The Department of Biochemistry strongly feels that it is important for our majors, obtaining a BS degree in Biochemistry, to be able to communicate in this field. This involves speaking the vocabulary of Biochemistry, explaining experiments and concepts. Biochemistry is a very visual science where much is expressed in drawing structures of biochemical compounds and looking at higher order structure of proteins and nucleic acids. The interpretation and graphical presentation of data are also essential to understanding Biochemistry and the ability to communicate to others. We will incorporate components of spoken, visual, and written communication in the Biochemistry Classes we require for the degree in Biochemistry. The goal is that graduates with the BS degree in Biochemistry will be able to communicate information in Biochemistry successfully by written, visual and oral communication techniques.

Graduates of our program should be able to:
1. Draw basic structures in biochemistry and use computer software for visualizing more complex structures.
2. Discuss and communicate orally concepts in biochemistry in a variety of technical formats, both formal and informal presentations and discussions.
3. Tabulate data and present it in graphic format in laboratory reports and oral presentations.
4. Search the scientific literature and present information in an oral and written format.

I have outlined below the communication skills required at the different levels in our program:

**BCHM 1014-Introduction to Biochemistry, 1 credit pass/fail.** Students in this freshmen class are introduced to some of the basic concepts in Biochemistry and are introduced to the use of software (Chime and RasMol) to look at complex structures of proteins and nucleic acids using pdb files obtained by x-ray crystallography. Students are required to take a library tour and one lecture is devoted to literature searching using various literature data bases and appropriate search engines available in the library (taught by Margaret Merrill from the library). The students then do an assignment to search the refereed literature on a specific topic (this year prions and mad cow disease). They must list three articles and their call numbers in the library.

**BCHM 2144-Organic Biochemistry, 1 credit A/F.** This sophomore level class, taught in the spring semester, is designed to help make the transition from organic chemistry to biochemistry with the focus on functional group chemistry. They are required to know the structures of many biochemical compounds (carbohydrates, amino acids, nucleotides, etc.). This is a major visual part of the class; for example, when they hear the word glucose they don’t “see” the word but the structure of glucose and because
they know functional groups, know a lot about the chemistry of the compound. Dr. John Hess in our department has developed a computer module that helps students learn and identify important functional groups in different classes of biochemical compounds. Students will again use software (Chime and RasMol) to look at complex protein and nucleic acid structure and now identify α-helical and β-pleated sheet structure in proteins and A and B helix structure in nucleic acids. Four demonstrations are presented to highlight various concepts and biochemical properties covered in the class. These are very visual and well received by the students. The students are again required to search the biochemical literature, identify research papers on specific topics, and then read and write summaries of three key papers. The test and quizzes are not multiple choice but require students to draw structure and answer in complete sentences questions on concepts and interpret graphical data.

**BCHM 4115- General Biochemistry, 4 credits A/F.** This junior or senior level class is the first semester of our one year biochemistry lecture course. Concepts introduced in **BCHM 2144** are investigated in more detail and other areas of biochemistry are covered (for example enzyme kinetics). Problem solving is a major part of this class, applying basic concepts to solving complex problems. Data are graphed and analyzed. The visual aspects of looking at structure are continued in this advanced level class. Quizzes and major test require students to discuss concepts, draw structures, draw chemical reaction mechanisms, plot and interpret data, etc. using all the skills they have developed.

**BCHM 4116- General Biochemistry, 3 credits A/F.** This is the second semester of our one year biochemistry lecture. In the second half of General Biochemistry, there is a concerted effort to promote independent thinking by students and to develop skills in oral, written, and visual communication of science. Although most students in sciences are introduced to the concepts of secondary, tertiary, and quaternary protein structure, they are not fully cognizant that molecular structure is important to protein function, just as household tools are shaped for specific tasks. In this biochemistry course, not only is information provided on basic metabolic concepts, but the application of spectroscopy to understanding the relationship between protein structure and function. Toward this end, web-based instruction modules and tools were designed, generated, and provided related to curricular topics. Currently, Belinda Carroll and Carl Estes from the Agriculture, Human, and Natural Resources Information Technology are building two interactive learning modules on the light reactions of photosynthesis and the mechanism of water oxidation for this course. These modules, utilizing both sound and animation, are educational pieces that facilitate student visualization of concepts.

Furthermore, inquiry-based methods in student education and instructional technologies are incorporated to facilitate these pedagogical methods and assessments. For example, in the general biochemistry course, a week-long introduction of x-ray crystallography is provided in the course, to integrate biophysical research techniques into the curriculum. Students were coached in understanding the research paradigm, using the example of three research papers on x-ray crystallography, describing the evolution of understanding the catalytic mechanism of the inositol phosphatase-endonuclease family. The development of written communication skills was based on
biweekly online discussion boards within student cohort groups, which also cemented interactive learning among the individuals. Oral and visual communication skills are developed by a formal oral presentation by student groups in front of the class; each cohort group must not only gather and synthesize appropriate, scientific content, but also organize and explain the material, using Powerpoint and other graphic programs, to the class.

**BCHM 4124-Laboratory Problems in Biochemistry and Molecular Biology, 6 credits A/F.** This six credit class has been the writing intensive class approved for our major meeting the six credits of WI required by the university (see enclosed copy of original proposal as a writing intensive class submitted in 1996). This class will remain our major writing intensive class with the additional of an oral communication module.

**Assessing Outcomes:**

The Department of Biochemistry will assess the success of our discipline specific instruction in Spoken, Visual and Written Communication by doing exit interviews and surveys of graduating students, by periodic surveys every four years of employers (we will identify as many employers as we can from contact with our graduates and employers that recruit our students) of our Biochemistry graduates, and by specific grading of communication assignments in the classes listed above. The employer (employee is used as a broad term to include students in graduate programs and professional schools as well as persons working in typical jobs) surveys will focus on the pedagogical goals stated at the beginning of this proposal. Are the graduates of our program in Biochemistry able to:

1. draw basic structures in biochemistry and use computer software for visualizing more complex structures?
2. discuss and communicate orally concepts in biochemistry in a variety of technical formats, both formal and informal presentations and discussions?
3. tabulate data and present it in graphic format in laboratory reports and oral presentations?
4. search the scientific literature and present information in an oral and written format?