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Mission and Learning Goals

Statement

Our program is designed to help students understand how the sciences of biology and chemistry provide a way to develop an understanding of how living material and processes are constructed, organized, and regulated. We seek to show how these two disciplines together, but not separately, can provide such an understanding, since neither a reductionistic approach of explaining life by an understanding of individual molecules, or a global approach of studying entire organisms or systems is sufficient.

In accord with the Benedictine traditions, we build these biological and chemical foundations in a context that helps students become scientifically responsible citizens, with the knowledge, skills, attitudes and values that will allow them to be successful in their selected professions. We accomplish this by providing students with a variety of learning opportunities such as:

- Formal courses with integrated laboratories
- Hands-on experiences with modern instrumentation and computers
- Research projects
- Seminar programs

We carry out this mission in an atmosphere of support and encouragement for both students and staff. The joint Biochemistry major of the Chemistry and Biology Departments of CSB/SJU supports the larger coordinate mission of our institutions. We present the major to:

- **Foster integrated learning, exceptional leadership for change and wisdom for a lifetime.**
  If a liberal arts education refers to broad undergraduate studies in the arts and sciences, which, in contrast to prevocational or pre-professional studies, is intended to prepare students for the variety of experiences and occupations they can expect to pursue over the course of a lifetime, the Biochemistry major is liberal arts in the best sense. The integrated learning experience provided by this major is, in effect, broader-based than either Biology or Chemistry alone, and students can be expected to derive even greater employment opportunities in a world where an understanding of the molecular basis of life will be increasingly valued.

- **Provide a unified liberal arts curriculum which focuses on questions important to the human condition, demands clear thinking and communicating and calls forth new knowledge for the betterment of humankind.**
  We are living in an unprecedented time in human history as we have in our hands the biochemical texts defining the blueprint for life. The challenge of this century will be to understand that blueprint and how our genome interacts with our environment to produce the creatures that we become. This is an endeavor of incredible magnitude and challenge, and that will require an integration of knowledge from different fields (biology, chemistry, computer science, mathematics, psychology). The knowledge derived from this effort will certainly impact our concept of self, our relationships to others, and our views of our place in society and in the universe. Can there be more important questions?

- **Provide an integrative environment for learning which stresses intellectual challenge, open inquiry, collaborative scholarship and artistic creativity.**
  This truly collaborative, integrated major, will be of the highest intellectual challenge, as articulated above. It will afford our students and our faculty with the chance to perform collaborative research with faculty from both departments. We envision a process in which faculty from both departments will share students who will perform research in integrated laboratory projects, which should foster greater success for all.
Learning Goals & Objectives

Through a variety of learning opportunities, our students will develop:

1. A knowledge-base necessary to understand the complexities of the biology and chemistry of life,
2. An ability to integrate their understandings of biology and chemistry at the molecular, cellular and organismal levels,
3. The technical and intellectual skills necessary to facilitate creative problem solving, and
4. The attitudes and values that foster a continuing discourse about science and its role in our world.
Biochemistry Graduates

First reported activity after graduation as of May of graduation year

**Academic Years 2008-2012** (39 students total)

- **medical school**-8 (Creighton, Med College of WI, UMD)
- Med school waiting list-2

- **Employed in biochemistry or a related field**-5 (UND research asst, Epitopix, FDA)
- Looking for work-7

- **Grad school in BC or related field**-4 (Mayo virology and gene therapy; Yale chem, Notre Dame biochem)
- Grad school waiting list-1

- **Pharmacy school**-1

- **Volunteering**-4 Benedictine Volunteer, Corps, Teach for America, Spanish-speaking nursing asst, medical scribe

- **Undecided or unknown**-7
Research Experience of Biochemistry Graduates

2009-2012 (n=31)

(Source—senior exit survey)

Some fall into more than one category and are counted twice.

Did no research-1

Did library research-6

Did research with a chem faculty member-14

Did research with a biology member-11

Did research off campus-8 (U of Missouri, UND, Southern Illinois, U of Iowa, Hormel Institute, LSU)

Did lab research but did not specify where-2

Did an honors thesis-4
Biochemistry Assessment

There is not Major Field Achievement Test (MFAT) in Biochemistry. Biochemistry majors may choose to take either the chemistry or the biology MFAT. Here are the recent results.

**Table 1: Biology MFAT results.** Biochemistry students taking the biology exam receive subscores in Cell Biology (Subscore 1) and Molecular Biology/Genetics (Subscore 2). These subscores are shown below.

| Academic Year | Subscore 1 (Cell Biology) CSB|SJU Mean (Nat%ile) | Subscore 2 (Mol. Bio./Gen.) CSB|SJU Mean (Nat%ile) |
|---------------|-------------------------------|-------------------|-------------------------------|
| 2009-2010     | 70 (85%)                      | 72 (85%)          |
| 2010-2011     | 72.7 (90%)                    | 64.7 (80%)        |
| 2011-2012     | 76 (95 use AY11 data)         | 71 (91 use AY11 data) |

The CSB|SJU results are consistently significantly above the national mean in this category.

**Table 2: Chemistry MFAT results.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of students</th>
<th>Average Total Score</th>
<th>Average National %ile</th>
<th>Average Sub-score (Physical Chemistry)</th>
<th>Average Sub-score (Organic Chemistry)</th>
<th>Average Sub-score (Inorganic Chemistry)</th>
<th>Average Sub-score (Analytical Chemistry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-2012*</td>
<td>1</td>
<td>175</td>
<td>99</td>
<td>70</td>
<td>78</td>
<td>62</td>
<td>72</td>
</tr>
<tr>
<td>2010-2011</td>
<td>6</td>
<td>158</td>
<td>80</td>
<td>55</td>
<td>62</td>
<td>52</td>
<td>57</td>
</tr>
</tbody>
</table>

The national MFAT results for biochemistry majors are very similar to the results for our chemistry majors. They are well above the national mean in this category.
Current Biochemistry Major (November, 2012)

The changes in the chemistry curriculum require concomitant changes in the Biochemistry Major as the present required chemistry courses for the Biochemistry major will no longer exist. The following set of courses requirements for the Biochemistry major, at least for the interim, has been negotiated and approved by the Biology and Chemistry Departments. Please note the reduction in the total number of required credits. We will continue to offer BCHM 322 until presently enrolled students can take the new 2 credit in-depth chemistry courses.

OLD BIOCHEMISTRY MAJOR: 4 YR PLAN

BIOCHEM Major: 4 Year Plan Update 10/21/10

Major Requirements – (F = Fall only, Sp = Spring only) Bio/Chem Credit 54; Total Credits 70

<table>
<thead>
<tr>
<th>COURSES</th>
<th>LABS</th>
<th>INDEPTH</th>
<th>ADDITIONAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 125 – Intro Mol Struct/Prop (F) (with attached lab)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>CHEM 234- Gen Chem II (Sp)</td>
<td>BCHM XXX (MFAT)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 235-Org Chem I (F)</td>
<td>BIOL 121 Cellular Life (F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 236- Org Chem II (Sp)</td>
<td>BIOL 221 Organismal Bio. (Sp)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 333 Thermo (F) OR CHEM 334 Quantum (Sp)</td>
<td>BIOL 311 Cell. Biol. (F)</td>
<td></td>
<td></td>
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<tr>
<td>CHEM 335 Analytical (F)</td>
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NEW INTERIM NON-ACS BIOCHEMISTRY MAJOR: 4 Year Plan

Major Requirements (credits) F (Fall) Sp (Spring). Bio/Chem Credit 46-50; Total Credits 62-66 (present 70)

<table>
<thead>
<tr>
<th>COURSES: INTRO/FDN</th>
<th>LABS: FDN/IN-DEPTH</th>
<th>INDEPTH</th>
<th>ADDITIONAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 125 (4) F Intro Chem Struct/Prop</td>
<td>CHEM 201 (0,1) F Purif/Struct L1</td>
<td>CHEM 3RQ(2)</td>
<td></td>
</tr>
<tr>
<td>CHEM 250 (4) Sp Rx Nucleo/Electro I (R1)</td>
<td>CHEM 202 (0,1) Sp Purif/Chroma L2</td>
<td>CHEM 3RQ(2)</td>
<td></td>
</tr>
<tr>
<td>CHEM 251 (4) F Rx Nucleo/Electro 2 (R2)</td>
<td>CHEM 203 (0,1) F Synthesis</td>
<td>BIOL 318 (4) Molecular Genetics w/ lab</td>
<td>MATH 119 (4) F Calculus 1</td>
</tr>
<tr>
<td>CHEM 255 (4) Sp Macro Chem Analy</td>
<td>CHEM 205 (0,1) Sp Measurement</td>
<td>BIOL 311 (4) Cell Biology w/ lab</td>
<td>MATH 120 (4) Sp Calculus 2</td>
</tr>
<tr>
<td>CHEM 315 (4) Sp Advanced Rx (R3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 121 (4) F Intro Cell/Mol Bio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 221 (4) Sp Intro Organismal Bio</td>
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SUPPORTING COURSES

<table>
<thead>
<tr>
<th>COURSES</th>
<th>LABS</th>
<th>INDEPTH</th>
<th>ADDITIONAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 317 Biochem (Biol) (F or Sp)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BCHM 350 OR 351(1) or HONR 398(4)</td>
<td>BCHM 322 Biochem [Chem] (Sp)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B 121 Cellular Life (F)</td>
<td>B 375 Capstone (Sp Sr 2 cr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 221 Organismal Bio. (Sp)</td>
<td>MATH 119 Calc I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 311 Cell. Biol. (F)</td>
<td>MATH 120 Calc II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 318 Mol. Biol. (Sp)</td>
<td>PHYS 191 (F) OR 105 (F)</td>
<td></td>
<td></td>
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<tr>
<td>BIOL 3XX Elective</td>
<td>PHYS 200 (Sp) OR 106 (Sp)</td>
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Possible choices for CHEM 3RQ: Chemical Biology, Bioanalytical Chemistry, Biophysical Chemistry OR equivalent courses approved by the Chemistry department.
Congratulations! You’ve made it through the first part of the survey. Thank you, thank you, thank you. Just a few more questions are left to answer. The questions represent issues specifically related to the CSB/SJU Chemistry Department, about which we would like information. We expect to get a great deal of very valuable information from all of the survey and really need your thoughtful responses to the following questions. They deal with undergraduate research experiences, other aspects of our chemistry and biochemistry programs, attitudes and skills, and an opportunity for a more open-ended response to something of interest to you. So hang in there, you are almost to the end.

The next few questions will help us evaluate our research program. Note that there are questions for those who did participate in undergraduate laboratory research, as well as those who did not.

1. Did you participate in a LABORATORY research experience, either in the summer or the academic year, while an undergraduate chemistry or biochemistry major?
   
   1. Yes, at CSB/SJU.
   2. Yes, but not at CSB/SJU.
   3. Yes, both at CSB/SJU and at another site.
   4. No, I did not participate in a laboratory research experience.

2. Based on what you have experienced since your graduation, select the response that expresses your view of an undergraduate laboratory research experience.

   1. I did participate in laboratory research as an undergraduate and wish I would have done even more.
   2. I did participate in laboratory research as an undergraduate and would participate to about the same extent again.
   3. I did participate in laboratory research as an undergraduate but would not do it again.
   4. I did not participate in laboratory research as an undergraduate but wish I would have.
   5. I did not participate in laboratory research as an undergraduate and would not the second time around.

   IF YOU DID NOT PARTICIPATE in undergraduate laboratory research, please go to Question 6.

3. The classroom and laboratory offerings within the department prepared me to participate in my undergraduate research experience.

   1. Disagree strongly
   2. Disagree
   3. Neutral
   4. Agree
   5. Agree strongly
4. As you now recall your work in our program, how important was your undergraduate laboratory research in your overall experience?

1. One of the most important learning experiences
2. Of above average importance
3. About the same importance as other learning experiences
4. Of below average importance
5. One of the least important learning experiences

5. What effect did that research experience have on your choice of career?

1. It made me more inclined to choose a career that involved laboratory science
2. I didn’t intend to work in a field that involved laboratory work, but the experience helped me appreciate the work of those who do.
3. It had no real positive or negative effect.
4. I had thought about working in a field that involved laboratory work, but my research experience made me less inclined to do so.
5. I did intend to work in a laboratory-related field, and my research experience made me appreciate laboratory work even less.

Please go to Question 7.

6. IF YOU DID NOT PARTICIPATE in undergraduate laboratory research at CSB/SJU, why not?

Select the most important reason.

1. I was unaware of research opportunities within the department.
2. I chose to do research at another college/university, company or organization.
3. I could not fit research into my schedule during the academic year or during the summer.
4. There weren’t enough research opportunities available so that I was unable to participate.
5. None of the projects available were particularly interesting to me.
6. I was not interested in participating in laboratory research.
7. Some other reason.

The next several questions seek your perceptions of the preparation in chemistry and biochemistry. Please use the options below each question to indicate your response.

7. Answer this question ONLY if you were a:
   • Biochemistry Major or a
   • Chemistry Major with a Biochemistry Concentration

Compared to others I have known in my career field since graduation, I would rate my preparation in BIOCHEMISTRY as:

1. much weaker than others.
2. weaker than others.
3. about the same as others.
4. stronger than others.
5. much stronger than others.
8. Answer this question ONLY if you were a Chemistry Major. Compared to others I have known in my career field since graduation, I would rate my preparation in BIOCHEMISTRY as:

1. much weaker than others.
2. weaker than others.
3. about the same as others.
4. stronger than others.
5. much stronger than others.

9. ALL majors should answer this question. Compared to others I have known in my career field since graduation, I would rate my preparation in chemistry or biochemistry as:

1. much weaker than others.
2. weaker than others.
3. about the same as others.
4. stronger than others.
5. much stronger than others.

For questions 10 through 18, reflect on your experience in the chemistry or biochemistry majors to decide your level of agreement, or disagreement, with each statement. Use the response scale below.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>Strongly Disagree</td>
<td>Agreement</td>
<td>Strongly Agree</td>
<td></td>
</tr>
</tbody>
</table>

The classroom and laboratory offerings within the department effectively developed my

10. laboratory skills.

11. written communication skills.

12. oral communication skills.

13. overall confidence in my abilities.

14. overall problem solving skills.

15. ability to analyze data.

16. ability to design experiments which answer meaningful chemical questions.

17. ability to work effectively with others in a group.

18. ability to learn independently.
19. Please indicate the year you graduated from CSB or SJU.

1. 1997 to 1999
2. 2000 to 2002
3. 2003-2005
4. 2006
Senior Exit survey results

Biochemistry majors 2009-2012

(27 completed surveys out of 32 graduates—84%)

1. Define good teaching. Did your chemistry and biology instructors demonstrate good teaching? Explain, giving concrete examples.

Despite a variety of at least slightly different definitions, the most common response was yes (8). Those who gave a more specific answer felt that they liked a mixture of lecture and discussion (3) with biology typically mentioned as being more likely to provide a format heavier in lecture (2). Some wanted more lecture in chemistry (2) or that there were unspecified problems with the teaching in chemistry (2). However, others specifically noted specific good examples in chemistry (3).

2. Is there good communication between faculty and students? If not, how would you like it to change?

Again, the overwhelming answer was yes (14). Some students felt that there was better communication between biology faculty and students than chem faculty and students (3). However, others noted that they did not know about the bio comprehensive exam time until days before it was to be taken (3). Two others noted that the biochem students were a bit out of the loop compared to chem or biol students.

3. Give your definition of sufficient availability on the part of faculty to answer questions, help with projects or class work, etc. Were faculty sufficiently available to help?

The most frequent response was a yes (18). A few students cited a specific good example in chem (2) or biology (1) or mentioned a problem with a chem (1) or biology faculty member (1).

4. Did the program stimulate your interest in biochemistry? Explain.

Many students (19) said yes. Several cited a specific example from chem (4) or biology (2) or mentioned one or the other or both biochem classes (2). Two gave a “yes and no” answer.

5. Did you learn a lot in your biology and chemistry courses?

The vast majority said yes (22). Several mentioned a lab as a particularly valued experience (7) while others mentioned research (3).
6. Do you feel that you have been exposed to biochemistry as a changing, modern discipline?
Thirteen gave a “yes” answer. Eight specifically noted professors mentioning current topics in their classes or discussing how science had changed since the profs had left grad school (4). Specific courses mentioned where this occurred were biochem II (1) and Molecular Genetics (2).

7. What were the most effective teaching/learning methods? (this question was only included in the last two years)
The most common answer was lab (4) followed by lecture and discussion mixed together (3). Two felt that discussion and groups were the best.

8. What did you like most about the biochemistry program?
Seven students noted either the scope of the field or the scope of classes as positives. In a closely related response, six enjoyed the emphasis on both chemistry and biology. Four students specifically mentioned biochemistry II, while two mentioned genetics.

9. What did you like least about the biochemistry program?
Four students noted that the majors felt homeless, while another five felt that they weren’t advised as well as chem or bio majors. Otherwise, some students (3) wanted a greater number of biochemistry classes (not bio or chem courses) or just more options for classes (3). Three noted that the workload was high. Three noted that there were conflicts for classes.

10. What suggestions do you have to improve the biochemistry program?
While there were a number of suggestions, few of them occurred more than once. The most common response was no improvements needed (5). Several did suggest that having some biochemistry sooner in their academic careers would help them find out what it is really like (3). Several had different tweaks to the list of required courses (4) though all involved adding courses. Three wanted a better biochemistry “community” of students.