Department: CHEM

Course No.: 129Q

Credits: 4

Title: Honors General Chemistry

Contact: Cecile Hurley

Content Area: CA3 Science and Technology- Lab

WQ? Q

Catalog Copy: CHEM 129Q-130Q (Honors course). Both semesters. Four credits each semester. Three class periods and one 3-hour laboratory. Prerequisite: Strong background in high school chemistry and physics. Prerequisite or corequisite: MATH 112 or 115; consent of instructor. Designed primarily for exceptionally well-prepared science and chemical engineering students, although any qualified hnors student may take it. This course can be used as an alternate wherever CHEM 127Q-128Q is listed as a prerequisite. Not open for credit to students who have passed CHEM 137Q-138Q, or 153Q-154Q. Prerequisite for CHEM 129Q: MATH 101 or passed Q Readiness Test or passed a Q course. Atomic and molecular theory and the properties of gases, liquids, solids and solutions. Topics which may be covered in depth are the nature of the chemical bond, chemical equilibria, thermodunamics, electrochemistry and nuclear chemistry. The laboratory work is primarily quantiative in nature. Considerable personal initiative will be demanded of students in carrying out laboratory assignments.

Course Information: A) The goal of this course is two-fold. First, the students are exposed to the qualitative and quantitative aspects of chemical elements, compounds and their reactions. It aims to introduce them to the concepts of modern scientific research and the chemical principles behind the products and tools of modern technology. Second, the student is trained to think quantitatively (by looking at and solving word problems with numerical answers), write precisely, and judge critically. B) The course consists of 3 in class exams, a final, weekly homework assignments and quizzes an hour of group work (weekly) and a 3-hour lab (also weekly). All problems in homework, group work and quizzes and exams require numerical answers. Most lab reports require calculations graph creation or interpretation. C) The main theme is atomic structure (viewed in a quantitative context) and the roles that they play in the chemical reactions that produce consumable products and technological tools used in this age. Topics include: molecular and solution stoichiometry, ionic and covalent bonding, nature of gases, liquids and solids (qualitative and quantitative), the relation of heat energy to chemical reactions.

Meets Goals of Gen Ed:
Acquire intellectual breadth and versatility. Chem 127Q meets the General Education Goal of ass isting students in acquiring intellectual breadth and versatility needed to understand, interpret and process the increasing amount of scientific data and terms that are often used in today's

news. This course gives the students enough technical information so that the students acquire an added dimension to their intellectual capabilities. For example, when we teach carbon-dating, it is our goal that students not only know something about the relics found in a new dig, but also understand something about the technique used to figure out how old the relics are. Furthermore, the students in this course are exposed to both microscopic (molecular size) and observable phenomena. They learn to observe a reaction in a test tube and translate it into a molecular equation. They also learn the reverse. For example, they are taught to predict observable phenomena based on a model of molecular collisions. While most non-scientists generally do not do this, the student will have learned to look at phenomena from several perspectives. This versatility will stand them in good stead at whatever career they pursue.

Acquire critical judgment. This course will assist students in acquiring critical judgement by teaching them to think quantitatively. A lot of public information available these days is in the form of statistical odds, charts or graphs. Since chemical concepts are presented in the context of a mathematical structure, students are taught to think quantitatively. Thinking quantitatively not only involves the algebraic solutions to problems but also the ability to quickly estimate magnitudes and look at the reasonableness of the numerical answers obtained. Knowing the principles involved in a particular scientific process for example, students should be able to analyze and criticize initiatives proposed by government to solve societal ills. After a discussion of fuel cells, students should be able to make a more educated and reasoned judgment on the feasibility and practicality of President Bush's initiative on fuel cell technology.

Acquire a working understanding of the processes by which they can continue to acquire and use knowledge. The scientific method is the cornerstone by which most scientific theories are proposed and most experiments are conducted. The students see this method used over and over again in lecture. They use it several times in the laboratory. It is hoped that by being constantly exposed to this method of scientific inquiry, they embrace it and make it their own. They should use it in exploring, deducing and enunciating their own theories for other non-chemical observations. If they do, they will be adept at seeing the flaws in numerous theories that they read or hear proposed in both scientific and nonscientific contexts.

CA3 Criteria:

1. ***Explore An Area of Science or Technology by Introducing Students to a Broad, Coherent Body of Knowledge and Contemporary Scientific or Technical Methods.*** This course presents a comprehensive, unified study of the properties of molecules, elements and compounds. Its unifying theme is the periodic table.

2. ***Promote An Understanding of the Nature of Modern Scientific Inquiry, the Process of Investigation, and the Interplay of Data, Hypotheses, and Principles in the Development and Application of Scientific Knowledge.*** With the periodic table as the backdrop, the students learn about “old”theory, proposed new theory, and the refinement of old theory with each new scientific discovery. The students for example are told about the alchemists and the atomic theory of Dalton which was a repudiation of alchemy. The experimental inquiry into the properties of the elements led to the periodic table which went through 3 different proposed systems of organization, while quantum mechanics led to a refinement of Dalton's theories.

3. ***Introduce Students to Unresolved Questions in Some Area of Science or Technology and Discuss How Progress Might Be Made in Answering These Questions.*** As an example, students are introduced, to the principles of solubility. While solubility may look like simple phenomena, as they go deeper into the subject, they are led to realize that all solubility data is empirical. There is no formal theory that allows a scientist to look at an unknown substance, (from Mars for example) and decide, just by calculation whether it will dissolve or not. More practical open questions could be nuclear waste disposal (that satisfies environmental standards), or alternative fuels. Besides exposing students to such unresolved questions, the unorthodox "solutions" to societal problems are discussed. For example: Chemists should work on a reaction that can convert the bad ozone that causes pollution into the good ozone to fill the ozone hole. Why can't they do that? It is hoped that after taking this course they will not take questions of that nature seriously.

CA3 Lab Criteria: Lab courses are conducted in a 3 hour block weekly. The students individually determine either a physical property (e.g. density) or a chemical property (how acidic is the compound?) of an unknown. This is done by learning specific chemical techniques, followed by a detailed process of chemical analysis and concluded by calculations done on the data acquired.

Q Criteria: Most homework, quiz and exam problems require numerical answers. The level of the problems vary throughout the course. On one end are plug and chug questions where numbers are plugged into a formula to get an answer. The next level requires algebraic manipulations of a formula to solve for a variable in terms of other variables and interpret its quantitative significance. At the other end, some problems require setting up and solving two simultaneous equations or deducing a function from the graph obtained by plotting experimental data. Most of the principles explained and tested for use formulas and functions, linear and quadratic equations. Graphs have to be interpreted and the method of successive approximations is used for occasional cubic equations. The students are also expected to have a working knowledge of powers, roots and logarithms to solve problems. The students (after solving algebraically for numerical answers) are asked to create graphs, draw conclusions, make comparisons and express their results in a precise and accurate manner with an emphasis on scientific notation and significant figures.

Role of Grad Students: The graduate students assisting in this course lead a collaborative learning session in the discussion section (40 minutes) and administer 10 min. quiz which has been approved by the course coordinator. They meet with the course coordinator weekly for 15 hrs. to go over the lab experiment, homework assignment solutions and the group learning worksheet. The graduate students grade lab reports according to a grading scheme given to them. They do not assign grades. They are supervised by the course coordinator - Thomas Seery