure (the quantum mechanical atom). Main group vs transition metals; metals vs nonmetals. Electronic configuration, valence shells, and the Periodic Table. The octet rule.

3. Molecules and Chemical Bonds — 3 hours

Ionic vs covalent bonding between atoms. Octet rule and ion formation. Naming ionic and covalent compounds. Lewis structures. Molecular polarity. VSEPR theory. Practical applications.

Exam 1 — 1 hour

4. Chemical Calculations — 5 hours

The mole and Avogadro's number. Calculating formula mass. Conversions between moles and grams. Writing and balancing chemical equations. Stoichiometry. Practical applications to medicines/doses, nutritional values, etc.

5. The Physical Properties of Gases — 3 hours

Units of pressure, volume, amount and temperature for gaseous behavior. Universal gas law. Quantitative descriptions of physical behavior. Solubilities of gases in liquids. Practical applications to health/breathing.

Exam 2 — 1 hour

6. Interactions Between Molecules — 3 hours

The states of matter and transitions between them. Secondary forces and chemical structure/physical properties. Principles of solution formation. Dynamic equilibrium. Applications of equilibrium to everyday reactions.

7. Solutions — 4 hours

Molecular properties required for solution formation. Quantitative definitions of concentration. Methods of solution preparation/dilution. Diffusion. Osmotic pressure. Macromolecules and colloidal dispersions. Applications to cells, blood, parenteral solutions and other intra- and extra-cellular fluids.

Exam 3 — 1 hour

8. Chemical Reactions — 3 hours

Factors that affect rate of reaction. Collision theory. Dynamic equilibria of chemical systems. Le Chatelier's Principle and qualitative/quantitative aspects of equilibrium. Applications to biochemical reactions and enzymatic catalysis.

9. Acids, Bases and Buffers — 4 hours

Acid base-chemistry and the ionization of water. pH. Strong vs weak acids and bases. Acid-base equilibria in solution. Bronsted-Lowry definitions. Buffers. Titration. Applications to biological fluids, e.g. maintenance of blood pH.

10. Chemical and Biological Effects of Radiation — 3 hours

Radioactivity and nuclear emissions. Nuclear equations. Radioactive decay and half-life calculations. Medical applications of radioactivity in diagnosis and therapy.

Exam 4 — 1 hour

Comprehensive Review for final exam — 1 hour

The final exam will occur during the final exam period.

Laboratory Topics - one laboratory period for each experiment

Week :
1 Check-in
2 Laboratory Safety
3 Chemical Calculations
4 Understanding Measurements
5 Density and Specific Gravity
6 Atomic Structure and Periodic Properties
7 Ions, Molecules, and a Reaction
8 The Gas Laws: Application to Molar Mass Determination
9 Physical and Chemical Changes: Thermochemistry
10 Solutions and Solubility
11 Titration
12 Dynamic Equilibrium

13 Acids, Bases, pH and Buffers
14 Check-out; final quiz

4. Evaluation Methods

The evaluation consists of the lecture grade as 75% of the course grade, while the laboratory component determines 25%. The lecture grade includes quizzes/homework (10-20%), hourly exams (55% - 70%), and the final exam (20-25%). The laboratory grade is based on lab reports (75 – 80%) and quizzes (20-25%). The student must earn 65% in the laboratory in order to pass the course.

5. Example Grading Scale

Final course grade is determined by the percentage of total points earned by the student in both lecture and laboratory.

A 90-100% B 80-89% C 70-79% D 60-69% F <60%

6. Undergraduate Course Attendance Policy

The University expects all students to attend class. The attendance policy for this course will be consistent with the Undergraduate Course Attendance Policy in the IUP Catalog.

7. Required textbook(s), Supplemental Books, and Readings

Required text: *Chemistry: General, Organic and Biochemistry, Connecting Chemistry to Your Life* Second Edition by Ira Blei and George Odian, W.H. Freeman and Co., New York, 2009 Media Update Edition

Note: Each chapter in the text contains a "picture of health" application that connects the topic to its importance in the human body.

Laboratory Manual: *College Chemistry I: Exploring Chemical Reality* Department of Chemistry, Indiana University of Pennsylvania, 2011 (available at ProPacket) To provide a dynamic set of experiments with specific applications for our students, the teaching faculty has developed its own laboratory manual that is available at a local photocopy center at low cost.

Supplemental Readings: Nursing and Allied Health students are encouraged to consult other references such as current issues of professional journals (e.g. *RN, American Journal of Nursing*) for supplemental information. Nutrition, safety science and other majors may also be directed toward current journals in their discipline.

8. Special Resource Requirements

Students are expected to have their own scientific calculators and to purchase and wear safety goggles that meet the ANSI standard in the laboratory.

Students are expected to study from the required text, and are encouraged to take advantage of supplemental learning aids that accompany the text, such as the chemportal tutorials and website 'pointers' that can direct them to learning aids

9. Bibliography

General Organic and Biological Chemistry, 7th ed by Katherine Denniston, Joseph Topping and Robert Caret, McGraw Hill, New York, 2011

General Organic and Biological Chemistry, 2nd ed by Janice Gorzynski Smith, McGraw Hill, New York, 2012

General Organic and Biological Chemistry, Structures of Life, 4th ed by Karen C. Timberlake, Pearson Education, New York, 2013

Math & Dosage Calculations for Healthcare Professionals, 4th ed by Kathryn A. Booth, James E. Wahley, Susan Sienkiewicz, and Jennifer F. Palmunen, McGraw Hill, New York, 2012

Student Solutions Manual for Chemistry: General, Organic and Biochemistry, Connecting Chemistry to Your Life by Mark D. Dadmun, W.H. Freeman and Co., New York, 2009

Study Guide for Chemistry: General, Organic and Biochemistry, Connecting Chemistry to Your Life by Marcia L. Gillette, W.H. Freeman and Co., New York, 2009

<u>*www.whfreeman.com/bleiodian2e:*</u> textbook website with online study aids, exercises, links to molecules in the news, etc

Sample Assignment CHEM 101: **Experiment 2 DENSITY AND SPECIFIC GRAVITY**

Introduction

Among the objectives of last week's experiment were (1) to familiarize you with the use of equipment for determining volume, (2) to teach you how to use significant figures for reporting data, and (3) to give you experience doing calculations based on that data. We will use these skills this week to determine the densities of both liquids and solids.

Density is defined as the ratio of the mass of an object to its volume. Mathematically, this can be expressed as:

$$\textbf{density} = \frac{\textbf{mass}}{\textbf{volume}} \quad \text{or} \quad \mathbf{d} = \frac{\mathbf{m}}{\mathbf{v}}$$

Therefore, to determine density we must find out the values of the two **extensive properties**, mass and volume [NOTE: extensive properties are those properties whose values depend on the size of the sample]. To determine the mass we simply weigh the object. Strictly speaking, mass and weight are not the same. The mass of an object is constant because it measures the amount of matter in the object. Weight varies because it measures the effect of gravity on the object. In most cases, the values of mass and weight are close enough to be considered the same. So we will use them as though they were. However, you should be aware of this difference.

Density is considered to be an **intensive property** of a substance. The density of a substance is the same regardless of the size of the sample. For example, one liter of mercury has exactly the same density as one milliliter of mercury. The size of the sample makes no difference.

Note that the popularly used expression "heavier than air" is really incorrect. A balloon filled with carbon dioxide gas will sink to the floor, not because carbon dioxide is "heavier than air," but because carbon dioxide has a higher density than air. Likewise, a balloon filled with helium rises, not because helium is "lighter than air," but because its density is lower than the density of air.

Since density is the ratio of mass to volume, it is always reported with the appropriate units for mass and volume. The density of liquids is usually reported as grams per milliliter **(g/mL)**, the density of gases as grams per liter **(g/L)**, and the density of solids as grams per cubic centimeter **(g/cm^3)**.

A quantity closely associated with density is **specific gravity**. The specific gravity of a substance is determined by comparing its density to the density of a standard. A different way of stating this is to say that specific gravity is the comparison of the masses of equal volumes of two substances or of two objects. The standard for liquids and solids is usually water. The standard for gases is air.

<u>Note that specific gravity has no units because the values being compared have the same units</u>. For example, the specific gravity of gasoline is

$$\textbf{specific gravity of gasoline} = \frac{\textbf{density of gasoline}}{\textbf{density of water}} = \frac{\mathbf{0.670\ g/mL}}{\mathbf{1.000\ g/mL}} = \mathbf{0.0670}$$

Earlier we said that density is an intensive property of a sample. That is, its value is independent of the size of the sample. This does not mean that the density never varies. Changes in temperature can change the density because, although mass stays the same, volume usually increases with increasing temperature and decreases with decreasing temperature. As a result, the density is lower at higher temperatures. For liquids and solids the density change is normally very small. For gases the changes are significant; so the temperature must be indicated when the density of a gas is given.

PART A: Density of a Liquid

The weight of a liquid is determined by difference: subtracting the weight of a container from the weight of the liquid and container together. To do this place an empty flask on a balance and push the re-zero button. This automatically subtracts the weight of the glassware and sets the balance to zero (the technical term for this procedure is taring). Once the balance returns to zero, you may remove the flask. A negative weight, equal to the weight of the flask, will appear. Pour the liquid into the flask and put the flask containing the liquid on the balance again. The weight that appears is equal to the weight of the liquid. When finished, you should remove the flask and liquid and press the re-zero button once again to zero the balance.

The same process can be performed without using the re-zero button. To do this, simply record the weight of the empty flask. Add the liquid and determine the weight of both the liquid and the flask. The weight of the liquid is the difference between the two weights.

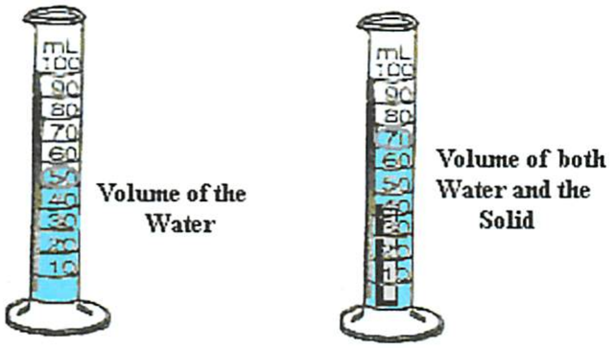
Wt. (Flask + Liquid) - Wt. (Flask) = Wt. (Liquid)

The volume of the liquid is determined by measuring it in a graduated cylinder or with a pipette. Using the experimental values for weight and volume, the density is calculated as shown on the previous page.

PART B: Density of Water-Insoluble Solids

In Part A we saw that, when working with liquids, volume is easily determined by reading the calibration of a graduated cylinder or of a pipette. However, the liquid cannot be poured on the balance, so its *weight* must be determined indirectly by difference as explained above. With solids, weight may be determined directly by placing the solid on the balance, or by difference if the solid is finely divided (putting the solid in a weighing dish or on weighing paper). The *volume of a solid*, on the other hand, may be a little more difficult to determine.

If the solid is insoluble in water and has a higher density than water, its volume may be determined by immersing it in a known volume of water and determining the new volume, which is the volume of the water and the object combined. The difference in the two volumes is equal to the volume of the solid. [Two objects cannot occupy the same space, so the solid must displace an amount of water equal to its own volume].



Volume determined by water displacement. The change in volume is equal to the volume of the solid.

If the solid has a regular shape, like the metal cylinder that you used in last week's experiment, the volume may also be determined by measuring the length, width and height (or diameter) and using the appropriate formula to calculate the volume. For irregular solids, however, the volume must be determined by the displacement of water, as described above.

Another method of determining volume of an irregular solid is to apply **Archimedes' Principle,** which states that when an object is submerged in a liquid, it will show an apparent loss in weight which is equal to the weight of the liquid that has been displaced. If the liquid is water, which has a density of 1.000 g/mL at room temperature, the volume of the object is equal to the observed loss of weight. This method can used to determine the volume of a person's body. The person is weighed and then immersed in water. While immersed, the person is weighed again. The difference in the two weights is equal to the person's volume. Dividing the weight by the volume gives the person's body density. Then doctors use charts that relate body density to the percent of body fat to determine if the person has too much body fat relative to their size .

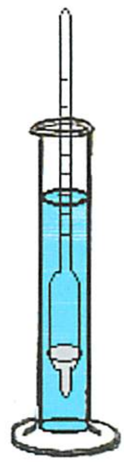
The density of an object can sometimes be used to identify the material from which it is made. For example, if you have a metal cylinder, you can weigh it to determine its mass and use Archimedes' Principle to determine its volume. These values can be used to calculate density. Some sample data are given below:

Weight of cylinder suspended in Air	25.00 g
Weight of cylinder suspended in Water	15.74 g
Volume of metal cylinder (1 g = 1 cm^3)	9.26 cm^3
Experimental density of metal cylinder	2.70 g/cm^3

This result (density = 2.70 g/cm^3) can be compared to the known densities of metal to determine that this cylinder is made up of aluminum. Alloys, which are mixtures (solid solutions) of metals, have densities that fall between the densities of the pure components and depend on the amount of each component. It is also possible to identify pure liquids or gases by density. Some mixtures of fixed composition, such as blood, can also be identified by density. Table 1, below, gives the densities of some of these substances.

Density of some common substances and mixtures at specific temperatures

Solids	Density (g/cm^3 or g/mL)	Temp. (°C)
Aspirin	1.40	25
Balsa Wood	0.160	25
Silicon	2.33	25
Table Salt	2.160	25
Liquids		
Bromoform ($HCBr_3$)	2.904	15
Chloroform ($HCCl_3$)	1.484	20
Ethanol (Ethyl Alcohol)	0.789	25
Hexane	0.660	20
Mercury	13.534	25
Water	0.997	25
Water	1.0000	3.98
Blood Plasma (a mixture)	1.027	25
Corn Oil (a mixture)	0.91	25
100% Hydrogen Peroxide*	1.44	25
75% Hydrogen Peroxide*	1.33	25
0.9% NaCl Solution*	1.0	25
26.5% NaCl Solution*	1.198	25
Urine (a mixture)	1.003-1.030	25
Metals		
Sodium	0.97	20
Aluminum	2.70	20
Zinc	7.14	20
Iron	7.86	20
Copper	8.96	20
Silver	10.5	20
Lead	11.4	20



Measuring the Specific Gravity of a Liquid with a Hydrometer

* Note that the density of the water solutions increase as the percent of the dissolved substance increases.

PART C: Specific Gravity

The density of a liquid can be calculated from the ratio of its measured mass and measured volume. Dividing the result by the density of water gives the specific gravity of the liquid. Specific gravity can also be measured directly using an instrument, called a **hydrometer**, which is a hollow glass vessel weighted by a determined amount of metal shot. When placed in a liquid, the hydrometer is partially submersed. The stem, which is above the liquid level, contains calibration marks which are read at the liquid surface. A hydrometer used to measure the specific gravity of urine is called a urinometer.

Additional Reading

Your textbook discusses density and specific gravity in section 1.9 (pages 21-23). You should read this section and do the appropriate exercises on pages 32-33 as part of your preparation for this experiment. [Exercises 1.41, 1.42 and 1.45-1.48]

EXPERIMENTAL YOU MUST WEAR SAFETY GOGGLES AT ALL TIMES IN THE LAB

PART A. Density of Liquids

Equipment: 125 mL Erlenmeyer flask, 100 mL beaker, 10.00 mL pipette, pipette pump

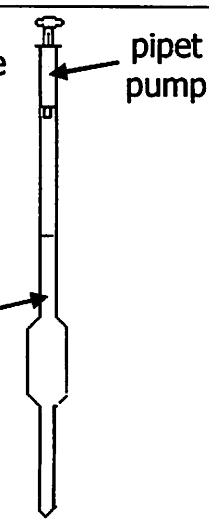
Reagents: Distilled water (available from taps on the 2 end sinks or from wash bottles), ethanol

Procedure: *check off the box as you complete each step*

Note: Last week you used tap water. This experiment and many others specify distilled water. Make sure that you know which taps in the lab dispense distilled water.

- ☐ Verify that the balance reads 0.00 g (if not, re-zero the balance)
- ☐ Weigh a 125 mL Erlenmeyer flask, record the weight on the data sheet in Table 1.
- ☐ Dispense about 20 mL of distilled water into the 100 mL beaker
- ☐ Attach a pipette pump to a 10.00 mL volumetric pipette, as shown below.
- ☐ Use this apparatus to measure out exactly 10.00 mL of distilled water.
- ☐ Dispense the water into the flask and weigh it again.
- ☐ Record this weight in Table 1 on the data sheet.
- ☐ Dry the outside of the pipette with a paper towel and rinse the inside of the pipette with ethanol by drawing some ethanol into it with the pump.
- ☐ Discard the rinse ethanol.
- ☐ Measure exactly 10.00 mL of a fresh sample of ethanol.
- ☐ Add the ethanol to the flask containing the water.
- ☐ Weigh the flask, which now contains both the distilled water and the ethanol.
- ☐ Record the data and calculate the weight and density of each liquid.

CAUTION: Always use a pipet pump to pipet liquids. Never touch a pipet with your mouth.



PART B. Density of Solids

Equipment: 50 or 100 mL graduated cylinder, metal cylinder, beaker, apparatus for Archimedes' Principle.

Procedure: *check off the box as you complete each step*

- ☐ Verify that the balance reads zero.
- ☐ Place the metal cylinder on the balance and record its weight in Table 2 on the data sheet. *This weight will be used to calculate the density in the three procedures that follow.*

1. Determination of Volume by Water Displacement

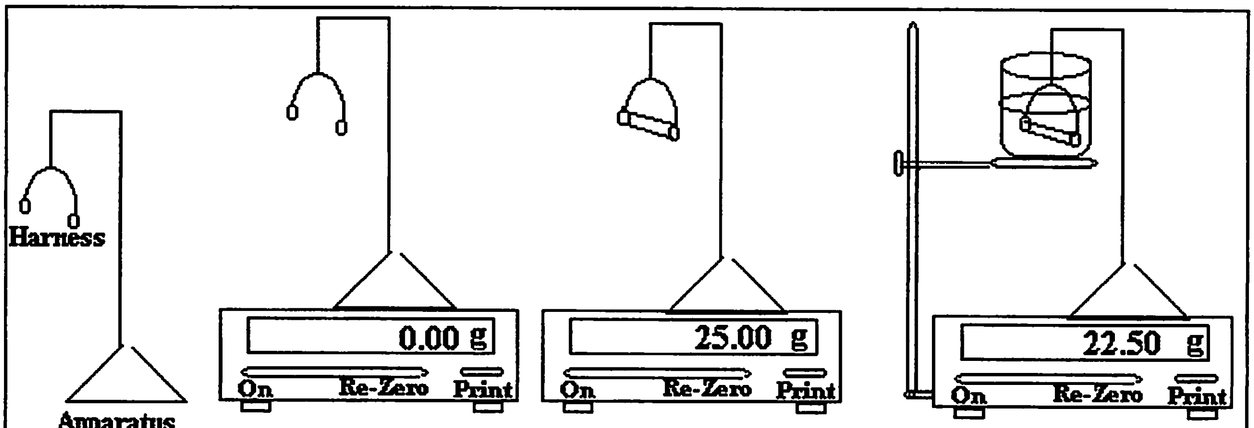
- ☐ Put enough water in the graduated cylinder so that the height of the column of water is higher than that of the metal cylinder.
- ☐ Record the volume of the water to the nearest o.1 mL on the data sheet.
- ☐ Tip the graduated cylinder and carefully slide the metal cylinder into it.

(**do not** let the metal cylinder **drop** into the graduated cylinder as it will go through the bottom of the glass).

- ☐ Read and record the volume of the liquid to the nearest 0.1 mL.
- ☐ Use the data to determine the volume of the metal cylinder and calculate its density.
- ☐ Show your set-up and your results on the data sheet. Be sure to report the calculations to the correct number of significant figures.

2. Determination of Volume by Archimedes' Principle.

- ☐ Place the apparatus shown in the drawing below on the balance and re-zero the balance.



Re-zero balance with apparatus

Add cylinder *Do not record this weight*

Suspend cylinder in water *Record this weight*

- ☐ Gently place the metal cylinder into the harness taking care that it does not fall out.
- ☐ Move the beaker of water, which is sitting on the ring clamp, into position so that the cylinder is suspended in and covered by the water, but is not touching the sides or bottom of the beaker.
- ☐ Tighten the clamp. Read and record the weight. This is the weight of the metal cylinder suspended in water.
- ☐ Use the data to determine the volume of the metal bar.
- ☐ Calculate the density using your data. Show your set-up and results on the data sheet.

3. Determination of Volume by Dimensions and Formula.

- ☐ Use the Vernier calipers to determine the diameter and the height of the metal cylinder.
- ☐ Record the data on the data sheet and calculate the volume using these data.
- ☐ Use this volume to calculate the density of the metal cylinder.

☐ **PART C. Specific Gravity of Liquids (Demonstration)**

Your instructor will place hydrometers in three solutions of known concentration and one of unknown concentration. Read the specific gravity of the solutions and record the data in Table 6.

NOTE: Please put away equipment, wipe the lab bench with a damp towel and leave the lab the way you would like to find it.

Experiment 2 - DENSITY AND SPECIFIC GRAVITY

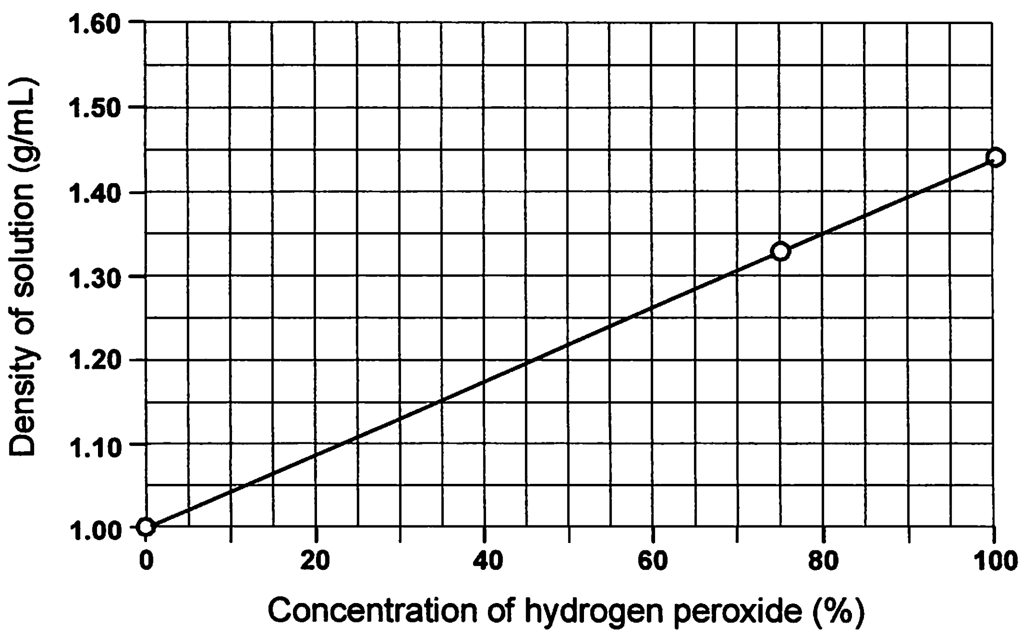
Name ______________________________ **Date**______________

Partner ___________________________ **Station #** _____ **Section** _____

Pre-Lab Preparation

1. As a joke, Sam asks, "Which weighs more, a pound of feathers or a pound of lead?" Dave answers, "Lead, of course!" Why does Dave make this mistake even though he knows that both weigh the same? What concept is he thinking of?

2. From Table 1 in the introduction, we can see that solutions of hydrogen peroxide (H_2O_2) or of sodium chloride (NaCl) can have different densities. In general the density of a solution increases as the concentration increases. From the graph below, determine the density of a 60% hydrogen peroxide solution.



3. Wood floats on water. What does this tell you about the relative densities of wood and water?

4. A graduated cylinder containing 242.0 mL of water weighs 950.0 grams. When a silver sphere is placed in the graduated cylinder the water level rose to 260.5 mL. The entire system, the cylinder, water and silver now weighs 1144.3 g. Calculate the density of silver.

Sample Assessment: Grading Rubric for CHEM 101

Pre-Lab 10 points

Q1 - 2 points: must include an explanation of why 'density' is the correct answer

Q 2 - 3 points: graph must be interpreted correctly (2 points) and include correct UNITS (1 point)

Q3 - 1 point: answer should be a complete sentence comparing the two densities

Q 4 - 4 points: correct calculation of volume (1 point), correct calculation of density (1 point), reported using the correct units (1 point) to the correct certainty (1 point)

Experiment 2 - DENSITY AND SPECIFIC GRAVITY

Name ________________________________ **Date**______________

Partner ____________________________ **Station #** _____ **Section** _____

DATA SHEET

PART A. Density of Liquids

Table 1. Data for determination of the densities of water and ethanol

A	Mass of flask	g
B	Mass of flask and water	g
	Volume of water	10.00 mL
	Mass of Water	g
C	Mass of flask, water and ethanol	g
	Volume of ethanol	10.00 mL
	Mass of ethanol	g

Using the values obtained above, calculate the density of each liquid. Show the set-up used in each calculation:

Set-up:	Set-up:

Compare the density of water and ethanol to the values in the table in the Introduction to the experiment. Are they accurate? Explain why or why not.

PART B. Density of a Solid

1. Determination of Volume by Water Displacement

Table 2. Data for determining density by using water displacement to find volume

Weight of metal cylinder	g
Initial volume of water in graduated cylinder	mL
Volume of water + metal cylinder	mL
Volume of metal cylinder	mL
Experimental density of metal cylinder	g/mL
Show set-up for density calculation	d =

2. Determination of Volume by Archimedes' Principle

NOTE: Volume of metal cylinder = loss of weight when suspended in water.

Table 3. Data for determining density by using Archimedes' Principle to find volume

Weight of metal cylinder (from Table 2)	g
Weight of metal cylinder suspended in water	g
Volume of metal cylinder (1 g = 1 cm^3)	cm^3
Experimental density of metal cylinder	g/cm^3
Show set-up for density calculation:	d =

3. Determination of Volume by Dimensions and Formula

NOTE: Vol. = $\pi d^2 h/4$; π = 3.1416, h = height or length

Table 4. Data for determining density by calculating volume from linear measurements

Length or height of metal cylinder	cm
Diameter of metal cylinder	cm
Volume of metal cylinder	cm^3
Show set-up for calculating volume:	
Calculated density of metal cylinder (use the weight from Table 2)	g/cm^3
Show set-up for density calculation:	d =

TABLE 5. Use your results from table 2, 3 & 4 to complete table 5.

Method	Volume	Density
Water Displacement		
Archimedes' Principle		
Dimensions & Formula		
Average		

1) Use the table in the Introduction to determine what the metal the cylinder is most likely made from by comparing the values to those in the table above. Which method do you think is most and least accurate? Explain your answers.

2) Explain any differences in the precision of the values you obtained for the density of the metal cylinder from these three methods.

3) Density is a good way to determine the amount of body fat a person has. This is more significant than just using weight as a measure. How would you determine the **density** of your best friend? [Hint: Which of the above methods could you use to determine a person's volume?]

Method for determining the person's <u>volume</u>: Step 1: Step 2: Step 3: Method for determining the person's <u>mass</u>:

PART C. Specific Gravity of Liquids (Demonstration)

Table 6. Specific gravity determined by using a hydrometer

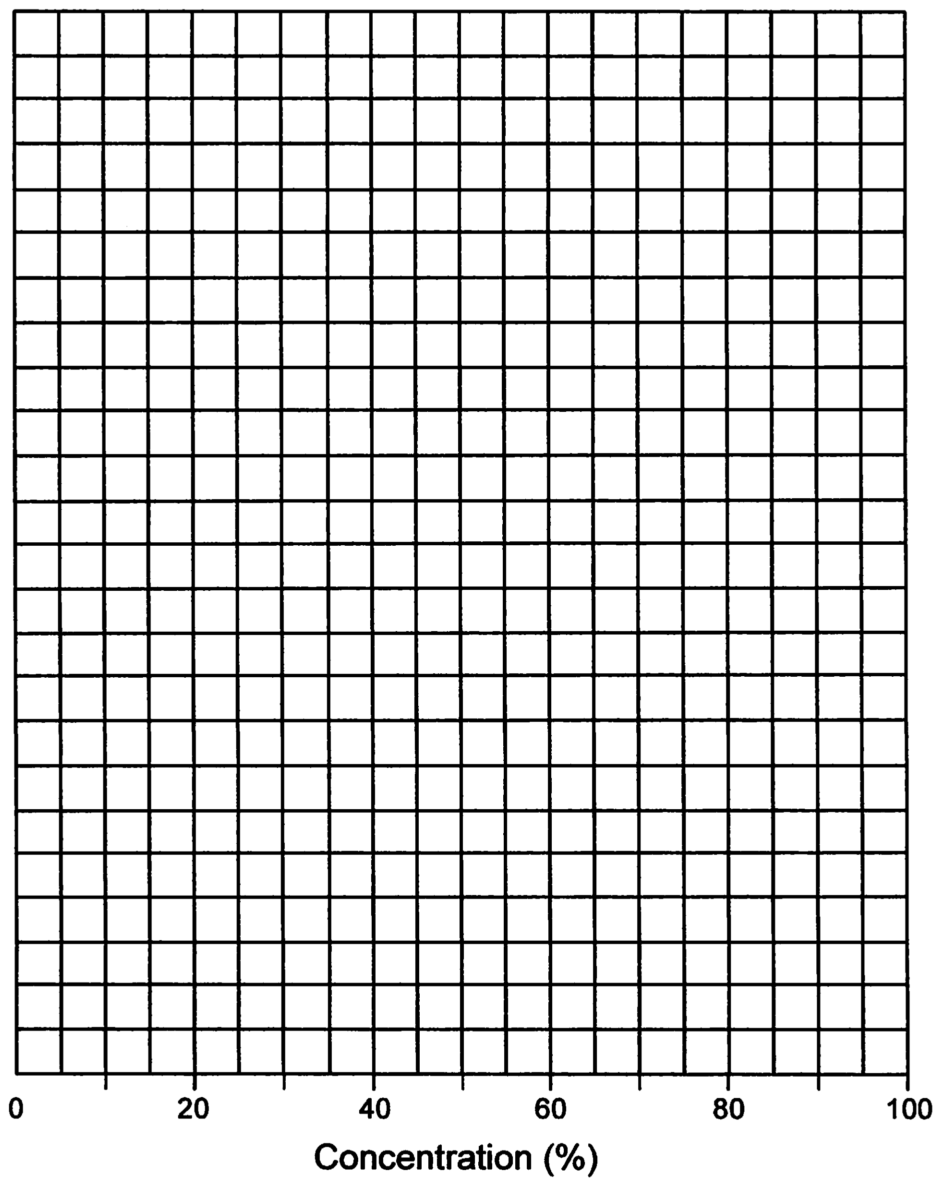
Solution	Specific Gravity	% Concentration of Solution
Solution A		
Solution B		
Solution C		
Unknown		

1) Why doesn't specific gravity have any units?

2) Using the data in Table 6, create on the next page a graph of specific gravity versus % concentration of solutions A-C. Use the graph to determine the % concentration of the unknown.

To create and use the graph:

- Label the y-axis with numbers that will include all the measured values of specific gravity.
- Plot the x-y coordinates of all the known solutions.
- Draw a line that has a position that is closest to all the points, although it may not touch any of them and it does NOT have to go through the point (0, 0).
- Use the measured specific gravity of the unknown to find its position on the y-axis. Draw a straight, horizontal line from the specific gravity of the unknown to the correlation line on the graph. Then make a right angle and go straight down to find the corresponding position on the x-axis. This will be the percent concentration of the unknown.



End of lab check-out form

Station # ___ is in good condition. Student initials ____ Instructor initials ____

Sample Assessment: Grading Rubric for CHEM 101

Lab Report 25 points

Grading Checklist for Lab Report:

- Measurements in Table 1 are made to the correct certainty (2 points)
- Calculations in the set-ups include units (2 points)
- Densities of the two liquids match published values (1 point).
- Measurements in Table 2 are made to the correct certainty (2 points)
- Density is reported using the correct units (1 point)
- Measurements in Table 3 are made to the correct certainty (2 points)
- Density is reported using the correct units (1 point)
- Measurements in Table 4 are made to the correct certainty (2 points)
- Density is reported using the correct units (1 point)
- Are all three values in Table 5 comparable? i.e. did the three methods agree? (1 point)
- Is the composition of the cylinder correctly identified? (1 point)
- Is the least certain measurement (in terms of sig figs) recognized by the student? (2 points)
- Did the student choose a method of volume measurement that accommodates irregular solids for their best friend? (1 point)
- Is the graph constructed correctly with an expanded ordinate scale? (1 point) Are the hydrometer readings correct? (1 point)
- Does the specific gravity of the unknown match the real value? (1 point)
- Did the student work safely - wearing goggles and cleaning up work areas? (2 points)

End of sample Assessment

Part II.
2. Summary of proposed revisions.

1. Revised course objectives to align with EUSLOs.
2. Updated laboratory schedule to include revised experiments.
3. Updated textbook edition and ancillaries.
4. Included sample laboratory experiment/report and grading rubric associated with Objectives2&3.

3. Justification/Rationale for the revision.

The course is a currently approved Liberal Studies Laboratory Natural Science course and is being revised to meet the new curriculum criteria for this category.

Course Analysis Questionnaire

Section A: Details of the Course

A1 How does this course fit into the programs of the department? For what students is the course designed? (majors, students in other majors, liberal studies). Explain why this content cannot be incorporated into an existing course.

This course is intended for students enrolled in the Colleges of Health and Human Services and Natural Sciences and Mathematics. Some lecture and lab sections may be designed for Nursing and Allied Health majors and for Nutrition and Dietetics majors.

A2 Does this course require changes in the content of existing courses or requirements for a program? If catalog descriptions of other courses or department programs must be changed as a result of the adoption of this course, please submit as separate proposals all other changes in courses and/or program requirements.

No. No changes are required.

A3 Has this course ever been offered at IUP on a trial basis (e.g. as a special topic) If so, explain the details of the offering (semester/year and number of students).

No, this course was not offered on a trial basis.

A4 Is this course to be a dual-level course? If so, please note that the graduate approval occurs after the undergraduate.

No, this course is not dual-level.

A5 If this course may be taken for variable credit, what criteria will be used to relate the credits to the learning experience of each student? Who will make this determination and by what procedures?

This course is not taken for variable credit.

A6 Do other higher education institutions currently offer this course? If so, please list examples (institution, course title).

Higher ed institutions that have Nursing Programs offer comparable courses, e.g. in PASSHE the Universities at: Clarion (CHEM 151 Chemical Principles I), Mansfield (CHEM 1101Introductory Chemistry), and West Chester (CHE/CRL 107 – General Chemistry for the Allied Health Sciences).

A7 Is the content, or are the skills, of the proposed course recommended or required by a professional society, accrediting authority, law or other external agency? If so, please provide documentation.

No, this course is not required by a professional society, accrediting authority, law or other external agency.

Section B: Interdisciplinary Implications

B1 Will this course be taught by instructors from more than one department? If so, explain the teaching plan, its rationale, and how the team will adhere to the syllabus of record.

No, this course is taught by one instructor from the Chemistry Department.

B2 What is the relationship between the content of this course and the content of courses offered by other departments? Summarize your discussions (with other departments) concerning the proposed changes and indicate how any conflicts have been resolved. Please attach relevant memoranda from these departments that clarify their attitudes toward the proposed change(s).

There is no significant overlap between this course and courses offered by other departments.

B3 Will this course be cross-listed with other departments? If so, please summarize the department representatives' discussions concerning the course and indicate how consistency will be maintained across departments.

This course will not be cross-listed.

Section C: Implementation

C1 Are faculty resources adequate? If you are not requesting or have not been authorized to hire additional faculty, demonstrate how this course will fit into the schedule(s) of current faculty. What will be taught less frequently or in fewer sections to make this possible? Please specify how preparation and equated workload will be assigned for this course.

Faculty resources are adequate to teach this course.

C2 What other resources will be needed to teach this course and how adequate are the current resources? If not adequate, what plans exist for achieving adequacy? Reply in terms of the following:

Space, equipment, laboratory supplies and other consumable goods have been adequate to teach this course.

C3 Are any of the resources for this course funded by a grant? If so, what provisions have been made to continue support for this course once the grant has expired? (Attach letters of support from Dean, Provost, etc.)

This course is not grant-funded.

C4 How frequently do you expect this course to be offered? Is this course particularly designed for or restricted to certain seasonal semesters?

This course is offered every semester and during the summer.

C5 How many sections of this course do you anticipate offering in any single semester?

One to four lectures are offered each semester, depending on lecture room availability and lab capacity (typically 18 labs and 6 trailer lab sections).

C6 How many students do you plan to accommodate in a section of this course? What is the justification for this planned number of students?

Lecture sections range from 80-120 students. Labs are limited to 24 students.

C7 Does any professional society recommend enrollment limits or parameters for a course of this nature? If they do, please quote from the appropriate documents.

There are no professional society limitations on enrollment.

C8 If this course is a distance education course, see the Implementation of Distance Education Agreement and the Undergraduate Distance Education Review Form in Appendix D and respond to the questions listed.

Not applicable.

Section D: Miscellaneous

Include any additional information valuable to those reviewing this new course proposal.

This course is an established Liberal Studies Natural Science Laboratory Course Elective. The reason for the course revision is to present the course objectives so that they apply to the LS EUSLO format.

4. The old syllabus of record.

SYLLABUS –CHEM 101

I. **CATALOG DESCRIPTION** CHEM 101

COURSE TITLE:	College Chemistry I
NUMBER OF CREDITS:	3c-2l-4sh
PREQUISITES:	none
COURSE DESCRIPTION:	Basic principles and concepts of inorganic chemistry are developed from the standpoint of atomic and molecular structure with illustrative examples from descriptive chemistry. The laboratory portion of the course illustrates physical and chemical properties in a qualitative and quantitative manner. Designed for selected majors within the College of Health and Human Services and to fulfill the Liberal Studies Natural Science Laboratory Sequence requirement.

II. **COURSE OBJECTIVES**

The students are expected to understand the basic principles of matter and energy, as they apply to chemistry. Measurements and mathematical calculations are a part of the course. Students should also gain an appreciation for the importance of chemistry to everyday topics such as health and nutrition.

III. **DETAILED COURSE OUTLINE**

College Chemistry I is a multi-section course taught by a team of instructors. However, it is always coordinated so that students receive exposure to the same series of lecture topics and the same experiments. There are special sections of both lecture and laboratory designated for students in Nursing and Allied Health Professions as well as Food and Nutrition.

A. Lecture Topics

1. The Language of Chemistry — 5 lectures

   Characteristics of elements, compounds, mixtures. Scientific measurements: units, uncertainty, significant figures. Scientific notation. Using the unit-conversion (factor-unit, dimensional analysis) method to solve problems. Concepts/measurements of mass, volume, density, temperature, heat, calorimetry. Applications to health and nutrition.

2. Atomic Structure — 4 lectures

   Dalton's atomic theory. Laws of constant composition and conservation of mass. Subatomic particles and atomic structure (the quantum mechanical atom). Main group vs transition metals; metals vs nonmetals. Electronic configuration, valence shells, and the Periodic Table. The octet rule.

3. Molecules and Chemical Bonds — 4 lectures

   Ionic vs covalent bonding between atoms. Octet rule an ion formation. Naming ionic and covalent compounds. Lewis structures. Molecular polarity. VSEPR theory. Practical applications.

4. Chemical Calculations — 5 lectures

   The mole and Avogadro's number. Calculating formula mass. Conversions between moles and grams. Writing and balancing chemical equations. Stoichiometry. Practical applications to medicines/doses, etc.

5. The Physical Properties of Gases — 3 lectures

   Units of pressure, volume, amount and temperature for gaseous behavior. Universal gas law. Quantitative descriptions of physical behavior. Solubilities of gases in liquids. Practical applications to health/breathing.

6. Interactions Between Molecules — 3 lectures

   The states of matter and transitions between them. Secondary forces and chemical structure/physical properties. Principles of solution formation. Dynamic equilibrium. Applications of equilibrium to everyday reactions.

7. Solutions — 4 lectures

Molecular properties required for solution formation. Quantitative definitions of concentration. Methods of solution preparation/dilution. Diffusion. Osmotic pressure. Macromolecules and colloidal dispersions. Applications to cells, blood, and other intra- and extra-cellular fluids.

8. Chemical Reactions — 3 lectures

Factors that affect rate of reaction. Collision theory. Dynamic equilibria of chemical systems. Le Chatelier's Principle and qualitative/quantitative aspects of equilibrium.

Applications to biochemical reactions and enzymatic catalysis.

9. Acids, Bases and Buffers — 4 lectures

Acid base-chemistry and the ionization of water. pH. Strong vs weak acids and bases. Acid-base equilibria in solution. Bronsted-Lowry definitions. Buffers. Titration. Applications to biological fluids, e.g. maintenance of blood pH.

10. Chemical and Biological Effects of Radiation — 2 lectures

Radioactivity and nuclear emissions. Nuclear equations. Radioactive decay and half-life calculations. Medical applications of radioactivity in diagnosis and therapy.

B. Laboratory Topics – 1 Laboratory Period for Each Experiment

1. Laboratory Safety
2. Measurement, Precision, and Significant Figures
3. Density and Specific Gravity
4. Exploring Density
5. Physical and Chemical Changes: Thermochemistry
6. Atomic Structure: The Color of Fireworks
7. Chemical Compounds
8. The Gas Laws: Application to Molar Mass Determination
9. Solutions and Solubility
10. Dynamic Equilibrium: Concentration Effects
11. Acids, Bases, and pH
12. Exploring Acids and Bases: Titration

IV. EVALUATION METHODS

The evaluation consists of quizzes/homework, hourly exams, weekly lab reports and the final exam. Usually the lecture grade determines 75% of the final grade, while the laboratory component determines one-fourth. The final exam grade usually contributes 20-25% to the lecture grade, and hourly exam grades and homework/quizzes make up the rest. The laboratory grade is based on lab reports and quizzes.

Final course grade is determined by the percentage of total points earned by the student in both lecture and laboratory. The percentage is the total number of *points earned by the student* divided by the *total number of points* possible:

A $\geq$ 90%

B $\geq$ 80%

C $\geq$ 70%

D $\geq$ 60%

F < 60%

V. REQUIRED TEXTBOOK(S)

Chemistry: General, Organic and Biochemistry, Connecting Chemistry to Your Life by Ira Blei and George Odian, W.H. Freeman and Co., New York, 2000

Note: Each chapter in the text contains a "picture of health" application that connects the topic to its importance in the human body.

Laboratory Manual: *College Chemistry I: Exploring Chemical Reality* by Ruiess Ramsey and Sharon Sowa, Department of Chemistry, Indiana University of Pennsylvania, 2001 (available at ProPacket)

To provide a dynamic set of experiments with specific applications for our students, the teaching faculty has developed their own laboratory manual that is available at a local photocopy center at low cost.

VI. SPECIAL RESOURCE REQUIREMENTS

Students are expected to have their own scientific calculators and to purchase and wear safety goggles that meet the ANSI standard in the laboratory.

Students are expected to study from the required text. Students are encouraged to take advantage of supplemental learning aids that accompany the text, such as the CD-ROM study-aid included that can also direct them to websites that provide learning aids for chemistry. Nursing and Allied Health students are encouraged to consult other references such as current issues of professional journals (e.g. RN, American Journal of Nursing) for supplemental information.

VII. BIBLIOGRAPHY

There is a *Student Solutions Manual* available for the text, as well as a *Study Guide*; both are not required but might be helpful to the student. There are also learning aids available online at the *Website* for the text.

Syllabus updated on	April 15, 2002

Answers to Liberal Studies Questions CHEM 101

1. This is a multi-section, multi-instructor course that has separate sections for Nursing/Allied Health majors and also Food&Nutrition majors. All sections use the same laboratory manual, and the lab experiments closely correlate with lecture topics. Course instructors participate in a 'College Chemistry Teaching Circle' through CTE. A course coordinator is assigned to College Chemistry I and II. There is a department guideline standard evaluation procedure for all sections that requires a student to earn 65% in the laboratory portion of the course in order to pass.

2. Perspectives and contributions by women and ethnic minorities in chemistry are historic: Madam Curie's discovery of radiation, Markovnikov's Rule, the periodic table described by Mendeleev, the foundation of organic chemistry by Frederich Wohler, etc. These landmark scientists and others are mentioned in the text and not overlooked by instructors.

3. The exception to non-textbook work is made by the quantitative nature of the course in both lecture (topics such as measurements, dimensional analysis, stoichiometry) and laboratory. Students are required to use calculators for complex algebraic problem-solving and for logarithmic functions (pH).

4. This is an introductory course. It serves as a basic foundation of knowledge that can be applied to specific fields such as nursing or nutrition, and also applies to human health in general. It differs from Concepts in Chemistry in terms of depth of coverage and complexity of calculations. For example, acid-base problems that do not require solving quadratic equations, and simple concepts of chemical equilibria as opposed to physical state and quantitative analysis.