MEMO

FERRIS STATE UNIVERSITY

TO: Jack Buss, Chair, Academic Program Review Committee

FROM: Kim Colvert, Chair, Biotechnology Program Review Panel

DATE: December 10, 2003 2004-2005

RE: PRP budget, Evaluation Plan

The Biotechnology PRP met December 4, 2003. The PRP accepted (with revisions) the Academic Program Review Evaluation Plan, assigned various surveys and data collection techniques to the people on the panel, estimated the number of individuals to be surveyed in each category, and arrived at an estimated budget. The Plan and Budget are as follows:

Budget: Biotechnology Program Review

Surveys: (~65)

Copying costs:	$10.00
Mailing Costs:	$25.00
Return Envelope Printing:	$8.00
Return Mailing Costs:	$25.00

Secretarial/Student Support:

40 hours at $5.85/hour	$234.00
Telephone Expenses:	$125.00
Final Document Copying Costs:	$85.00
External Advisory Committee Meeting:	$450.00
TOTAL	$762.00

One item requires some explanation. The members of the External Advisory Committee must travel to Ferris from as far as Detroit and Ann Arbor. Those members from that area must be provided overnight accommodation in Big Rapids. To keep meal expenses down, we plan to schedule the meeting for a Friday afternoon at 1 or 2 pm, offer dinner afterward for all, and accommodation to those three who travel from the Detroit/Ann Arbor area. If this cannot be approved, the alternative is a conference call.

Evaluation Plan

Program: Biotechnology

Degrees Awarded by Program: B.S. Biotechnology

Panel Members:
Kim Colvert, Physical Sciences, Chair
James Hoerter, Head, Biology Dept., Program Coordinator
Maude Bigford, University College, Honors Program Director (external faculty)
James Epperson, Biotechnology Program Alumnus
Connie Boogaard, Biology
Roger Mitchell, Biology

Purpose: To conduct an evaluation of the Biotechnology Program in order to identify its strengths and weaknesses, and in doing so, to improve the program and its service to students, to the biotechnology industry, and to the academic community.

Data Collection Techniques and Information Sources:

Each PRP member will be responsible for at least one of the following report sections: Surveys of Graduates, Students, Employers, Faculty, Internal Advisory Committee and External Advisory Committee; labor market analysis from position vacancies advertised in a variety of forums including journals and internet postings; curriculum, facilities and equipment evaluations, curriculum review, enrollment trends. All surveys have already been developed and agreed on. A summary and analysis of the results from each survey will submitted to the panel as a whole by the target date(s) for consideration. After review the panel will meet to discuss the contents of the reports, make amendments and prepare the final three sections.

Schedule of Events:

Activity	Leader	Target Dates
Program Overview	Colvert	3/19/04
Graduate Survey	Bigford	3/19/04
Employer Survey	Boogaard	3/19/04
Student Evaluation Surveys	Bigford	3/19/04
Faculty Perceptions	Epperson	3/19/04
External Advisory Committee	Hoerter	3/19/04
Labor Market Analysis	Boogaard	3/19/04
Facilities/Equipment	Colvert,	3/19/04
Curriculum Review	Hoerter	3/19/04
Enrollment Trends	Mitchell	3/19/04
Program Productivity and Costs	Hoerter	3/19/04
Conclusions	panel	4/30/04
Recommendations	panel	4/30/04
Internal Advisory Committee	panel	4/30/03

The following questions or requests for information are the result of our discussion concerning specific statements or material within the B.S. in Biotechnology Program Review Panel document. The page number containing the material upon which the question is based is cited prior to the question.

1-1 **Your introduction indicates that students are given the skills of an entry-level research technician. Through out the document you mention the rigor of the program. Does an entry level research technician need all of the rigorous courses you have in your curriculum? Would students graduating with a degree in chemistry of biochemistry meet the requirements of for obtaining a job at this level? Would there be any advantage to making this program a MS level degree?**

Our students are indeed competing with students graduating with a Bachelor of Science in Biochemistry or a Bachelor of Science in Chemistry. We do not offer these degrees. Biotechnology students from Ferris compete with graduates of these programs from other schools. The rigor is comparable even though the distribution of classes is dissimilar. This is part of the advantage of the program. The students can hold their own on a theory basis but often have an edge based on their laboratory skills. We do not have the resources to offer a Master of Science in the true sense of the word though the course components might be repackaged. Other Master' Degree programs would have to be researched. More importantly, the market value of such a degree would need to be examined

1-1 **Do you have a separate admission process for accepting students into the Junior year of the program? If so, please describe the process and identify the criteria used for admission. If there is a separate admission standard for entrance into the Junior Year of the program, why should this program not be considered a 2 year upper division BS degree program?**

response *In a way, yes. From the check sheet: "Admission to the third year level is granted on a competitive basis based on GPA and space available. As an Applied Biology or Biotechnology student, you must have completed the course prerequisites and have earned a GPA of 2.7 or above, both in science and overall, to be eligible to apply. There has been a tendency to be flexible, and allow students to begin their junior classes while rectifying underclass shortcomings. This has been tolerated due to low enrollment. In contrast, if we ever got to the point where the number of prospective junior students exceeded the cap on junior lab class size, the system of junior admission is open-ended in the sense that the less capable students meeting the minimum requirements could be refused admittance in order to limit the numbers of students. Allowing students to declare the major as Freshmen gets them into the proper advising system sooner and tests their commitment to the academic challenge early.*

1-2 **You indicate that your Capstone course is either an internship or independent research project. Do any of your students complete their independent research project requirement on Campus? If students do have only an on campus internship, are they at a disadvantage?**

response *About one third of the graduates since 2000 have fulfilled this obligation on campus. There does not appear to be any disadvantage. Students who have interned on campus have been employed at Assay Design, Henry Ford Hospital and Pfizer as have students who went elsewhere.*

1-6 **Please elaborate on the concern expressed with respect to advising and indicate what steps you have taken to address this problem.**

response *When transfer students are admitted to the program or when Ferris students change majors they are often "off sequence". Making up one or two deficiency courses as they begin the upper division sequences can be very challenging and success is largely determined by the abilities of the individual student. Without a "history" of performance it can be difficult for an advisor to recommend an appropriate schedule of course combinations. Some students have no problems, some can be overwhelmed and there is no way to determine this in advance. Through discussions with faculty such course combinations have been identified and advisors are aware of the potential pitfalls. Also, part of the difficulty this year has been the increase in enrollment because we have a limited number of faculty to advise these students. Strategies for coping that have been discussed include grouping advisees by year and preparation so that advisors are more aware and more familiar with the options.*

3-1
-4 **Mention is made that there are no storage or preparation rooms dedicated to the Biotechnology Program. Are these matters of concern and do they have an impact**
7-13 **on instruction? What are the options with respect to addressing this problem.**

response *Increasing enrollment at Ferris in general has challenged everyone to be creative when it comes to space utilization. The laboratory facilities and storage space are adequate for the upper division labs but there isn't much room for anything new. The changes in Science Stores operation have resulted in the necessity of storing more supplies in the laboratory along with the wide variety of specialized instruments and equipment but there is no real problem. The mention was more for informational purposes rather than a concern as prep-rooms and storage areas are often designated for other courses.*

3-4 **What is the internal advisory committee? What is its function?**

response *This committee consists of faculty who teach in the program and the two department heads. We meet to discuss program-wide concerns: curriculum, admission standards, graduation requirements, program review, etc. The name has been used since the program inception.*

3-4 **Do you have a systematic plan for equipment acquisitions and replacement?**

response ***The program coordinator maintains an equipment "wish list," updated annually by input from each lab faculty member. This list has been used to direct equipment purchases (as well as expensive repair)*** **as funding becomes available.** ***Recent years have seen this process become less formal.***

4-2 **If the capacity of the program for each year is 12, why is 10 considered to be an excessive number?**

response *The capacity of the program for the upper division courses is twelve. Ten is not considered to be excessive just unusual until recently.*

4-8 **With respect to recruitment of students, what are your current efforts?**
5-2 **Describe the workshops and their role in recruitment. How many students have**
9-2 **been attracted to Ferris as a result of these workshops?**

Recruitment Efforts

All of the following activities raise the awareness among high school students and teachers of the biotechnology program at Ferris. By encouraging students and teachers to visit our campus helps to acquaint them with this career option, the biotech program, lab facilities, and professors.

We have not conducted a survey to determine how many made a decision to attend Ferris because of the workshops. However, we do know that over 11 students in the freshman/sophomore class attended one of our workshops. It would be difficult to determine if the workshop was the deciding factor in their decision to attend Ferris; many variables seems to contribute to a student's decision, for example, admission to honors program, scholarships, etc.

*For the last six years, Jim Hoerter has been offering **biotechnology workshops** for high school students on our campus. The number of workshops vary each year, with each one accommodating up to 24 students. Last academic year, we offered six workshops and a mini-workshop in support of one Dawg Day.*

*For the last three years we have been offering a 5-day **Biotechnology Summer Institute** for high school students. This past year, 17 students attended (2003 there were 26 students; 2002, there were 36 students). We will offer the institute again in summer 2005.*

*For the past three years, we have been offering an **Advanced Placement Summer Institute** for high school biology teachers. These institutes are supported with grants from the Michigan Department of Education. Last year we received a $56,000 grant to support over 70 teachers in attending the 7-day institute on our campus in the areas of biology, chemistry and calculus. We will offer the institute again in summer 2005.*

response

4-8 **Is there any advantage for a student who wishes to go to medical school or graduate school to go through this program as opposed to a student obtaining a degree in Applied Biology, Chemistry, or Biochemistry?**

response *There is no advantage. Graduate school or Med school are simply options for graduates. The Biotechnology graduate may be more experienced in a laboratory setting than some pursuing graduate school but they are first and foremost prepared to enter the work force in a laboratory environment.*

5-1 **What is the Fall 04 enrolment in the program? Please indicate total and the numbers in each year.**
The program numbers for the academic years 2001-2004 are as follows:

2001---27
2002---38
2003--36
2004--44

Fall 04 Enrollment (by hours not by year of program)

Freshman:	*10*
Sophomore:	*6*
Juniors:	*9*
Seniors:	*19*
Total	*44*

5-1 **The Administrative Program Review indicates that the program has a capacity of 12 students in each year of the program. In view of the attrition in the program and the courses taken by students during the first two years, is there any reason that enrollment is limited to 12 per year? How many times have you admitted 12 students as the freshman year of this program?**

response *The 12 student limit only applies to the upper division courses. (Twelve is the optimistic total retention number) These limits have never been exceeded, so students have never been denied progress in the program because of them. These limits would be doubled if the lab classes ever went to 2 sections, instead of the 1 we have always had but we do not have adequate faculty to double lab sections. There are no limits on freshman or sophomore students, and the number of freshman students has frequently been above 12.*

5-2 **What actions have been taken with respect to the future goals listed in the Administrative Program Review document.**

response Progress on Administrative Program Review Goals

Continue and Expand Biotechnology workshops: We are expanding and continuing the number of workshops (see recruitment comments).

Visit Michigan Community Colleges and Department Heads: To reduce travel costs associated with this goal, we meet with representatives of community colleges when they visit our campus during a special invitational hosted by the admissions office.

Enhance website for biotechnology: The CAS decided to standardize the website, and establish a mechanism for keeping the website up to date. Some problems were encountered with initiating this system and with the training schedule. Ted Halm is working with the CAS.

Continue developing articulation agreements with community colleges--we continue to work with Carol Quigley, coordinator of articulation. Many colleges

desire to establish multi-departmental articulations, however, this year, due to the technical focus of Calhoun Area Technology Center, we established an articulation agreement that grants credit for a course taken at the center that is equivalent to introduction to biotechnology. This helps to establish a linkage with FSU and encourage students to consider enrolling in the biotech program.

Continue to correlate recruitment activities with Honors Program: I work closely with Maude Bigford in identifying students who are applying to the honors program and also interested in biotechnology. When they come to campus for the honors invitational, I talk with the students and provide opportunities for them to visit our labs. Some of our best students are also enrolled in the honors program. We currently have 7 students in biotechnology who are also enrolled in the honors program.

6-1 **Please submit the check sheet for this program.**

response *Attached at end of questions along with Biochemistry and Cell Biology Minor sheets.*

6-5 **The course Biotechnology 1: Tissue Culture Lab has no number. Is this**
6-8 **course currently being taught? Is the ability to maintain cells in tissue culture a vital skill for Biotechnology students?**

response *It does have a number, it is not currently being taught. The tissue culture lab was originally conceived to cover plant and animal tissue culture equally. In the years since then, animal tissue culture has continued to be important, but plant tissue culture has not become important to biotechnology as had been anticipated. The techniques in and of themselves do not truly require eight hours a week to impart. In recognition of this and as part of efforts to maximize the efficiency of the program the techniques are being incorporated into the Immunology lab on a trial basis, possible as a prelude to a program revision decision.*

7-8 **What percentage of students actually graduate from this program 4 years? In view of the specialized nature of the courses in the last two years and the decision to offer some courses during alternate years, what will be the impact on the ability of a student to progress through the program in a timely manner?**

response *The alternate-year offerings are all junior or senior classes, and were carefully chosen and scheduled so that the upper-level sequence can still be completed in 2 years. We chose times that would not conflict with the several other classes the upper-classmen take, even though our students are technically supposed to have taken some of those courses as underclassmen. We have always had so many program-specific junior and senior classes that transfer students will always require 2 years to graduate after transferring (either from off- or on-campus), with or without alternate-year listings. Students take more than 4 years either because they transferred into the program or because they got a bad grade in a required class.* *The alternate-year offerings are all junior or senior classes, and were carefully chosen and scheduled so that the upper-level sequence can still be completed in 2 years. We chose times that would not conflict with the several other classes the upper-classmen take, even though our students are technically supposed to have taken some of those courses as underclassmen. We have always had so many program-specific junior and senior classes that transfer students will always require 2 years to graduate after transferring (either from off- or on-campus), with or without alternate-year listings.* *This was all done to avoid under-enrolled classes and*

is not set in stone. In fact, due to the large number of juniors this year Immunology lab will be offered next year as well as this winter semester. Large enrollments may result in a total return to every-year offerings.

7-3 **Please comment on the view expressed by one graduate that the program seems to be slipping academically.**

response *Every student that graduates from a program at Ferris cannot be at the top of his class. Without knowing the specifics we can only suppose that this graduate had the unfortunate experience of meeting one of the less successful students. The record of employment and anecdotal reports from employers and other graduates to faculty suggest that this dissatisfaction is not the norm*

8-3 **Please elaborate on the concern expressed about the position of Program**
9-1 **Coordinator. What is the current status of that position and what steps have**
9-2 **been taken to address that concern? Please discuss the work load issues.**

response ***The program needs a faculty coordinator with the time and interest to give it the attention it deserves. Currently there is no faculty member that has both. Ideally the coordinator should teach in the program, but not have so many teaching responsibilities that the position becomes an overload. Without this the program is maintained but not productively creative. A high quality program is being offered and in the short term can be maintained but a long term solution is needed to meet the challenges of a rapidly expanding technology. The best hope for maintaining vitality is to keep the position in mind for new hires.***

9-2 **Please discuss in more detail the anticipated effect of the Minor in Cell Biology on this program. Who will take this minor and what courses to you anticipate that they will take?**

response *A BA in Biochemistry has a wide choice of minors given the extensive liberal arts focus of the BA degree. One excellent choice would be to minor in Cell Biology. Biochem majors are required to take BIOL 121 and 122 and BIOL 375 (Principles of Genetics). The additional requirements for the minor would include lecture courses traditionally taken only by Biotech students. These are Molecular Genetics (BIOL 470), Proteins (BIOL 472) and Advanced Cell and Molecular Biology (BIOL 474). The number of students pursuing this option is not expected to be large. The degree is too new to predict how it will go. Since these are not laboratory courses there should be no discernable effect on the program except to add enrollment. The same could be said of any other degree track (possibly Forensics, pre-Med, other professional programs) that meet the Chemistry and Biology prerequisites for these courses.*

9-2 **Please discuss in more detail the differences between this program and the Biochemistry Degree. What are the advantages of each degree to students?**

response *The Bachelor of Arts degree in Biochemistry is a degree with a broad base of liberal arts courses (languages, communications, etc.) The Biotechnology student fulfills basic general education requirements. The Biochemistry degree is not focused on developing the advanced laboratory skills that distinguish the Biotechnology graduate. Depending on which minor is chosen by the Biochemistry major, there may be some overlap in post-graduate opportunities, both academic and professional, but the Biotech graduate is a highly skilled laboratory technician while the BA Biochemist is a well rounded generalist with a solid grounding in Biochemistry.*

BACHELOR OF SCIENCE IN
BIOTECHNOLOGY

FERRIS STATE UNIVERSITY

PROGRAM COORDINATOR: DR. JAMES HOERTER
OFFICE: ASC 2004 Phone: (231) 591-2550 E-Mail: hoerterj@Ferris.edu

Admission requirements: First year student admission is open to high school graduates (or equivalent) who demonstrate appropriate academic preparedness, maturity and seriousness of purpose. High school courses and grade point average, ACT composite score, and ACT Mathematics and Reading sub scores will be considered in the admission and course placement process. Transfer students must have at least 12 credits at the time of application with a minimum 2.0 overall GPA including an English and mathematics course or they will be considered as first year students.

Admission to the Junior Year Professional Sequence is competitive
Graduation Requirements
1. 2.0 Cumulative Grade Average in all courses. No grade lower than a C- in science and math courses allowed for graduation
2. Minimum 130 Credits including general education requirements
3. Residency Requirements: 30 minimum FSU semester credits
4. Minimum 40 credits numbered 300 or higher

Program requirements: for students entering Biotechnology Fall Semester 2004

REQUIRED		COURSE TITLE – FOR PREREQUISITES NOT INDICATED, SEE FSU CATALOG COURSE DESCRIPTIONS		FSU S.H.	GRADE
No grade lower than a C- allowed for graduation.					
BIOL	121	General Biology 1	(CHEM 114 or 121 concurrent)	4	
BIOL	122	General Biology 2	(BIOL 121 & CHEM 114 or 121)	4	
BIOL	321	Human Physiology and Anatomy 1	(BIOL 122 and CHEM 122)	4	
BIOL	322	Human Physiology and Anatomy 2	(BIOL 321)	4	
BIOL	370	Developmental Biology	(BIOL 122)	4	
BIOL	375	Principles of Genetics	(BIOL 122 and a BIO CHEM course)	3	
BIOL	379	Biotech 1: Tissue Culture Lab	(Admission to upper level Bio Technology)	2	
BIOL	386	Microbiology and Immunology	(BIOL 232 and a BIO CHEM course)	5	
BIOL	388	Advanced Immunology Laboratory	(BIOL 386)	2	
BIOL	470	Molecular Genetics	(CHEM 364 and BIOL 375)	4	
BIOL	471	Biotech 2: Recombinant DNA Lab	(BIOL 470)	3	
BIOL	472	Proteins	(BIOL 122 and CHEM 364)	3	
BIOL	473	Biotech 3: Proteins Laboratory	(CHEM 364 and BIOL 472)	3	
BIOL	474	Advanced Cell & Molecular Biology	(CHEM 364 and BIOL 375)	3	
CHEM	121	General Chemistry 1	(MATH 115 and prior CHEM)	5	
CHEM	122	General Chemistry 2	(CHEM 121)	5	
CHEM	321	Organic Chemistry 1	(CHEM 122)	5	
CHEM	322	Organic Chemistry 2	(CHEM 321)	5	
CHEM	231	Quantitative Analysis	(CHEM 122)	4	
CHEM	332	Biochemistry Lab 1	(CHEM 222, corequisite = CHEM 364)	2	
CHEM	333	Biochemistry Lab 2	(CHEM 332)	2	
CHEM	364	Biochemistry (PHCH 320 is acceptable)	(CHEM 322)	4	
CHEM	474	Advanced Biochemistry	(CHEM 364)	3	
MATH	130	Advanced Algebra & Analytical Trigonometry	(MATH 120 or placement)	4	
MATH	251	Statistics for the Life Sciences	(MATH 130)	3	
PHYS	211	Introductory Physics 1	(MATH 120)	4	
PHYS	212	Introductory Physics 2	(PHYS 211)	4	

CHOOSE ONE:					
BIOL	491	Biotechnology Internship	(instructor consent)	3-6	
BIOL	496	Independent Studies in Biology	(instructor consent)	3-6	
CHEM	497	Independent Studies in Chemistry	(instructor consent)	3-6	

GENERAL EDUCATION REQUIREMENTS

Courses which qualify in the Scientific Understanding (Z), Cultural Enrichment (C) and Social Awareness (S) categories are delineated in the General Education section of the FSU electronic catalog:

http://www.ferris.edu/htmls/academics/gened/courses.html

I. GENERAL EDUCATION REQUIREMENTS		
A. COMMUNICATION COMPETENCE 12 Sem Credits		
Course	Grade	Credit
ENGL 150		3
ENGL 250		3
ENGL 311		3
COMM 105 or 121		3
	TOTAL	
B. SCIENTIFIC UNDERSTANDING 7 Sem Credits		
This requirement is satisfied in the program requirements area.		
C. QUANTITATIVE SKILLS		
This requirement is satisfied in the program requirements area.		
D. CULTURAL ENRICHMENT 9 Sem Credits		
Only approved "C" courses may count toward this category. Requirements: 1) one course must be 200+ level, 2) maximum 3 credit hours of music and/or theater activities may apply		
Course	Grade	Credit
200+ level		
	TOTAL	
E. SOCIAL AWARENESS 9 Sem Credits		
Only approved "S" courses may count toward this category. Requirements: 1) two different subject areas including at least one "foundation" course, 2) one 300+ level course		
Course	Grade	Credit
Foundation		
300+ level		
	TOTAL	
F. GLOBAL CONSCIOUSNESS		
Each student must complete one course from the list of qualifying courses presented in the FSU catalog. This course may also count toward fulfilling the Cultural Enrichment or Social Awareness requirement.		
Course:		
RACE/ETHNICITY/GENDER		
Each student must complete one course from the list of qualifying courses presented in the FSU catalog. This course may also count toward fulfilling the Cultural Enrichment or Social Awareness requirement.		

Course:

BS. Degree in Biotechnology

Sample Course Sequence: The following chart depicts one method to begin the course work requirements. In order to compete this program in a four year plan, students must average 16-17 credit hours per semester. Students MUST consult their faculty advisor to develop a course sequence plan appropriate to their academic development and educational plans.

First Year

Fall		Winter	
BIOL 121	4	BIOL 122	4
CHEM 121	5	CHEM 122	5
ENGL 150	3	MATH 130	4
COMM 105 or 121	3	Cult. Enrich Elec.	3
	15		16

Second Year

Fall		Winter	
BIOL 321	4	BIOL 322	4
CHEM 321	5	CHEM 322	5
CHEM 231	4	PHYS 211	4
Soc. Aware Elec.	3	ENGL 250	3
	16	BIOL 274	1
			17

Admission to the third year level is granted on a competitive basis based on GPA and space available. As an Applied Biology or Biotechnology student, you must have completed the course prerequisites and have earned a GPA of 2.7 or above, both in science and overall, to be eligible to apply.

Third Year

Fall		Winter	
CHEM 364	4	BIOL 472	3
CHEM 332	2	CHEM 333	2
PHYS 212	4	BIOL 370	4
BIOL 375	3	MATH 251	3
Cult. Enrich	3	BIOL 386	5
	16		17
		Summer	
		Internship or Independent Study 3-6	

Fourth Year

Fall		Winter	
BIOL 379	2	BIOL 470	4
BIOL 388	2	BIOL 471	3
BIOL 473	3	CHEM 474	3
BIOL 474	3	Soc. Aware Elec.	3
ENGL 311	3	Cult. Enrich Elec.	3
Soc. Aware Elec.	3		16
	16		

It is strongly recommended that students take electives during the first and second year summer semesters either at Ferris State University or at a community college, it will lighten the load during the year.

NOTICE REGARDING WITHDRAWAL, RE-ADMISSION AND INTERRUPTION OF STUDIES

Students who return to the university after an interrupted enrollment (not including summer semester) must normally meet the requirements of the curriculum which are in effect at the time of their return, not the requirements which were in effect when they were originally admitted.

BACHELOR OF ARTS
BIOCHEMISTRY MAJOR

FERRIS STATE UNIVERSITY

Major Advisor: Dr. Kim Colvert

Phone: (231) 591- 5851 E-mail: colvertk@ferris.edu Campus Address: ASC 3098

Admission requirements: First year student admission is open to high school graduates (or equivalent) who demonstrate appropriate academic preparedness, maturity and seriousness of purpose. High school courses and grade point average, ACT composite score, and ACT Mathematics and Reading sub scores will be considered in the admission and course placement process. Transfer students must have at least 12 credits at the time of application with a minimum 2.0 overall GPA including an English and mathematics course or they will be considered as first year students.

Graduation Requirements:

1. Minimum 2.0 minimum CUMULATIVE grade average in all courses.
2. No grade lower than a "C" in course work included in the minimum 30 credit "major"; 15 credits must be FSU credits; 15 credits must be 300/400 level.
3. Must complete an approved academic minor.
4. 126 Minimum semester credits including general education requirements
5. Residency requirement: 30 minimum FSU semester credits
6. Minimum of 40 credits numbered 300 or higher (excluding community college credits)

Courses required for students entering this major Fall Semester 2004

REQUIRED		COURSE TITLE – FSU PREREQUISITES SHOWN IN BRACKETS ( )		FSU S.H.	GRADE
MAJOR: Minimum 35 credits – No grade lower than "C" (2.0) allowed to apply toward this major.					
CHEM	121	**General Chemistry 1**	**(MATH 115)**	5	
CHEM	122	General Chemistry 2	(CHEM 121, MATH 115)	5	
CHEM	321	Organic Chemistry 1	(CHEM 122)	5	
CHEM	322	Organic Chemistry 2	(CHEM 321)	5	
CHEM	332	Biochemistry Lab 1	(CHEM 322, co – CHEM 364)	2	
CHEM	333	Biochemistry Lab 2	(CHEM 332)	2	
CHEM	364	Biochemistry	(CHEM 332)	4	
CHEM	451	Intro to Physical Chemistry	(CHEM 322, Phys 212 or 242,MATH 220)	4	
CHEM	474	Advanced Biochemistry	(CHEM 364, BIOL 375)	3	
Required Capstone Course:					
COAS	499	Senior Transition Seminar		1	
Supporting Sciences					
BIOL	121	General Biology 1	(CHEM114 or CHEM121)		
BIOL	122	General Biology 2	(CHEM114 or CHEM121, BIOL122)		
Electives to the minimum 126 credits required for this degree.					

BS. Degree in Biotechnology

Academic Minor: An academic minor of 18 – 24 credits is required, any approved minor is allowed (except teacher education minors). Students should consult their major advisor if uncertain as to an appropriate minor to select. For graduation, both the academic minor clearance form and this major audit form must be attached to the graduation application.

GENERAL EDUCATION REQUIREMENTS

Courses which qualify in the Scientific Understanding (Z), Cultural Enrichment (C) and Social Awareness (S) categories are delineated in the General Education section of the FSU electronic catalog:
http://www.ferris.edu/htmls/academics/gened/courses.html

I. GENERAL EDUCATION REQUIREMENTS

A. COMMUNICATION COMPETENCE 18 Sem Credits

Course	Grade	Credit
ENGL 150		3
ENGL 250		3
ENGL 311 or 321 or 323 or 325		3
COMM 105		3
COMM 121		3
COMM 221		3
	TOTAL	

B. FOREIGN LANGUAGE 12 Sem Credits

Three semesters in a single foreign language or demonstrating third semester college proficiency; Courses which satisfy this requirement include FREN101, 102, 201, GERM101, 102, 201, SPAN101, 102, 201

Course	Grade	Credit
		4
		4
		4
	TOTAL	

C. SCIENTIFIC UNDERSTANDING 11 Sem Credits

Only approved "Z" courses may count toward this category. At least 8 credits outside the major including 2 lab courses.

Course	Grade	Credit
BIOL375 (BIOL 121, BIOL 122)		4
Choose one Physics sequence: PHYS 211 and PHYS 212		 4 4
OR PHYS 241 and PHYS242		5 5
	TOTAL	

D. QUANTITATIVE SKILLS

This requirement can be fulfilled by ONE of the following options:

CHECK	Course	Grade	Credit
	MATH 220 or higher		
		TOTAL	

E. CULTURAL ENRICHMENT 12 Sem Credits

Only approved "C" courses may count toward this category. Requirements: 1) 9 credits outside the major; 2) two disciplines; 3) three credits must be 200+ level, 4) maximum 5 credit hours of music and/or theater activities may apply

Course	Grade	Credit
200+ level course		3
	TOTAL	

F. SOCIAL AWARENESS 12 Sem Credits

Only approved "S" courses may count toward this category. Requirements: 1) 9 credits outside the major; 2) two disciplines; 3) at least one "foundations" course, 4) three credits at 300+ level

Course	Grade	Credit
Foundation		
300+ level		
	TOTAL	

G. GLOBAL CONSCIOUSNESS: Each student must complete one course from the list of qualifying courses presented in the FSU catalog. This course may also count toward fulfilling the Cultural Enrichment or Social Awareness requirement.

Course:

H. RACE/ETHNICITY/GENDER: Each student must complete one course from the list of qualifying courses presented in the FSU catalog. This course may also count toward fulfilling the Cultural Enrichment or Social Awareness requirement.

Course:

Questions for B.S. In Biotechnology Program Review Panel Fall 2004

NOTICE REGARDING WITHDRAWAL, RE-ADMISSION AND INTERRUPTION OF STUDIES
Students who return to the university after an interrupted enrollment (not including summer semester) must normally meet the requirements of the curriculum which are in effect at the time of their return, not the requirements which were in effect when they were originally admitted.

CELL AND MOLECULAR BIOLOGY MINOR

FERRIS STATE UNIVERSITY - COLLEGE OF ARTS AND SCIENCES

ADVISOR: Dr. Connie Boogaard
PHONE: (231) 591- 2544 E-MAIL: boogaarc@ferris.edu CAMPUS ADDRESS: ASC 2116

Why Choose the Cell and Molecular Biology Minor?

This minor is designed for students who desire to expand their understanding of biology in the rapidly developing field of cell and molecular biology. It is also suitable for students who have completed substantial courses in a pre-professional degree, but who have not yet been accepted into their chosen professional school. Cell and Molecular Biology is also suitable for students who may choose to pursue a Bachelor's degree in chemistry, especially one with an emphasis in biochemistry.

Admission Requirements

This Cell and Molecular Biology minor is open to any student admitted to Ferris State and pursuing a baccalaureate degree.

Graduation Requirements

An academic minor may only be awarded upon completion of a baccalaureate degree at Ferris State.

Students must have at least a "C" grade in all BIOL courses. At least 50% of the credits of the minor must be Ferris State University credits.

Required Courses

BIOL 121	General Biology 1	4
BIOL 122	General Biology 2	4
BIOL 375	Principles of Genetics	3
BIOL 470	Molecular Genetics	4
BIOL 472	Proteins	3
BIOL 474	Advanced Cell/Molecular Biology	3

COLLEGE OF ARTS AND SCIENCES - ACADEMIC MINOR CLEARANCE FORM

MINOR IN CELL AND MOLECULAR BIOLOGY

NAME_____ STUDENT NUMBER _____

STUDENT'S COLLEGE: _____ B.S./B.A. PROGRAM: _____

Procedures:

1) The student and the advisor for this minor will review and complete the General Requirements and Required Courses sections of this form (Section A).
2) Upon completion of Section A, this form will be sent to the department office for approval. The original form will be filed in the appropriate office (either the advisor or the department) and copied for the student. Students in Bachelor of Arts degree programs must also provide a copy of this form to both the B.A. coordinator and their faculty advisor. All deviations from or substitutions for courses listed in this original plan must be approved by the Department Head on official Course Substitution Forms and must accompany this form.
3) Upon completion of this minor, the student will notify the advisor of the minor. The department and the advisor will verify that the student has completed the minor and will forward the original form to the College of Arts and Sciences Dean's Office for approval and from there it will be forwarded either to the Registrar's Office (Section B) or to the B.A. coordinator as appropriate.

SECTION A

General Requirements:

1) At least 50% of the credits of the minor must be numbered 300 or higher
2) At least 50% of the credits of the minor must be Ferris State University credits
3) This minor requires a minimum of 21 credits
4) This minor requires a minimum GPA of 2.0 in these courses. No grade lower than "C" is acceptable for this minor.
5) A minor will not be entered in the academic record until the student has been certified for a bachelor's degree

Required Courses	Credit Hours	*Grade*	Semester Completed
BIOL 121	4		
BIOL 122	4		
BIOL 375	3		
BIOL 470	4		
BIOL 472	3		
BIOL 474	3		

Signatures		Date
Student		
Advisor		
Department		

SE **Routing** (FOLLOWING COMPLETION OF THE REQUIRED COURSES FOR THE MINOR) **Date**

	Department		
	CAS Dean		
	Registrar		

MEMORANDUM

DATE: November 17, 2004

TO: Academic Senate

FROM: Academic Program Review Council

RE: Recommendations for:

Bachelor of Science Degree in Biotechnology

CC: Kim Colvert, James Hoerter, Matthew Klein Thomas Oldfield, Michael Harris

IDENTITY OF PROGRAM:

BS Degree in Biotechnology

RECOMMENDATION OF ACADEMIC PROGRAM REVIEW COUNCIL:

We recommend that this program be Continued with Redirection.

Significant documented problems exist within the curriculum which should be addressed. Curricular revision (redirection) in accordance with accepted University policies and procedures will be undertaken by the faculty and administration of the program. The recommendations for redirection must be submitted as a part of the final program review report.

CATALOG ENTRY:

Why Choose Biotechnology?

The Biotechnology program is designed to prepare students for positions in biological, medical or agricultural research laboratories, for graduate school or for professional school. The program is built on four basic aspects of laboratory expertise: recombinant DNA, tissue culture, immunology and advanced protein isolation techniques.

The first two years of the Biotechnology program are preparatory, structured to complete the biotechnology foundations course work. The professional sequence of biotechnology course work typically begins with the student's junior year. Students submit an application demonstrating completion of the preparatory coursework either at Ferris or another university. Admission to the professional biotechnology sequence is competitive and based on the foundation coursework. Internships are available to biotechnology students and enable them to spend a summer gaining work experience in a laboratory setting.

Get a Great Job

The Ferris Biotechnology program is designed for those who want to work at a laboratory bench or pursue study at the graduate level. The biotechnology field is a growing industry, making the technological and medical advances that improve the quality of life.

Biotechnology offers a career in furthering our understanding of the world and applying that knowledge toward the improvement of our lives. Job opportunities exist in most industries that conduct research and

development programs. Biotechnology graduates are especially marketable, since the hands-on experiments conducted at Ferris give students real-world experience in a controlled laboratory setting. In fact, over 90 percent of graduates have jobs in the industry or are in graduate or professional schools.

Admission Requirements

First year student admission is open to high school graduates (or equivalent) who demonstrate academic preparedness, maturity and seriousness of purpose with educational backgrounds appropriate to their chosen program of study. High school courses and grade point average, ACT composite score, and ACT reading and mathematics subscores will be considered in the admission and placement process. Transfer students must have at least 12 credits at the time of application with a minimum 2.0 overall GPA including an English and mathematics course, or they must provide their high school records and ACT scores for admission review.

Graduation Requirements

The Biotechnology program leads to a bachelor of science degree. Graduation requires a minimum 2.0 GPA overall and a minimum of 130 credits including completion of all general education requirements as outlined on the General Education website.

BACKGROUND INFORMATION OBTAINED FROM THE ACADEMIC PROGRAM REVIEW PROCESS:

CRITERIA SUMMARY BASED ON THE CONCLUSIONS OF THE ACADEMIC PROGRAM REVIEW PANEL:

- **Centrality to FSU Mission**
  - The Biotechnology Program fulfills the mission of "innovative teaching and learning in career-oriented technological and professional education" by graduating students prepared to move quickly and productively into biotechnology laboratory environments.
  - The panel believes that the depth of their laboratory experience most especially has made them valuable resources in firms both in Michigan and across the country.
- **Uniqueness and Visibility**
  - For many years the Biotechnology degree at Ferris was the only undergraduate program in the state. The growth in the field has prompted the formation of a number of two- and four- year degrees at other Michigan institutions.
  - The efforts of Dr. Hoerter to promote the program and operate summer workshops and to work with our advisory committee has kept the program familiar to employers and prospective students.
  - The summer workshops especially have recruited a number of students into the program. With the competition increasing even more effort should be made to recruit and guide our Biotechnology students.
  - The program is recognized by BioLink, a national organization that is linking the community and 4-year programs in biotechnology across the nation.
- **Service to State and Nation**
  - The need for qualified technologists in the life sciences will continue to increase across the nation.
  - Michigan is nationally recognized as a leader in the growth of life-science based companies. Biotechnology students are contributing to this development by serving as technicians and eventually in management in both large pharmaceutical firms and small but growing biotechnology companies.
- **Demand by Students**
  - Enrollment in the program has shown steady increases over the past eight years. Though the attrition rate is somewhat high and there have been some bumps in the graduation rate, the number of program graduates per year is on the rise.
  - This trend is expected to increase as Ferris continues to improve its appeal to academically successful students in general. The panel would like to increase Biotechnology' s share of these students to graduate 12 per year.

- **Quality of Instruction/Demand for Graduates**
  - The best indicator of quality of instruction is the success of the Biotechnology students.
  - The quality of courses is not limited to those specific to the program. The auxiliary courses have provided solid foundations for advanced courses which is absolutely necessary for success.
  - The students have consistently rated the instructors in the program as above average to excellent.
  - There have been very few instances of dissatisfaction with our graduates. With the expected increase in demand and the competition for those positions it is very important that the causes of such dissatisfaction be determined and rectified as completely as possible.
- **Placement Rate and Average Salary of Graduates**
  - Of the students pursuing employment upon graduation (rather than graduate or professional school) the placement rate has been approximately 90 %.
  - Starting salaries have ranged from the high $20 K to the mid $40 k and averaged $33.8K over the last five years
- **Service to Non-Majors**
  - Until recently very few of the upper level courses have had non-Biotechnology enrollment, partially because of the extensive prerequisites.
  - This is beginning to change as Forensics majors, Biochemistry majors, pre-Pharmacy and Chemistry Education majors begin to enroll in the classes for which they have the prerequisites. The numbers are still small but could grow.
- **Facilities and Equipment**
  - While currently sufficient there is concern that equipment repair and replacement costs will seriously tax the annual S/E budgets of both the Biology and Physical Sciences Departments.
  - The program requires an administrative commitment to an on-going budget line item for equipment repair and replacement.
- **Library Information Services**
  - The journal and book collection of FLITE is adequate but could be better.
  - Faculty have worked with library representatives to improve holdings and the availability of on-line resources.
  - Accessibility to current journals has improved and students are finding it much easier to obtain publications. Interlibrary loan times have decreased on average making it more effective support for research and literature presentations required in several courses.
- **Faculty: Professional and Scholarly Activities**
  - The faculty most closely associated with the Biotechnology Program are: Dr. Kim Colvert (Physical Sciences), Dr. Roger Mitchell (Biology), Dr. Connie Boogaard (Biology), Dr. Kemi Adewusi (Biology), Mr. Frank Hartley (Biology) and Ms. Mary Bacon (Physical Sciences). They have all maintained a variety of professional and scholarly activities including research, publications professional associations, workshops. and student organization mentoring. Vitae are available upon request.
- **Administrative effectiveness**
  - The role of program coordinator is vital to efficient operation of the program. Due to personnel changes, resignations and reduction of release time for program coordination the administrative effectiveness has been diminished since the last review.
  - There are numerous projects and improvements that have been suggested that do not come to pass due to the lack of that central, focused, coordinating presence.
  - While high quality instruction is not affected the overall quality of the program can be significantly enhanced under the direction of a committed program administrator that can actualize the contributions from the faculty, students and Advisory Board.

COST INFORMATION:

According to the 2001-2002 report from institutional research:

Total cost per SCH

BS Degree in Biotechnology	**$258.72**

Total program cost

BS Degree in Biotechnology	**$33,633.29**

In its conclusion, the APR Panel states that Biotechnology is an expensive program. The program is very laboratory intensive and the classes small. Laboratory supplies and equipment for biotechnology are more expensive than for lower level laboratory classes and require direction from highly qualified instructors. Space is limited and extensively utilized. While the total cost per SCE for Biotechnology may seem high the recent productivity studies have ranked both the Biology Department and the Physical Sciences Department as two of the most productive. This suggests that both departments have the means to support some higher cost programs for the benefit of the university. The academically rigorous nature of the program may diminish the enrollments in upper level classes but is necessary to maintain a reputation among employers. As can be seen from the Enrollment trends the Biotechnology Program attracts students to Ferris, many of whom stay even if they do not graduate from Biotech which partially offsets the cost.

ASSESSMENT OF THE PROGRAM BY THE ACADEMIC PROGRAM REVIEW COUNCIL:

OBSERVATIONS:

- The Degree Program Cost Document for 2001-2002 published by Institutional Research and Testing lists all programs; 2 year, 4 year, graduate, and professional degrees in the same table.
- The BS Degree in Biotechnology ranks 29/229 in programs at the University based on **total cost per student credit hour** ranked from high to low.
- The BS Degree in Biotechnology ranks 12/229 in programs at the University based on **total program cost** ranked from high to low.
- According to the Administrative Program Review, the capacity of the program is 48 students, 12 in each of the 4 years of the program.
- Enrollment in the program over the last 6 years:

1999	2000	2001	2002	2003	2004
24	29	27	38	36	44

- The number of graduates in the program over the last 6 years:

1999	2000	2001	2002	2003	2004
6	5	6	4	6	5

- The Administrative Program Review states that 1.57 FTE were assigned to this program in the Fall of 2003.
- The Administrative Program Review states that .69 FTE were assigned overload/supplemental in the Fall of 2003.
- The graduate survey was sent to 16 graduates. A total of 6 surveys were returned for a 37.5 % return rate
- The employer survey was sent to 12 employers. A total of 2 surveys were returned for a 16 % return rate.
- A survey was administered to 36 students. A total of 12 surveys were returned for a 33 % return rate.
- The Faculty survey was sent to 16 Biology faculty. A total of 5 surveys were returned for a 31.25 % return rate.

THE PROGRAM HAS A NUMBER OF IMPORTANT STRENGTHS:

- Most faculty who teach in the program are highly qualified
- The program has strong Administrative support from the Department of Biological Sciences and the College of Arts and Sciences
- The quality of the equipment available for students taking courses in the program is high and meets the needs of the program
- There are many employment opportunities for graduates of this program
- The students who complete this program are high quality students and are a credit to the University
- The Department Head in the Department of Biological Sciences has been able to obtain grant support for Biotechnology workshops for high school students which increase the visibility of the program
- A variety of approaches have been explored to enhance recruiting efforts

THE ACADEMIC PROGRAM REVIEW COUNCIL HAS THE FOLLOWING CONCERNS:

- Since its inception, this program has been characterized by below capacity enrollment
  - Capacity enrollment in any of the upper division courses dedicated to this program is extremely rare
  - In the last few years there has been a steady increase in the total number of students who declare this program as a major. As a result enrollment in the program appears to have increased significantly during this time period (however, still not to capacity)
    - The number of students actually enrolling in the third year of the program and populating the expensive courses in the 3rd and 4th years does not appear to have increased appreciably
    - The change to alternate year status of the program specific courses does make it difficult to determine, using the SIS system, how many individuals are in the Junior class and how many are in the Senior class however, examination of enrollment in selected courses does not suggest that there is a significant increase in enrollment in the Junior class this fall
  - The graduation rate in this program is consistently at or below half of the capacity
    - The evidence does not support the conclusion of the panel that the number of graduates per year is on the rise
    - The program faculty anticipates 6 graduates at the end of the current academic year which is consistent with past years.
- The admission requirements and rigor of the courses in the 3rd and 4th years of the program may be a factor in the below capacity enrollment in the courses offered during those years
  - According to the check sheet, this program requires 27 credits of lecture and laboratory intensive upper division courses (not including the capstone) that are specifically designed for this program
    - Due to the focus of and rigor in these laboratory courses, it seems unlikely that students from other programs or majors will enroll in these courses in significant numbers
    - Until recently, the 13 credits in lecture courses that accompany and support these laboratory courses were not open to individuals other than those enrolled in the Biotechnology Program
    - Due to the focus of and rigor in these lecture courses, it seems unlikely that students from other programs or majors will enroll in these courses in significant numbers
  - The current nature of the institutional incentives to high ability students works to the disadvantage of programs such as Biotechnology in which there is an attempt to maintain academic rigor in courses and quality control in graduates
- Consistent with the conclusion of the APR Panel, Institutional data indicates that the program is expensive
  - While the cost data available to the APR Panel and the Council from Institutional Research is three years old and does not reflect the decision last year to schedule classes in alternate year format, it is unlikely that the current cost calculations are significantly different from those of several years ago
  - The laboratory intensive, low enrollment courses that require expensive equipment and costly chemical reagents continue to be offered
  - Although the lecture courses that accompany these labs are now open to students with the necessary prerequisites, it is unlikely that there will be a significant increase in non-biotechnology student enrollment in them

- The panel states that there is concern that equipment repair and replacement costs will seriously tax the annual S/E budgets of both the Biology and Physical Sciences Departments
  - The low enrollment in these courses raises the question as to whether a program that graduates 6 or less students a year merits this type of on going investment of scarce University resources
- The high S&E budget coupled with the below capacity enrollment in the upper division laboratory and lecture courses in the 3rd and 4th years of the program results in Biotechnology being listed as one of the most expensive programs on campus
- It should be noted that the total cost per student credit hour ranking of 29 of 229 from high to low as reported in the Institutional Research documents is artificially low due to the nature of the accounting system used by the University.
  - The program is in effect, an upper division 2 year program with specific admission criteria for acceptance into the Junior Year of the program.
  - The first two years of the program, with the exception of one course, is essentially a pre-professional curriculum consisting of basic science and math courses and general education electives
    - The same courses are taken whether the student is a pre-medical, pre-pharmacy, pre-optometry, or Biotechnology student
  - These basic science and math courses have a relatively large enrollment and relatively low cost which reduces the impact of expensive upper division courses in the calculation of the total cost per student credit hour in the institutional data.

- The stated goal of this high cost program is to prepare students for an entry level technician position.
  - The rigor and highly technical orientation of the program does not appear to be essential for a career in Biotechnology
    - The APR Panel indicates that graduates with bachelors degrees in chemistry and biochemistry are able to compete for the same jobs for which students in this program are trained
- The entry level salary reported in the Administrative Program Review for graduates of this program is relatively low in view of the rigor and cost of this program to the University
- There does not appear to be strong support for the program on the part of the Department of Biological Sciences Faculty
  - There was a low return rate from Biology faculty with respect to the survey from the Biotechnology program
  - There is currently no faculty member in the Biology department willing to serve as the program coordinator
  - The Program Review Panel was chaired by a faculty member from Physical Sciences since no Biology faculty member was willing to chair the panel

THE ACADEMIC PROGRAM REVIEW COUNCIL RECOMMENDS THAT THE FOLLOWING STEPS BE TAKEN BY THE FACULTY AND ADMINISTRATION OF THIS PROGRAM:

- The panel, program faculty and administration must conduct a study to evaluate the effectiveness of the current recruiting efforts and determine whether or not additional efforts are likely to increase the number of students who enter the 3rd year of the program and continue on to graduate
- The panel, program faculty, and program administration must conduct a study to evaluate the curriculum of this program with respect to its cost effectiveness and benefit to the University
  - This study should determine if the curricular design is a major factor in the below capacity enrollment in the program
  - The study should also determine if the current curriculum provides sufficient advantage to graduates with respect to the goal of providing an opportunity for employment as an entry level technician to justify the expense to the University of providing such a highly technical education
  - The study should determine what alternatives exist with respect to curricular design that could accomplish the stated goal of this program of training individuals to obtain employment as an entry level technician
    - Individual courses should be reevaluated with respect to the necessity of the current course design to ensure that this goal is met

- Consideration should be given to making this program a track of the Applied Biology program with a decrease in the number of highly specialized, low enrollment, and faculty intensive courses currently required in the track
- The feasibility of converting this program into a minor that might meet the needs of this particular category of students should be explored
- In view of the rigor and sophistication of the courses in the 3rd and 4th years of the program, the possibility of reconfiguring the course offerings in this program into a MS degree should be explored
  - A market analysis of the need for graduates of such a program should be carried out

- This report must be submitted to the Academic Program Review Council on or before Oct 15, 2005.
- If there is no evidence that the program has taken significant steps to increase enrollment in and decrease the cost of the program and/or no acceptable plan for redirection is developed by the faculty of the program and the program administration by the due date, the Academic Program Council should recommend to the Academic Senate that the program be closed

Report of the Biotechnology Program Review Panel

October 10, 2004

Members of the Panel

Kim K. Colvert, Faculty,Physical Sciences and Chair
James Hoerter, Biology Department Head
Roger Mitchell, Faculty, Biology Department
James Epperson, program graduate, Biology instructor
Maude Bigford, Honors Program Director

Report of the Biotechnology Program Review Panel

Section

Appendix

Section 1: Biotechnology Program Overview

History:

The Biotechnology Program accepted its first students in 1989. It was designed to provide intensive hands-on laboratory experience to feed the growing biotechnology industry. It was therefore designed to have a very focused curriculum, oriented toward understanding of both the principles and theory of biotechnology, and the ability to perform relevant procedures in the laboratory. It was designed to be a small program, with a maximum capacity of 16 students per year, and considered to be full at 12 students per year. Enlarging the program beyond this number of students prevents the laboratory experience from being considered "hands-on," since students are then working in large groups.

The educational goals of the Biotechnology Program are to provide students with a quality baccalaureate degree in biotechnology, encompassing a solid grounding in liberal arts, an ability to communicate well in written and oral interactions, and technical expertise in the theoretical and practical aspects of biotechnology.

Graduates possess an occupational skill level equivalent to an entry-level research technician. Performance objectives include but are not limited to the following:

a. good oral and written communication skills
b. geographical, social and cultural awareness, through required coursework in social awareness and cultural general education.
c. an understanding of the major areas of biology, including general biology, physiology and anatomy, microbiology and immunology, genetics, and molecular and cell biology.
d. an understanding of inorganic, organic and biological chemistry
e. an in-depth understanding of the four major areas of biotechnology, including proteins, nucleic acids, immunology, and cell/molecular biology.
f. an ability to function efficiently and with versatility in laboratory settings centered around the areas listed in "e" above.

The Curriculum:

The Pre-Professional Sequence:

Because the curriculum is focused into the area of biotechnology, there is limited flexibility in course selection. The Biotechnology Program is similar in level of sophistication to other professional programs such as Pharmacy, Optometry, Pre-Medicine, and Pre-Dentistry. These programs share very similar first, second, and even third year requirements. This enables students who come to Ferris to reserve a final decision on their major field of study until the third year. Students in these programs take two years of majors Biology classes (BIOL 121-2, BIOL 231-2), two years of majors Chemistry classes (CHEM 121-2;

CHEM 321-2), a year of non-majors Physics (PHYS 211-2) and mathematics through Analytical Trigonometry (MATH 130). Biotechnology requires, in addition to these, CHEM 231, Quantitative Analysis, and Statistics. Transfer students from community colleges may take most of these classes elsewhere before transferring to Ferris in their junior year. The exception to this is BIOL 231-2, which is not usually available at community colleges. This course sequence is offered every summer, and transfer students usually take it during that time. CHEM 231, which is also not available at community colleges, is scheduled in such a way that transfer students can take it in their first year here, as juniors. The higher level courses of the professional sequence in the second two years of the program all assume a basic knowledge of the material taught in these majors classes. Therefore, substitutions of lower-level science classes for these science-majors classes are not allowed. The curriculum of the first two years is rounded out with general education electives to satisfy the requirements for cultural enrichment, global consciousness, and communications.

The Professional Sequence:

The professional sequence of the second two years of the curriculum is designed to address the major areas of biotechnology in both theory (lecture) and lab. The major areas of biotechnology are: protein purification, recombinant DNA work, cell and tissue culture, and microbiology/immunology. Therefore, the course requirements include: one year of majors biochemistry (CHEM 364 and CHEM 474), one year of biochemistry laboratory (CHEM 332-333), Genetics (BIOL 375), Developmental Biology (BIOL 370), Microbiology and Immunology (BIOL 386), Advanced Immunology Lab (BIOL 388), Proteins (BIOL 472), Proteins Lab (BIOL 473), Advanced Cell and Molecular Biology (BIOL 474), Cell and Tissue Culture Lab (BIOL 379), Molecular Genetics (BIOL 470), and Recombinant DNA Lab (BIOL 471). In addition, ENGL 311 (Technical Writing) is required, because of the importance of this ability in the biotechnology job market. Our capstone course is an internship or independent research project, which most students complete off-campus, at other universities, at industry sites, or at government or medical foundation research labs.
Students are required to demonstrate competence in the use computers including: windows type operating systems, word processing, spreadsheets, presentation software, and the Internet.

In the course of the last fourteen years, the curriculum has been reviewed four times. Because of the rapidly changing nature of the field, we consider this to be an important and on-going exercise. The most recent review has resulted in some changes in the professional sequence order to maximize the efficiency of the offerings,

The Program Facilities:

There is one major lab which serves for biochemistry and biotechnology. In this lab (Sci 337, and the instrument room adjacent to it, Sci 343, and in the cold room across the hall in Sci 338), most of the laboratory courses are taught. There is a separate lab (Sci201A) for tissue culture, since the organic fumes would kill the cells if this were carried out in the same room with organic solvents. In addition, the immunology lab and the tissue culture lab make use of the animal care facility located in pharmacy. These facilities, and the equipment contained in them, are outlined in the section on Facilities and Equipment.

The Program Faculty:

The program makes primary use of faculty in the biology department and the physical sciences department. The major faculty who contribute to the program are: Dr. Kim Colvert (Physical Sciences), Dr. Roger Mitchell (Biology), Dr. Connie Boogaard (Biology), Dr. Kemi Adewusi (Program Coordinator, 1999-2003), Mr. Frank Hartley (Biology) and Ms. Mary Bacon (Physical Sciences). Dr. Jim Hoerter (Biology Department Head, Current Program Coordinator) contributes to maintaining high visibility of the program by offering Biotechnology Workshops for community college and high school teachers and students, by establishing partnerships with industry for industrial internships, by grant-writing to cover the costs of renovation of the lab and purchase of new equipment, and by establishing articulation agreements with community colleges. All faculty involved in the program teach other courses as well as biotechnology courses. Of the required 130 credits for graduation, less than six credits are taught by part-time faculty who have not earned the Ph.D. degree in their fields.

The Biotechnology Program Students:

The typical biotechnology laboratory worker is an intelligent person with a good work ethic and the ability to work independently. This is a reasonable description of our average biotechnology student. Many of biotechnology students are eligible for the honors program. The requirement for entry into the professional sequence is a gpa of 2.7 or higher in the lower-level science classes, as well as over-all. This selective group of students is generally self-motivated, hard-working, and intelligent. They are capable of responding to the challenge of the program. The presence of these students on campus is one of the major contributions of the program to the university community.

The Relevance of the Biotechnology Program to the Mission Statement of FSU:

The FSU Mission Statement reads: ***Ferris State University will be a national leader in providing opportunities for innovative teaching and learning in career-oriented, technological and professional education.*** Ferris specializes in combining hands-on training with liberal arts education. It is therefore especially fitting that Ferris has the state's first BS-level Biotechnology Program. This program teaches hands-on skills in an extremely intensive sequence of advanced laboratory classes. These courses strive to re-create the laboratory work atmosphere. This "applied" part of the program is what elevates this program above others in the state and nation. At the same time that the program is scientifically and technologically strong, it also has a significant requirement for liberal studies. This is consistent with the mission statement's emphasis that liberal studies must be part of every student's program. Quality teaching is stressed throughout the Biotechnology Program. This is reflected is the success of our graduates, 90% of whom have found employment in the field.

The Contribution of the Program to the University:

The Biotechnology Program brings to the campus community many very well-qualified students, who come here specifically to take this program. Their level of scholarship helps "raise the bar' in the courses they take. Through the research carried out by the students and faculty, and through the quality of the courses that are taught, the Biotechnology Program contributes to academic excellence in the community at large.

To attract quality students awareness of the Biotechnology Program is promoted through outreach to community colleges and workshops for high school teachers. Through contact with alumni and the external advisory committee the program maintains a high visibility in the state. Industry representatives and visiting faculty present seminars that contribute to student and faculty development. Activities of the student organization, DNA, not only foster a sense of identity among Biotechnology Students but contribute to the quality of campus life through service and events.

The Biotechnology Program contributes to the state and nation through the training of students in an area that has traditionally been ignored in the academic community at large: hands-on laboratory experience. Our graduates readily find employment because of the high demand for this training. Many of our graduates, having demonstrated success in laboratory settings have moved into managerial positions and turn to our graduates to fill new positions with their companies.

Relationship of The Biotechnology Program to Other Programs:

For the first three years of its existence, the Biotechnology Program was part of the Applied Biology Program. However, the differences between this and the other tracks of the Applied Biology Program were sufficiently significant to warrant establishing this as a separate program. These differences include: a reduced number of general education electives, an increased number of overall credits required to graduate, a very narrowly focused scientific curriculum which leaves very little choice in terms of electives, a requirement for three years of chemistry-majors level chemistry courses in addition to the biology courses (Applied Biology students are only required to take a minimum of one semester of non-majors chemistry), an emphasis on advanced laboratory classes, and a pre-requisite of a gpa of 2.7 for entry into the professional sequence. In addition to these major differences, the advantage to graduates in terms of salary was approximately $5000/year, the program was separated from the Applied Biology Program and given its own standing.

Two newly created degree programs are expected to have a positive effect on the enrollment in some of the courses currently taken primarily by Biotechnology majors. Some of the exceptional students majoring in Forensic Biology will have the prerequisites and possibly the interest in taking advanced courses such as BIOL 470 and BIOL 474. Students in the newly created B.A. in Biochemistry could choose to minor in Cell Biology and would also increase the enrollment in these courses, thus improving efficiency. The actual impact of these programs on Biotechnology are yet to be determined. They are not expected to have an adverse affect as these degrees are not laboratory intensive programs and graduates are not likely to compete for placement.

The Biotechnology Program is similar to the Medical Technology Program in that both programs train students in labwork. Medical Technologists primarily work in hospital labs carrying out routine assays on blood or urine samples. Biotechnologists typically work in research labs or industry labs designing assays (that will perhaps someday be used by those medical technologists), splicing genes, purifying proteins from large or small scale cultures, culturing cells, sequencing DNA, mapping genomes, characterizing malignant transformations, designing drugs or testing them on animal cells, etc. This level of laboratory skill has traditionally been learned in graduate school, and results in a competitive edge for our graduates for employment or post graduate studies.

Program Strengths and Concerns:

The following are strengths of the program:

1. Quality hands-on training in laboratory skills
2. Quality teaching in all aspects of theory in the field of biotechnology.
3. An extremely focused curriculum.
4. Average costs
5. The small student numbers, and increased teacher-to-student ratio in the lab.

The following are concerns of the program:

1. Promoting full enrollment with highly qualified students in the professional sequence.
2. Identifying a permanent Program Coordinator
3. Improving student advising.
4. Securing ongoing funding for equipment repair and replacement.

BIOTECHNOLOGY PROGRAM
ROLE AND MISSION STATEMENT

MISSION:

An understanding of the basic concepts of biology, a solid grounding in the liberal arts, an ability to communicate well in oral and written interactions, an understanding of basic concepts underlying biotechnical techniques, and an ability to carry out basic biotechnical procedures, are all essential for students to become productively employed members of the biotechnical community.

The mission of the Biotechnology Program is to provide a quality 4-year degree in biology, encompassing a good general education in liberal arts as well as a sound understanding of the basic principles and laboratory practices of biotechnology.

GOALS:

1. To increase student understanding of basic biological and chemical principles, and to increase student knowledge in basic areas of biology and chemistry.
2. To increase student ability in carrying out such technical skills as:
    a. careful observation
    b. attention to detail
    c. record keeping and documentation
    d. relevant calculations
    e. taking direction
3. To increase student understanding of the basic areas of biotechnology.
4. To increase student awareness of, or ability in carrying out, such advanced technical skills as:
    a. data manipulation and interpretation
    b. experimental design with proper controls
    c. combination of several techniques into a reasonable sequence
    d. coordination of several projects for the maximum utilization of time.
    e. following instructions at an intermediate to advanced level of difficulty, such as those found in research lab manuals and in technical literature supplied by product manufacturers.
5. To increase student awareness of the career opportunities in biotechnology.

OBJECTIVES:

1. To develop educational strategies designed to enhance the ability to think critically about scientific questions.
2. To develop educational experiences designed to increase the ability to function in a biotechnology laboratory.
3. To encourage student-faculty discussions about specific career opportunities in biotechnology.
4. To provide opportunities to observe biotechnology laboratories directly.

RECENT BIOTECHNOLOGY PROGRAM GRADUATES

STUDENT	INITIAL JOB SITE
Spring 2003	
Candice Colby:	Medical School
Diane Tessman	
Jennifer Franklin	Lab Director, Dr. Hoerter
Alan Arnold	Graduate School
Spring 2002	
Joseph Gerstenschlager	Graduate School
Dorota Kuczinska	Van Andel
Tyler Voss	Henry Ford Hospital
Spring 2001	
Joy Grundy	Van Andel
Karie McGowan	Assay Designs
Jaime Minda	MPI Research
Akemi Shibuya	unknown
Laura Tahash	Henry Ford Hospital
Spring 2000	
Chidi Okechuckwu	unknown
Lisa Randazzo	Medical School
Chad Schultz	Henry Ford Hospital
Kelly Suino	Mayo Clinic
Spring 1999:	
Angela Anderson	Unknown
Barbara Woods	Unknown
Spring 1998:	
Robin Demers	Pfizer
Brian Fetterley	
Bobbi Gronemeyer	Assay Designs
Kyle Ingersoll	Assay Designs
Todd Rentfrow	Unknown
Gaseene Sebetso	Graduate School
Karen Wilson	Assay Designs
Spring 1997:	
Micah Doty	Cayman Chemical
Melanie Fitch:	Upjohn/Pharmacia
Matt Larson	MSU Bioinformatics
Brian Metzger	Pharmacia & Upjohn

PAST BIOTECHNOLOGY PROGRAM GRADUATES

STUDENT	INITIAL JOB SITE
Glen Alberts	Pharmacia/Upjohn
Dana Biroscak	Assay Designs
Rebecca Bishop	unknown
Scott Bowen	Cayman Chemicals; ParkeDavis
John Bryant	Parke Davis
Dennis Buckley	Neogen
Brian Chisholm	Jackson Labs, Bar HarborMaine
James Corrigan	Cayman Chemical
Melissa Crane	Dow Chemical/Dow Corning
William Cripps	Oxford Biomedical Co.
Tawny DeWulf Dahring	UM Dermatology Research; Parke Davis
Ernest Delameester	Pharmacia & Upjohn
James Epperson	UM Protein Facility
Tammy Fowler	U Wisconsin, Madison
Nicole Fuester	graduate school
Nicole Gerard	Pharmacy Dept, Meijers; Eli Lilly
Shelli Gaul	Parke-Davis
Martin Gaut	unknown
Laura Rentfrow Hagen	Enzyme Research Labs; Pharmacia-Upjohn
Jennifer Allington Hansen	Pharmacia/Upjohn
Carla Henry	graduate school
Lara Huetter .	UM Animal Care Facility
Van Le Huynh	UM Molecular Biology Dept.; Cayman Chemi
Eric Jerks	UM DNA Sequencing Core Facility
Howard Johnson	Pharmacia & Upjohn
John Joubran	Scripps Clinic and Research Institute
Dinh Luu	unknown
Jeff Magalski	unknown
Angela Miller	Enzyme Research Labs (Indiana)
Charlene Nichols	Greyson and Sons
Funmi Onowu	Genesys
Nicole Oswald	graduate school
Christopher Parrish	Aastrom Biosciences
Gregory Poynter	Mayo Clinic
Faith Prior	Parke-Davis
Don Rempinski	graduate school
Chad Storer .	Cayman Chemicals; Parke-Davis
Jon Supernault	Assay Designs
Robert Tierney	graduate school
Jacob Tropea	UM Protein facility, then Genentech
Erik Troxtel .	3M
Shana Wallace	Amway Chemcial Labs

Section 2: Labor Market Analysis

The Biotechnology Program has a record of over 90% employment of its graduates in biotechnology-related positions. The biotechnology industry is a nation-wide and world-wide industry, so that our graduates are competing with others from very prestigious institutions. Nevertheless, they have done exceptionally well in finding employment both within the state of Michigan and across the country and often rise quickly into supervisory positions.

Most laboratory positions at smaller firms are advertised only locally, in newspapers or by word-of-mouth. The major biotechnology companies, however, advertise primarily in such periodicals as *Science* or *Nature* or in professional periodicals such as Chemical and Engineering News. Internet employment banks such as Scencejobs.com and Monster.com are becoming prime sources for locating appropriate positions. Academic positions are usually listed on University web sites. Our graduates are eligible for a wide variety of positions requiring backgrounds in molecular biology or biochemistry, with lab experience in tissue culture, protein purification, recombinant DNA techniques, or immunology. These positions include biomedical research, molecularly-oriented areas as environmental protection and remediation, agricultural research, forensics labs, paternity-testing labs, biological product development, academic research, sample analysis centers (protein and nucleic acid sequencing) and so on.

The US Department of Labor reports in the Occupational Outlook Handbook (www.bls.gov) that employment in professional, scientific and technical services will grow by 27.8 percent by 2012. The Michigan Occupational Information Service (MOIS) reports that employment of biological scientists is expected to increase about as fast as the average for all occupations through the year 2012, or at about 12 percent . It is interesting to note however that this may not reflect the commitment Michigan has made to the biological sciences. In a 2002 article in *The Scientist (16[1]:57, Han. 7, 2002)* entitled "Michigan Moves from Motors to Molecules" the author reviews the financial outlay in the Michigan Life Sciences Corridor` (MLSC) initiative and is very positive about the future of biotechnology in the state. (Article appended). MICHBIO, the state's biotech organization reported that $25 million will be invested to foster growth in the life sciences in 2004 and that there are 542 companies that are a part of Michigan's Life Sciences Industry.

Starting salaries for biotechnologists range from $30-45,000, depending on the venue. At the smaller firms, starting salaries are lower but often allow for faster promotion, and include stock options as a benefit.

Section 3: Facilities and Equipment

A. FACILITIES SURVEY:

FLOOR SPACE DEDICATED TO BIOTECHNOLOGY:

The program has space dedicated to teaching biochemistry and biotechnology in Sci 337 (Teaching Lab), Sci 343 (Instrument Room), and Sci 201A (Teaching Lab for Tissue Culture). The total floor space of these labs is 1615 ft^2.

There is a cold room dedicated to biotechnology, with an area of 64 ft^2.

There are no storage or preparation rooms dedicated to biotechnology.

FLOOR SPACE SHARED WITH OTHER CLASSES:

The program shares many additional teaching labs with biology and with chemistry. The total chemistry laboratory space is 5657 ft^2, and the total biology laboratory floor space is 9617 ft^2.

Lecture rooms are shared with other biology and physical sciences departmental courses. Total number of lecture rooms in biology is 2, with an area of 3885 ft^2 (including Str136), and in physical sciences is 6, with an area of 7663 ft^2. (including STR 233).

Other facilities that are available and used for some biotechnology classes are:

The animal-care facility:
- PHR 314F: (rabbit room): 160 ft^2 (20 x 8)
- PHR 314M: (rat room): 32 ft^2 (8 x 4)
- PHR 314C: (surgery and lab): 200 ft^2 (25 x 8)
- Sci animal care room: 940 ft^2

The greenhouse: 1785 ft^2

Research laboratories:
- Sci 234: (Drs. Mitchell, Adewusi, Buss & Boogaard): 527 ft^2
- Sci 233: (Dr. Strasser: 277 ft^2
- Sci 338: (Dr. Colvert): 358 ft^2
- Sci 201: (Dr. Hoerter): 360 ft^2
- Sci 229: (Drs. Watson & Murnik): 374 ft^2
- Sci 313: (Dr. Shetty): 266 ft^2

B. EQUIPMENT SURVEY:

ITEM	QUANTITY
TEMPERATURE CONTROL	
Incubator 4 cu ft.	2
hybridization incubator	1
Plant Tissue Incubator	1
Plant Cold storage	1
CO_2 incubator	1
Large water bath	1
Small water baths	6
Freezer (-20° C)	3
Refrigerator (4 °C)	3
Freezer (-70° C)	1
SAMPLE ID AND SEPARATION	
FTIR Spectrometer	2
Atomic Absorption Spectrometer	1
Gas Chromatograph	4
Gas Chromatograph Detector, UV-vis	1
Gas Chromatograph Detector, UV	2
Gas Chromatograph Detector, Ion	1
Gas Chromatograph Detector, Refractometer	1
Gas Chromatograph Detector, Fluorescence	1
HPLC w/UV/fluor. detection: photodiode array detection/ gradient	2
ELECTROPHORESIS	
2-D isoeletric focusing system	1
Large Horizontal Gel Apparatus	3
Medium Horizontal Gel Apparatus	3
Small Horizontal Gel Apparatus	15
Sequencing Gel Apparatus	1
Immunoelectrophoresis Gel Apparatus	1
Tube Gel Electrophoresis Apparatus	1
Western Blot Chambers	4
Large Vertical Gel Electrophoresis Apparatus	4
Small Vertical Gel Electrophoresis Apparatus	8
High Volt Power Supply	2
Small Power Supplies	6

BALANCES	
Large Capacity Balance	1
Medium Capacity Balance	1
Analytical Balance	1
CENTRIFUGES	
Microcentrifuges	2
Sorvall prep Centrifuge	1
Ultracentrifuge	1
Clinical Centrifuge	2
MISC.	
Orbital Shaker	2
Transluminator	1
Land Camera	1
Inverted Scope	2
Biohazard (Vertical) Laminar Flow Tissue Culture Hood	2
Horizontal Laminar Flow (Plant) Tissue Culture Hood	2
Spectrophotometers	4
Ice Maker	2
MilliQ Water Maker	1
Pipette Aids (12)	12
Small Light Box	1
Large Light Box	1
pH Meters(2)	2
Stir/Hot Plates (6)	6
Vortex Mixers (4)	4
Blender	1
Peristaltic Pumps	2
Microwave	1
Homogenization Motor	1
Lyophilizer	1
Gel Dryer	1
Fraction Collector	4
Autoclave	2
Dishwasher	2
X-Ray Film Cassette Large	1
X-Ray Film Cassette Small	4
X Ray Film Development Machine	1
Scintillation Counter	1
Hybridization Bag Sealer	2
Evaporating Centrifuge	1
ELISA Plate Reader	1

ELISA Plate Washer	1
PCR Thermal Cycler	1
Scanner	1
Halogen Lamp	
Dynamil	1
IBM Compatible Computer	3
Macintosh Computer	1
Sonicator	1
Pipettors/adjustable, range of volumes	35

FACILITIES AND EQUIPMENT EVALUATION:

Progress is being made on solving the leaking ceilings. Generally the difficulties are less severe than at the time of the last review but it is an ongoing issue for the entire building but it is being dealt with.

The facilities and equipment supporting the program have been sufficient for the needs of the program but many high use (and high cost) items are reaching the end of their life span. The major concern is the on-going need for a repair and replacement budget for such equipment. This becomes an even greater issue in the face of increasing enrollment in introductory courses (CHEM 332). Currently these needs are being met as budgets allow. Both the Biology Department and the Physical Sciences department have improved the holdings for courses that support the program throug donations and by targeting funds specifically for use in the Biotechnology/Biochemistry labs to address the more pressing needs. Work and storage space is being tested by the increasing numbers as well. The Administration has been very helpful in one-time funding (including a new spectrophotometer) but a baseline budget is needed. The program review panel, in consultation with the internal advisory committee, believes that creative management will address most of these concerns and will allow the program to continue to function without loss of quality. It is hoped however that administrative support for equipment budgets will continue and increase.

Section 4: Biotechnology Enrollment Trends

Dr. Roger Mitchell 4/22/04

INTRODUCTION

The purpose of this document is to provide an overview of enrolment in the Ferris State University Bachelor of Science degree in Biotechnology. The source data was gathered into a single document by the Department of Biological Sciences office. The data set covers the period from the Summer 1997 semester until the present semester, Winter 2004. Here the data are analyzed in a number of ways, and some brief conclusions have been made.

RESULTS, PART ONE: OVERALL ENROLMENT TRENDS

The total enrolment in the biotechnology program has shown a gradual increase over the last 7 years (see Figure 1). These numbers include both biotechnology (upper-classmen) and pre-biotechnology students.

Figure 1: Total Program Enrolment Over Time

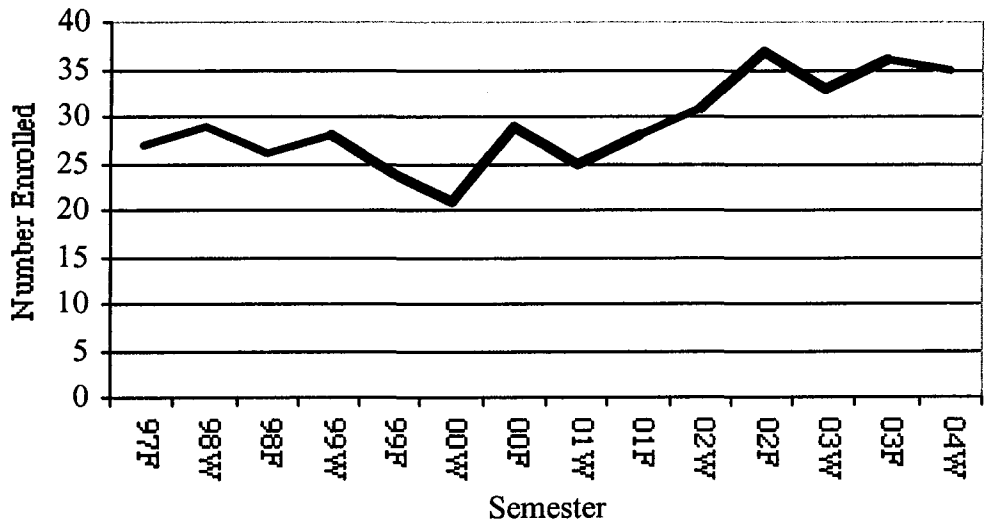
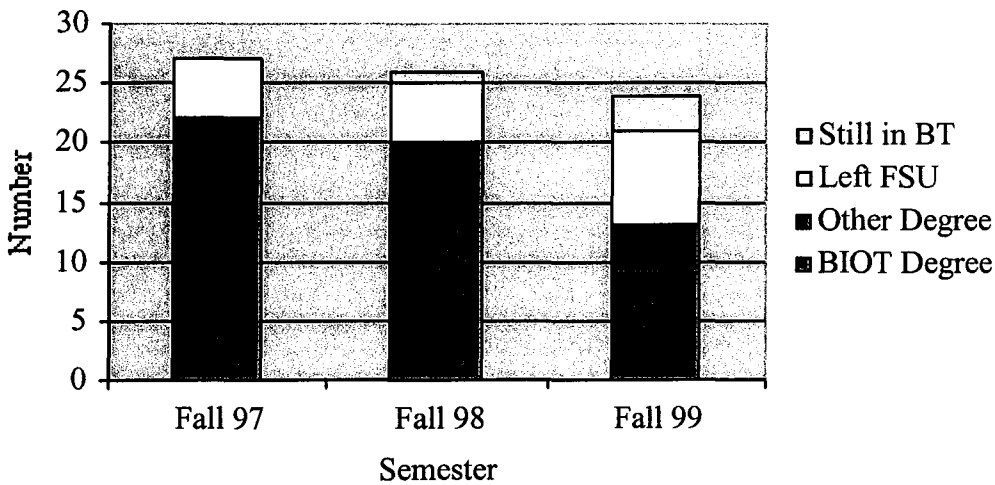


Figure 1 legend: The total official enrolment in the biotechnology program is graphed against semester for seven years. Summer semesters have been excluded.

RESULTS, PART TWO: OUTCOME OF ENROLMENT

Graduation from with a B.S. in biotechnology is only one possible outcome of enrolment in the biotechnology program. Some students elect to transfer to another program at Ferris State University to continue their education, while others leave the university altogether. Figure 2 indicates the eventual outcome for all students enrolled in the program during each of the first three fall semesters in the data set ('97, '98, '99). Only early years are shown because the accuracy of the analysis drops rapidly as the number of students still in the program increases. The number of students who were enrolled in the fall of 2000 who are still in the program is ten, an excessive number. Obviously, the outcomes for the students currently enrolled in the biotechnology program are not yet known. This is especially important since transferring to a new major, or dropping out of the university, can come early in a student's career, while graduating with a biotechnology degree can only come at the end of a lengthy period. This artificially decreases the apparent proportion of students graduating with the biotechnology degree in later years, even if current students were to be excluded from the analysis.

Figure 2: Final outcome of Enrolment for all Students Enrolled in the biotechnology Program as of Fall 1997, 1998, and 1999.



For those students who transferred out of the biotechnology program into other majors at Ferris State University, the identity of their new major is available, and presented here in Table 1.

Table 1: New Majors of Students Transferring Out of Biotechnology.

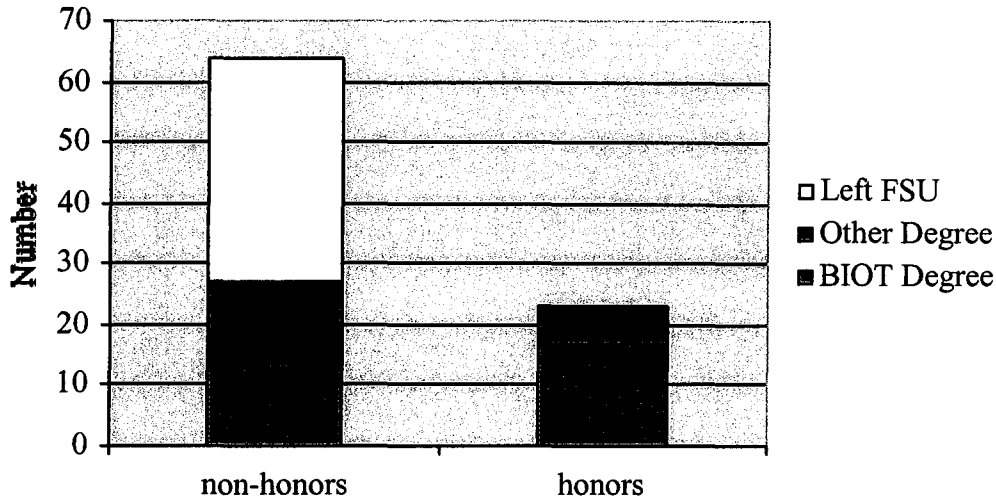
NEW MAJOR	Major Name	Number
INCT	industrial chemistry	6
MEDT	medical technician	5
APBI	applied biology	4
MLT	medical laboratory technology	3
BIED/RFIM	biology education/restaurant and food industry management	2
CHED	chemistry education	2
EHS	environmental health and safety management	2
ELED	elementary education	2
PHPR	pre-pharmacy	2
ABPT	applied biology, pre-physical therapy	1
ARCH	architectural technology	1
BIOL	biology BA	1
CIS	computer information systems	1
ENGL	English	1
HSM	health services management	1
MIM	music industry management	1
MSCJ	masters in criminal justice	1
NUCM/APBI	nuclear medicine technology/applied biology	1
OHT	ornamental horticulture technology	1
PCRJ	pre-criminal justice	1
PHAR	pharmacy	1
PHAR/AMTH	pharmacy/applied mathematics	1
TCOM/ENGL	technical and professional communication/English	1
Total		**42**

Legend for Table 1: New majors chosen by those students leaving the biotechnology major, but staying at Ferris State University from Summer 1997 through Winter 2004. Note that some students moved into a dual major. Subsequent changes in major, or graduation from any program, are not reflected.

RESULTS, PART THREE: CORRELATIONS

One factor that might act as a predictor for success in the biotechnology degree is membership in the honors program. To correlate this factor to outcomes, students still at Ferris State University were first excluded. Students were sorted into two categories: enrolled in the honors program, and not enrolled (see Figure 3).

Figure 3: Correlation Between Honors Program Enrolment and Biotechnology Enrolment Outcome.



Legend for Figure 3: All students enrolled in the biotechnology program from Summer 1997 through Winter 2004 were included in this analysis, after students who are currently still in the program were excluded.

RESULTS, PART FOUR: DROP-OUTS

Enrolment data was also examined to see when students who leave the biotechnology program do so. The seven-year data set lists grades for most required courses. Furthermore, grades are only listed for those semesters in which a student was initially enrolled in the biotechnology program. Students may have dropped out of the program either during or directly after the last recorded semester. This is useful, since some course requirements are shared with other programs, but they do not show up in the data set if taken after dropping out of the program. The challenge was that a student's official status as a freshman, sophomore, and so on, does not necessarily reflect his or her actual progress in the program. Changes in major and transfers into Ferris State University often inflate the number of credits a student has, for example. For this reason, the following was done: Certain courses were chosen as indicators for each level in the program, expressed in terms of when the courses are most typically taken. To increase accuracy, those required courses that different students may take at very different stages of their education were excluded. This included all math, English, and physics courses as well as several in biology. It is still true that some students took even these classes in an unusual order, but the courses are still indicative of the attainment of certain levels in the program. Additionally, students often took only one or two courses at the highest level that they reached. Table 2 lists the indicator courses that were used and the level that they indicate.

Table 2: Required courses in the biotechnology that were used as indicators of the progress of students.

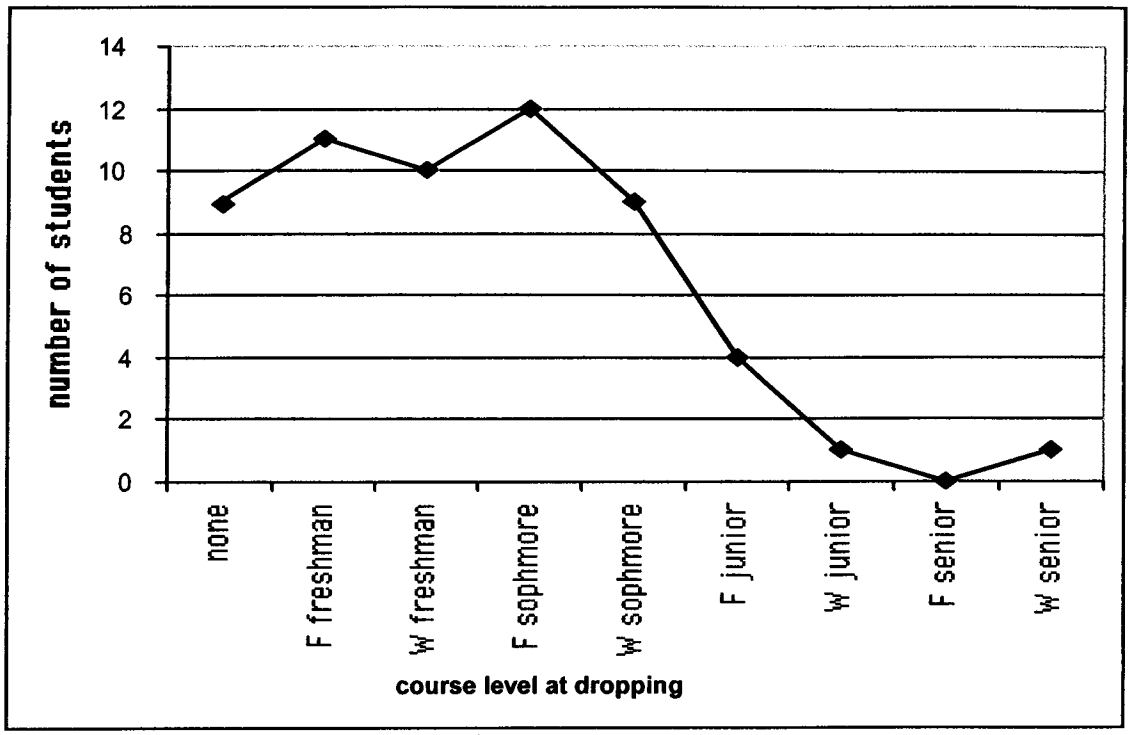
COURSE NUMBER	COURSE TITLE	USED AS AN INDICATOR OF
BIOL 121	General Biology 1	F freshman
CHEM. 121	General Chemistry 1	F freshman
[redacted]		
BIOL 231/321	Human Physiology And Anatomy 1	F sophomore
CHEM. 221/321	Organic Chemistry 1	F sophomore
CHEM. 231	Quantitative Analysis	F sophomore
[redacted]		
CHEM. 364	Biochemistry [Lecture]	F junior
CHEM. 332	Biochemistry Lab 1	F junior
[redacted]		
BIOL 388	Advanced Immunology Laboratory	F senior
BIOL 473	Biotech 3: Proteins Laboratory	F senior
BIOL 474	Advanced Cell And Molecular Biology [lecture]	F senior
[redacted]		

Legend for Table 2: F = Fall semester, W = Winter semester. Courses with double numbers: "2XX/3XX" had their numbers changed during the period examined. The semesters during which biotechnology majors took those classes was not altered.

Students transferring to a new degree at Ferris State University and those leaving the university altogether were pooled to yield all students who left the program during the seven-year period analyzed. A student was considered to have reached a particular level as long as she or he took at least one of the courses indicative of that level. Indicator courses were counted without regard to grades, and withdrawal was also counted.

The number of students dropping out of the biotechnology program after reaching each level in the program is graphed in Figure 4. Note that some students entered the program, but never took any of the indicator courses before dropping out.

Figure 4: last semester of biotechnology dropouts



Legend for Figure 4: Number of students initially enrolled in the biotechnology program who dropped after the semester indicated. "None" indicates students who enrolled in the program, but dropped before taking any of the indicator classes.

It was also possible to examine the grades that each student received at the maximum level to which they advanced. The same list of indicator courses was used (see Table 2). In this way, other classes that may have been taken during the actual semester in question, but would be less informative, are omitted. The omitted classes would include courses not specifically required for the program, and courses usually taken at a lower level.

Table 3: Biotechnology students' average GPA in the highest level of indicator courses for which they were enrolled.

GPA range	number
0 - 0.49	10
0.5 - 0.99	3
1 - 1.49	3
1.5 - 1.99	4
2 - 2.49	8
2.5 - 2.99	2
3 - 3.49	3
3.5 - 3.99	2
4 - 4	2

Legend for table 3: For each student who took at least one course on the list in Table 2, and later dropped out of the biotechnology program, their highest equivalent level was determined. Their GPA was calculated by averaging all of the

indicator courses that they took at that level. A course withdrawal was counted as a zero.

The average GPA during the last semester before students left the program was 1.377568, just above a D+.

CONCLUSIONS

Several conclusions can be reached from the preceding data analysis.

1) The number of students in the biotechnology program has shown a modest increase with time. Enrolment in the Fall of 1997 was 27, while the Fall 03 enrolment was 36, a 33% increase. The stability of the enrolment numbers, revealed in Figure 1, supports the idea that this increase is a genuine trend.

2) Many students who drop out of the biotechnology program remain at Ferris State University (see Figure 2). The new majors of former biotechnology majors cover the entire spectrum of university offerings, with a concentration in natural science (Biology and Chemistry)-related fields (see Table 1).

3) Membership in the honors program clearly increases the probability that a student will both remain at Ferris State University and graduate with a biotechnology degree (Figure 3).

4) Anecdotal evidence, supplied to instructors and advisors in the program, has always indicated that the main reason students leave the program is its academic rigor. The results here strongly support this hypothesis, since: 1) students continue to drop the program at about the same level in their sophomore as in their freshman year (see Figure 4) and, 2) The GPA in indicator courses for students just before withdrawing form the program was only 1.38 (see Table 3).

RECOMMENDATIONS BASED ON CONCLUSIONS

These recommendations are based on the corresponding conclusions above.

1) Since the biotechnology program has shown a modest enrolment increase in the past seven years, it seems safe to conclude that the biotechnology program represents a good continuing use of resources. The high dropout rate in the program seems to be due to its academic rigor. This suggests that untargeted recruitment, such as faculty visits to high schools, is unlikely to succeed at further increasing the number of graduates from the program. On the other hand, an intensified effort by the university's recruitment staff would probably be well rewarded, if the need to target the most academically serious students is kept in mind.

2) Any evaluation of the biotechnology program's beneficial effect on Ferris State University recruitment must include both students remaining in the biotechnology program and those who remain at the university in other programs. It must also be remembered that the presence of such an academically rigorous program

increases the stature of the university as a whole, although data analysis is unlikely to be able to demonstrate this factor.

3) The data relating to retention of honors students suggests that an expansion of recruitment efforts among future and current honors students would be particularly beneficial to the program and university. One possibility might be to occasionally allow biotechnology faculty to meet directly with honors candidates or current students to explain and promote the program. Some honors students who have transferred out of the program into other Ferris State University programs have indicated that the GPA requirement of the honors program played a part in their decisions. They felt that they could get grades high enough in our courses to remain in biotechnology, but not high enough to remain in honors. The data showing biotechnology's successful retention of honors students suggests that this is not a frequent occurrence, and therefore not a matter for concern.

4) The biotechnology program was always intended to be academically rigorous. This has proven critically important to our graduates because it improves the program's reputation. It also allows our graduates to effectively pursue a range of options after graduation. These include lab technician, graduate student, and medical student. Although we would obviously like to keep more of our students, it would not make sense to do so by weakening the program. Once again, the program will grow only if more students who have the ability to excel are recruited. It is also worth noting that few students leave the program after starting their junior courses. This speaks well for these classes, which are often even more rigorous than the more general courses taken by students during their first two years in the program.

Section 5: Administrative Program Review

ADMINISTRATIVE PROGRAM REVIEW 2003

Program/Department: **BIOTECHNOLOGY**

Enrollment

	Fall 1999	Fall 2000	Fall 2001	Fall 2002	Fall 2003
Tenure Track FTE	1.57	1.57	1.57	1.57	1.57
Overload/Supplemental FTEF	1.0	.69	.69	.69	.69
Adjunct/Clinical FTEF (unpaid)					
Enrollment on-campus total*	24	29	27	38	36
Freshman	5	7	7	11	
Sophomore	7	9	10	9	
Junior	4	2	2	9	
Senior	8	9	9	9	5
Masters					
Doctoral					
Pre-Professional Students					
Enrollment off-campus*					
Traverse City					
Grand Rapids					
Southwest					
Southeast					

*Use official count (7-day)

If there has been a change in enrollment, explain why:

Capacity:

Estimate program capacity considering current number of faculty, laboratory capacity, current equipment, and current levels of S&E. 48 total or 12 in each class.What factors limit capacity? The availability of instrumentation and S & E.

What factors limit program capacity? The only limitation would be FTE faculty which would limited the number of sections that could be offered.

Financial

Expenditures*	FY 00	FY 01	FY02	FY03	FY04
Supply & Expense	$13,500	$14,649	$12,293	$14,495	$13,778
Faculty Prof. Development					
General Fund					
Non-General Fund					
UCEL Incentives					
Equipment					
Voc. Ed. Funds					
General Fund		$6,534		$4,350	
In-Kind					
Non-General Fund					
UCEL Incentives					

Revenues	FY99	FY 00	FY01	FY02	FY04		
Net Clinic Revenue							
Scholarship Donations							
Gifts, Grants, Cash Donations							
Endowment Earnings							
Institute Program/Services							
In-kind							

Other

	AY 98/99	AY 99/00	AY 00/01	AY 01-02	AY 02-03	AY 03-04
Number of Graduates* - Total	7	3	3	4	6	5
- On campus	6	5	6	4	6	5
- Off campus						
Placement of Graduates	6	5	6	4	6	5
Average Starting Salary	$31,600	$34,500	$36,600	$32,480	$28,569	
Productivity - Academic Year Average						
- Summer						
Summer Enrollment	5	4	5	4	5	5

* Use total for full year (S, F, W)

1. a) Areas of Strength:

- Biotechnology is a mega-growth industry (more than 30% per annum) in the United States and Canada, with rapidly expanding global markets.
- Strong and expanding ties through internships with the expanding Michigan biotechnology industry.
- Recently renovated laboratories and state-of-the-art instrumentation.
- One of the few undergraduate programs in the U.S..
- Growing biotechnology/research industry in Grand Rapids (Van Andel Research Institute)
- High placement rate of graduates into the biotechnology industry (100%).
- Monetary program support by the biotechnology industry
- Completion of National Genome Project has now opened up many career opportunities
- Increased emphasis on anti-bioterrorism research and forensics increases student interest in program

b) Areas of Concern and Proposed Action to Address Them:

- Low enrollment in upper-division courses; revert to alternate year offerings in some courses
- Number of students enrolled in program; increase to 12 per class through recruitment/visibility activities such as high school biotech workshops, summer scholars program and teacher outreach activities (web page teacher resources. Much progress has been made in this area through workshops.
- Keeping instrumentation state-of-the-art; establish annual equipment replacement budget
- High cost of summer internships; create tuition scholarships.
- Attrition rate among freshman and sophomores; establish linkages with community colleges to attract more and better prepared junior transfer students; work with honors program to attract better prepared students.

2. Future goals (please give time frame)

- Continue and expand biotechnology workshops for high school students
- Visit Michigan community colleges and department heads; invite select department heads to FSU campus
- Enhance web page for biotechnology program
- Continue developing articulation agreements with 2-yr community college biotech programs
- Continue to correlate recruitment activities with the Honors Program

3. Other Recommendations:

- Allocate funds to support recruitment activities
- Establish endowment fund for internship scholarships
- Allocate resources for equipment replacement on an annual basis.

4. Does the program have an advisory committee?

a) If yes, when did it last meet? Yes, Winter 2001

b) If no, why not? Program coordinator was on sabbatical leave. By what other means do faculty receive advice from employers and outside professionals?

c) When were new members last appointed? Last year.

d) Are there non-alumni/ae on the committee? How many? Five scientists on the committee are not graduates

5. Does the program have an internship or other cooperative or experiential learning course?

a) If yes, is the internship required or recommended? Required

b) If no, what is the reason for not requiring such an experience?

6. Does the program offer courses through the web?

a) web-based (fully delivered through the internet) courses the program offered last year? No.

b) Please list the web-assisted (e.g., WebCT) courses the program offered last year.

7. What is unique about this program?

a) This program has national recognition by the National Science Foundation. It was awarded a renovation grant ($233,000) in 1997 based on its quality, mission and potential to serve the growing biotech industry. This program is also recognized by BioLink, a national organization that is linking community and 4-yr programs in biotech across the nation. Because of its emphasis on intensive hands-on laboratory training, the program is one of the best in the nation.

b) What are some strategies that could lead to (greater) recognition? Increased emphasis on news releases about our graduates and accomplishments; improved website

8 Is the program accredited? No, there is no official accrediting agency

9. Major achievements by students/graduates of the program?

10. Questions about Program Outcomes Assessment (attach additional sheets, if necessary):

a) What are the program's learning outcomes?

- Overall understanding of biological and chemical concepts relevant to biotechnology
- Acquire lab skills required to function effectively in a biotechnology lab

- Development of critical and analytical thinking skills in a laboratory setting

b) What assessment measures are used, both direct and indirect?

- Direct observation in laboratory setting
- Evaluation of research notebooks
- Lab presentations, oral reports and lab exams
- Course grades and assignments
- Internship evaluation and reports by supervisors
- Evaluation of graduates by supervisors

c) What are the standards for assessment results?

- Laboratory protocol standards
- Research notebook requirements in industry
- Laboratory requirements in industry for research performance

d) What were the assessment results for 2002-03?

Evaluation of reports, notebooks, and research internships, and supervisor reports on graduates indicate that the program is preparing students well for positions in the biotechnology industry.

e) How will / how have the results been used for pedagogical or curricular change?

Reports from internship supervisors are used to improve the curriculum to better reflect the needs of industry.

11. Questions about Course Outcomes Assessment:

a) Do all multi-sectioned courses have common outcomes?

Yes, all multiple sections of a single course focus on a common set of course objectives and outcomes.

b) If not, how do you plan to address discrepancies?

c) Do you keep all course syllabi on file in a central location? Yes

*If you have questions about the outcomes assessment portions of this survey, please contact Laurie Chesley (x2713).

Form Completed by Jim Hoerter, Biological Sciences Department Head
Name and Title

Reviewed by Dean_____
Name and Date

Section 6: Curriculum Review

The purpose of the Biotechnology Program is to prepare students not only to work in biotechnology environments but to be prepared to adapt to changing technologies. The curriculum was developed to provide the fundamental principles and laboratory skills needed to work in Biotechnology. It was also designed to foster a strong work ethic, cooperative laboratory behaviors and the ability to take direction as well as to work independently. The need for strong communication skills were also recognized.

The stated goals and objectives of the program are as follows:

GOALS:

1. To increase student understanding of basic biological and chemical principles, and to increase student knowledge in basic areas of biology and chemistry.
2. To increase student ability in carrying out such technical skills as:
   a. careful observation
   b. attention to detail
   c. record keeping and documentation
   d. relevant calculations
   e. taking direction
3. To increase student understanding of the basic areas of biotechnology.
4. To increase student awareness of, or ability in carrying out, such advanced technical skills as:
   a. data manipulation and interpretation
   b. experimental design with proper controls
   c. combination of several techniques into a reasonable sequence
   d. coordination of several projects for the maximum utilization of time.
   e. following instructions at an intermediate to advanced level of difficulty, such as those found in research lab manuals and in technical literature supplied by product manufacturers.
5. To increase student awareness of the career opportunities in biotechnology.

OBJECTIVES:

1. To develop educational strategies designed to enhance the ability to think critically about scientific questions.
2. To develop educational experiences designed to increase the ability to function in a biotechnology laboratory.
3. To encourage student-faculty discussions about specific career opportunities in biotechnology.
4. To provide opportunities to observe biotechnology laboratories directly.

The courses in the curriculum below are evaluated with respect to these goals with the appropriate letter and number indicating which the course fulfills.

The Curriculum

COMM 121 Fundamentals of Public Speaking Max credits: 3

Training and experience in preparation and delivery of short speeches with emphasis on the clear, concise, logical communication of ideas. Emphasis will be placed on informative and persuasive speaking. **G 2c**

BIOL 121 General Biology 1 *Z Max credits: 4

The first semester of a year-long sequence in introductory biology designed for the science major and as a prerequisite for advanced biology courses. The topics include an introduction to scientific thinking, ecology, Mendelian genetics, evolution, and the diversity of the biological kingdoms, with concentrated study of cell theory and cell structure, the Monera, Protista, Fungi and Plantae. Laboratory exercises are designed to enhance the lecture material with hands-on experiences. Designed for students in science baccalaureate degree programs. This course meets General Education requirements: Scientific Understanding, Lab. **G 1,2,3 O 1**

Requires: CHEM 121 or CHEM 114

BIOL 122 General Biology 2 *Z Max credits: 4

The second semester of a year-long sequence in introductory biology. The topics covered include the kingdom Animalia (Invertebrates, vertebrates, embryology, Homeostasis, and behavior), biomolecules, and cell endrgetics (enzyme function, respiration and photosynthesis), and molecular genetics (gene expression, mutation, recombination, and genetic engineering). Laboratory exercises are designed to enhance the lecture material with hands-on experiences. Designed for students in science baccalaureate programs. This course meets General Education requirements: Scientific Understanding, Lab. **G 1,2,3 O 1**

Requires: BIOL 121 and CHEM 121

BIOL 321 Human Physiology and Anatomy 1*Z Max credits: 4

First of two semesters of a comprehensive, integrated course in anatomy-physiology, developing logical correlations between structures and their functions with emphasis on the molecular and cellular basis of organ system structure and function. Topics: cell physiology; control mechanisms; nervous, muscle, and endocrine systems. Laboratories include cadavers in anatomical studies and animal experimentation demonstrating physiological principles. Designed for students in science baccalaureate degree programs.

Requires: BIOL 121 & BIOL 122 & CHEM 122

BIOL 322 Human Physiology and Anatomy 2*Z Max credits: 4

Second of two semesters of a comprehensive, integrated course in anatomy-physiology developing logical correlations between structures and their function.

Topics: respiratory, digestive, metabolic, cardiovascular, excretory and reproductive systems. Designed for students in science baccalaureate degree programs. **G 1,2,3 O 1**

Requires: BIOL 321

CHEM 121 General Chemistry 1 *Z Max credits: 5

Fundamental principles, laws and theories of general chemistry, including stoichiometry, gas laws, thermochemistry, atomic structure, chemical bonding, periodicity, liquids and solids, solution chemistry, and theories of acids and bases. Concurrent laboratory/workshop sessions will include exercises illustrating the principles discussed in lecture. Students who anticipate enrolling in chemistry courses at the 200-level or higher should take this course. This course meets General Education requirements: Scientific Understanding, Lab. **G 1,2,3, 4 a,b O 1**

Requires: MATH 115 with grade of C- or better; ACT 24 or SAT 560; and CHEM 103 or year of high school chemistry

CHEM 122 General Chemistry 2 *Z Max credits: 5

Continuation of CHEM 121, including oxidation-reduction reactions, electrochemistry, chemical equilibrium, chemical kinetics, nuclear chemistry, thermodynamics, and descriptive chemistry of metals and nonmetals. Laboratory will involve some experiments illustrating topics discussed in lecture along with several sessions devoted to the qualitative analysis of common cations and anions. Is a prerequisite for most 200-level or higher classes in chemistry. This course meets General Education requirements: Scientific Understanding, Lab. **G 1,2,3, 4 a,b O 1**

Requires: MATH 115 with grade of C- or better; or ACT 24 or SAT 560; and CHEM 121 with grade of C- or better

CHEM 321 Organic Chemistry 1*Z Max credits: 5

Modern bonding theory in organic molecules, theory of reactions, stereochemical principles, chemistry of alkanes, cycloalkanes, alkenes, dienes, alkynes, aromatics, and alcohols, with special emphasis on reaction mechanisms. Concurrent laboratory includes basic laboratory techniques, synthesis, TLC and GC, stereochemistry and spectroscopy workshops. **G 1,2,3, 4 a,b O 1**

Requires: CHEM 122

CHEM 322 Organic Chemistry 2*Z Max credits: 5

Study of ethers and epoxides, carbonyl-containing compounds, aldehydes, ketones, carboxylic acids and their derivatives, carbanion chemistry, aliphatic and aromatic nitrogen-containing compounds, with special emphasis on bioorganic compounds, amino acids and polypeptides, carbohydrates and lipids. Concurrent laboratory includes multistep synthesis, spectroscopic analysis, and the systematic identification of organic compounds with emphasis on chemical separation and purification techniques. **G 1,2,3, 4 a,b O 1**

Requires: CHEM 321

Quantitative Analysis *Z Max credits: 4

Introduction to classical quantitative and modern instrumental methods of analysis, including data handling, statistics, volumetric and gravimetric techniques, potentiometry, spectroscopy, and liquid chromatography. Concurrent laboratory includes the topics referred to above. This course meets General Education requirements: Scientific Understanding, Lab. **G 1,2,3, 4 a,b O 1**

Requires: CHEM 122 with a grade of C- or better

MATH 130 Adv Algebra & Analytical Trig Max credits: 4

Quadratic equations, inequalities, straight lines, graphing equations, functions and inverse functions, exponential and logarithmic functions, trigonometry from an analytical point of view, sequences, mathematical induction, and the binomial theorem. **G 2d**

Requires: MATH 120 with a grade of C- or better, or 24 ACT or 560 SAT

PHYS 211 Introductory Physics 1*Z Max credits: 4

Basic concepts and applications of motion, force, energy, fluids, heat and sound. This course meets General Education requirements: Scientific Understanding, Lab. **G 1,2,3, 4 a,b O 1**

Requires: MATH 116 or 120 with a grade of C- or better or 26 ACT or 590 SAT

PHYS 212 Introductory Physics 2*Z Max credits: 4

Continuation of PHYS 211. Basic concepts and applications of electricity, magnetism, light and modern physics. This course meets General Education requirements: Scientific Understanding, Lab. **G 1,2,3, 4 a,b O 1**

Requires: PHYS 211 with a grade of C- or better

BIOL 370 Developmental Biology*Z Max credits: 4

A study of the fundamental principles of development and the mechanisms responsible. An examination of the morphological changes which occur during

development in vertebrates. Designed for students in science baccalaureate degree programs. This course meets General Education requirements: Scientific Understanding, Lab. **G 1,2,3, 4 a,b O 1**

Requires: BIOL 122

BIOL 375 Principles of Genetics*Z Max credits: 3

A comprehensive course in genetics including molecular aspects of gene structure, function, and control in prokaryotes and eukaryotes, transmission genetics and genes in populations. Designed for students in science baccalaureate programs. This course meets General Education requirements: Scientific Understanding. **G 1,2,3, 4 a,b O 1**

Requires: BIOL 122

Biotechnology 1: Tissue Culture Lab*Z Max credits: 2

Hands-on technical instruction in both animal and plant cell culture. The term is divided into two projects. Students prepare primary embryo explant cultures from rats, and learn to carry these cells in culture, stain the cell chromosomes, cryopreserve and recover cells from cryopreservation, among other techniques. The plant cell culture project involves establishing both callus and suspension cultures, and carrying out metabolite studies on these cultures. This course meets General Education requirements: Scientific Understanding, Lab. **G 3,4 O 1,2,3**

Requires: Biotechnology students only

BIOL 386 Microbiology & Immunology*Z Max credits: 5

Fundamentals of the microbial world with emphasis on the medical aspects of microbiology, molecular basis of pathogenicity, chemotherapy, and the role of humoral and cellular immune responses in host protection and hypersensitivity. The laboratory provides practical experiences with fundamental concepts, techniques and instrumentation. Designed for students in science baccalaureate degree programs. This course meets General Education requirements: Scientific Understanding, Lab. **G 1,2,3, 4 a,b O 1**

Requires: BIOL 232

BIOL 388 Advanced Immunology Laboratory*Z Max credits: 2

An experimental immunology laboratory with an emphasis on the problem-solving potential of immunoligical reagents and the maintenance of a research quality laboratory notebook. This course meets General Education requirements: Scientific Understanding, Lab. **G 3,4 O 1,2,3**

Requires: BIOL 386

BIOL 470 Molecular Genetics*Z Max credits: 4

An analysis of genetic phenomena at the molecular level. Topics include: structures of DNA, replication, recombination, mutation, repair, genomic

sequences, chromatin structure, transcription, processing, translation, and the theory of selected techniques. Emphasis is on regulatory mechanisms. This course meets General Education requirements: Scientific Understanding. **G 3,4 O 1,2,3**

Requires: CHEM 364 and BIOL 375

BIOL 471 Biotech 2: Recombinant DNA Lab*Z Max credits: 3

Practical training in recombinant DNA techniques. The term project includes tissue DNA isolation, restrictions, electrophoresis, and Southern transfer; plasmid (ultracentrifugal) DNA isolation; and restriction; isolation of cloned gamma crystallin gene; non-radioactive labelling of cloned insert; and hybridization to Southern transfer. RFLP analysis of genetic defect in blind rats. This course meets General Education requirements: Scientific Understanding, Lab. **G 3,4 O 1,2,3**

Requires: Corequisite: BIOL 470

BIOL 472 Proteins*Z Max credits: 3

The theory, molecular mechanisms, and practical aspects of the major techniques used in protein purification. Emphasis is placed on data interpretation and manipulation, trouble-shooting, and prediction of the impact of various errors on the data, for each technique. Included are: enzyme kinetics; buffer design; cell disruption; differential solubility; ion exchange, gel permeation, and affinity chromatography; ultracentrifugation; chromatofocusing; radioisotope use; PAGE; and IEF. This course meets General Education requirements: Scientific Understanding. **G 3,4 O 1,2,3**

Requires: CHEM 364 and BIOL 122

BIOL 473 Biotech 3: Proteins Laboratory*Z Max credits: 3

Hands-on practical experience in protein purification. Term project includes radioisotope training, enzyme assays, ammonium sulfate precipitation, ion exchange, ultracentrifugation, gel permeation chromatography, SDS-PAGE electrophoresis and other techniques. This course meets General Educaiton requirements: Scientific Understanding, Lab. **G 3,4 O 1,2,3**

Requires: Corequisite: BIOL 472

BIOL 474 Advanced Cell & Molecular Biology*Z Max credits: 3

Molecular biology of the cell, including basic genetic mechanisms, cell techniques, membranes and membrane components, cellular compartments, intracellular sorting, cytoskeleton, cell signalling, energy conversions, cell growth and division, differentiation, cell junctions, and others. This course meets General Education requirements: Scientific Understanding. **G 3,4 O 1,2,3**

Requires: CHEM 364 & BIOL 375

CHEM 332 Biochemistry Lab 1*Z Max credits: 2

Laboratory theory and techniques of biochemistry are introduced. Experiments focus on the application of photometry, chromatography, electrophoresis and activity assays to the isolation and analysis of biomolecules such as amino acids, proteins, enzymes and nucleic acids. This course meets General Education requirements: Scientific Understanding, Lab.

Requires: CHEM 222

CHEM 333 Biochemistry Lab 2*Z Max credits: 2

Biochemistry laboratory techniques and theory are continued. Experiments will include the isolation of sub-cellular systems such as chloroplasts, mitochondria and microsomes. The metabolic properties of these systems, including chemiosmotic coupling, electron transport and substrate preference will be examined. This course meets General Education requirements: Scientific Understanding, Lab. **G 3,4 O 1,2,3**

Requires: CHEM 332 and CHEM 364

CHEM 364 Biochemistry*Z Max credits: 4

A rigorous course in the chemistry of such biomolecules as amino acids, polypeptides, proteins and enzymes, carbohydrates, lipids and nucleic acids. The structure/function relationships of these biomolecules will be stressed and the biosynthetic and biodegradative pathways discussed. Credit will not be given for both CHEM 324 and CHEM 364. This course meets General Education requirements: Scientific Understanding. **G 1,2,3, 4 a,b O 1**

Requires: CHEM 322

CHEM 474 Advanced Biochemistry *Z Max credits: 3

Builds on the introduction to biochemistry presented in CHEM 364. Metabolism will be examined in greater detail, stressing mechanisms, regulation, and research implications. A significant component of the course is literature driven, requiring research, analysis, and discussion of current topics in biochemistry. This course meets General Education requirements: Scientific Understanding. **G 3,4 O 1,2,3**

Requires: CHEM 231 or CHEM 451; & CHEM 364 & BIOL 375

MATH 251 Statistics for the Life Sciences Max credits: 3

A first course in statistics, including a broad range of applications from science. Topics include: Data display, descriptive statistics, probability, estimation, inference, and regression. **G 2d O 4a**

Requires: MATH 130 with a grade of C- or better, or 26 ACT or 590 SAT

BIOL 491 Biotechnology Internship Max credits: 6

Direct laboratory experience in a biotechnology company carrying out research

projects to be assigned by that company. This course meets General Education requirements: Scientific Understanding. **G 4,5 O 3,4**

Requires: Biotechnology students only

Special Studies in CHEM

Special studies in chemistry, 400 level **G 4,5 O 3,4** Max credits: 4

The recommended course sequence has been as follows:

First Year		Second Year	
Fall	Winter	Fall	Winter
BIOL 121	BIOL 122	BIOL 321	BIOL 322
CHEM 121	CHEM 122	CHEM 321	CHEM 322
ENGL 150	MATH 130	CHEM 231	PHYS 211
COMM 105 or 121	CE elective	Soc.Aw. elec.	ENGL 250
15 hrs	16 hrs	16 hrs	BIO: 274
			17 hrs
Third Year		**Fourth Year**	
Fall	Winter	Fall	Winter
CHEM 364	BIOL 472	BIOL 379	BIOL 470
CHEM332	CHEM 333	BIOL 388	BIOL 471
PHYS 212	BIOL 370	BIOL 473	CHEM 474
BIOL 375	MATH 251	ENGL 311	Soc. Aw. elec
CE elective	BIOL 386	Soc. Aw. elec	CE elec.
16 hrs	17 hrs	16 hrs	16 hrs

While this has been an effective sequence pedagogically there are occasionally very small classes in the upper level courses. The Biotechnology Advisory Committee met to discuss the issues of low enrollment and have recommended some changes in the third and fourth year sequence that may increase productivity. Some courses were identified that could be taught to both juniors and senior and thus be offered on alternate years. A plan was developed to offer BIOL 388, BIOL 474, BIOL 470, and BIOL 471 in alternate years and implemented in Winter 2004. This required other adjustments to insure all students were able to take all required classes. The plan also involved the possibility of offering a re-focused BIOL 274 (Introduction to Biotechnology) in the freshman year as a motivational/recruiting class and to integrate Tissue Culture techniques into other laboratory courses or as independent study. The alternate year offerings are being conducted on a trial basis. It is important to note that this year the junior class is too large to accommodate in the winter semester Immunology lab and will thus require that it be offered in the next academic year as well. If the class size is maintained or even grows the plan will have to be revisited.

BIOL 474: Advanced Cell and Molecular Biology

Instructor: Dr. C. Boogaard
Office hours: M, W: 1-2; W, F: 10-11 **or by appointment**
Office: ASC 2116; phone: 591-2544.

Course Objectives: To increase the students' knowledge and understanding of:

1. the basic principles of cellular processes, organization, and growth
2. the nature and genesis of cell structures and organelles
3. the means by which cells move, and interact with each other
4. the theoretical basis of the techniques of cell culture

Pre-requisite: a minimum grade of C- in PHCH 320 or CHEM 364, and BIOL 375, or consent of instructor.

Textbook: Molecular Biology of the Cell, fourth edition; Alberts et al., Garland, 2002

Optional Material: **A lecture notes booklet with study guide included may be purchased at Great Lakes Book and Supply.**

Examinations and grading:

1. There will be 3 exams, each covering one third of the material.

2. The exam format is usually short-answer essay. However, problems will be introduced where appropriate. Some problems may be handed out before the exams to be completed as a take-home assignment and turned in at the exam time. Work turned in late will be docked a certain percentage per day.

3. There may be unannounced pop quizzes. These may be given on an extra-credit basis. There will be no make-up quizzes.

4. Extra-credit points may be assigned for insightful classroom participation.

Lecture and Exam schedule:

The following is a tentative schedule of topics to be included in the lectures, and of the exams. This is a tentative schedule only. The instructor reserves the right to change the order or length of time spent on each topic, as need arises.

The dates of the exams may be changed according to the wishes of the class, subject to the approval of the instructor. However, no exam will be delayed longer than two weeks.

	Date	Topic	Text
Cell Evolution:			
Tues.	Aug. 26	Evolution of the Cell, Cells and Genomes	Chapter 1
Thur.	Aug. 28	Cell Culture	handout
Tues.	Sept. 2	How Cells Read the Genome	Chapter 6
Basic Genetic Mechanisms:			
Thur.	Sep. 4	Control of Gene Expression	Chapter 7
Tues.	Sep. 9	Control of Gene Expression	Chapter 7
Techniques:			
Thur.	Sep. 11	RFLP, Sequencing, PCR, and hybridomas	Chapter 8
Tues.	Sep. 16	Fusion Proteins, In vitro mutagenesis	Chapter 8
Thur.	Sep. 18	Transgenics, Membrane Lipids	Chapter 8,10
Membranes:			
Tues.	Sep. 23	Membrane Proteins; Membrane sidedness, fluidity	Chapter 10
Thur.	Sep. 25	Mechanisms of Transport	Chapter 10
Tues.	Sep. 30	Exam (Chapters 1,6,7,8)	
Thur.	Oct. 2	Gated Channels and the Neuromuscular Junction	Chapter 11
Tues.	Oct. 7	Grand Synaptic Potential &Long-Term Potentiation	Chapter 11
Thur.	Oct. 9	Receptors, Cell Markers, and Cell Junctions	Chapter 19
Identity and Maintenance of Cellular Compartments:			
Tues.	Oct. 14	Protein Sorting & Compartmentalization	Chapter 12
Thur.	Oct. 16	Nuclear and Mitochondrial Transport	Chapter 12
Tues.	Oct. 21	The Endoplasmic Reticulum	Chapter 13
Thur.	Oct. 23	Golgi, Lysosomes, and Cell Surface	Chapter 13
Tues.	Oct. 28	Vesicle Targeting	Chapter 13
Cell Signaling and Signal Transduction:			
Thur.	Oct. 30	Overview of Signaling Mechansims; Steroids	Chapter 15
Tues.	Nov. 4	Second messenger-based signaling: cAMP, IP_3 and DG	Chapter 15
Thur.	Nov. 6	Coordination of Signaling Mechanisms	Chapter 15
Energy Conversions:			
Tues.	Nov. 11	Mitochondria	Chapter 14
Thur.	Nov. 13	Test (Chapters 10, 11, 12, 13, 19	
Tues.	Nov. 18	Chloroplasts	Chapter 14
The Cytoskeleton:			
Thur.	Nov. 20	Intermediate Filaments; Actin Filaments	Chapter 16
Tues.	Nov. 25	Tubulin-based mictotubules	Chapter 16
Thur.	Nov. 27	Thanksgiving recess	
The Cell Cycle and Oncogenes:			
Tues.	Dec. 2	CellCycle and Programmed Cell Death	Chapter 17
Thur.	Dec. 4	Review or Oncogenes (Chapter 23)	
Tues.	Dec. 9	Final exam (Chapters 14, 15, 16, 17)	

SYLLABUS

Course: CHEM 364 Biochemistry 4 Cr
Prereq.: Completion of CHEM 322
Instructor: Dr. Kim K. Colvert ASC 3098 Office Hours: MTF 9-9:50 R 1-1:50
colvertk@ferris.edu (other times by appoint.)
Home 796-2058 (before 10 p.m.)
Ext. 5851

Text: "Essential Biochemistry,"Pratt and Cornely, Wiley Publishing. A scientific calculator is also required. Get used to checking the WebCT page and be sure you can access and use your Ferris e-mail.

Attendance: There is no specific penalty for absences however, in-class assignments cannot be made up. Late assignments will not be accepted. If possible, make arrangements for absences in advance. Excused absences must be documented . Special arrangements for excused absences must be made in person as soon as possible after return and no later than the day after return to class. You are responsible for obtaining notes, etc. from classmates or from the web page. Handouts will be available on the web page or from me if not posted there.

Being late isn't a good idea. Get up early. If you are late come in quietly and avoid disrupting the class.

Class Deportment: See ***Student Handbook***. We will strive to create a friendly, positive environment. If any of us happen to come into conflictthese concerns must be addressed outside of class. Try to remember that education is a two-way street. You cannot be magically endowed with knowledge; you must come prepared and strive for understanding both in and out of class. I am a facilitator not a programmer so I must come prepared to help you in that
process. There are two common questions I do not answer: 1) "Will this be on the test?" and 2) I'll never use this, why do I have to know it?" In the first case assume that if it is covered in class or in the assigned reading it is fair game for an exam. In the second case assume there is a reason even if it is not immediately apparent. If it is keeping you up nights, come and ask; I probably have an answer.

I'd rather you didn't eat in class and falling asleep could prove to be embarrassing.

Cheating : In a word, don't. See ***Student Handbook***. Penalty for a first offense will be a zero for that assignment. A second offense will result in failure of the course.

Grading: There will be four in-class exams worth 100 pts each. These exams will be part multiple choice and part short answer/essay/ problem combinations and will primarily test your ability to **apply** the specific knowledge you have accumulated rather than testing your ability to accumulate data. There will be a comprehensive final worth 100 pts. It is **not** optional. It can however replace your lowest test score and thus count twice. There will be approximately six group assignments or projects worth 20 pts. each. In addition there will be occasional computer/Internet assignments worth 5 pts each.

Grading Scale	Cutoff Grade
89%	A-
78%	B-
67%	C-
56%	D-

Exam Schedule:
Exams will begin at 7:45 a.m. (optional, it's a chance for more time)

Exam 1	Sept. 23
Exam 2	Oct. 18
Exam 3	Nov. 11
Exam 4	Dec. 9

Final Dec. 16 7:40-9:40 a.m.

Review Sessions: (locations to be announced)
Tuesday, September 21 5:30-7:30 p.m.
Sunday, October 17 2:00-4:00 p.m.
Tuesday, November 9 5:30-7:30 p.m.
Tuesday, December 7 5:30-7:30 p.m.

Class Format: Read the appropriate material before you come to class. The power point lectures will be available on the web site. I encourage you to listen and take notes to enhance your understanding. Work on processing the information in class and be ready to answer and ask questions. Questions are encouraged. Be sure that if you didn't understand something you weren't the only one. By the way, USE YOUR TEXT. There are some excellent reading lists at the end of the chapters and a nice selection of problems. Pay special attention to the problems. These will not be assigned for credit but you **must** do them as part of your study routine. Do the media exercises. Pay attention to the learning objectives, summaries, and other learning aids provided. Utilize the publishers web site. Try not to use the solutions in the back of the book until after you have made an effort. It is conceivable that I could draw exam problems or inspiration for exam problems from these sources when I make the exam. I will not necessarily cover everything in the text and I will have occasional extra information. Remember the rule of thumb for study time: you must spend two to three hours outside of class for every hour in class. Study groups are encouraged. You learn a lot by explaining to others.

Group Assignments: You will be divided into groups of four. Each group will consist of an Alpha, Beta, Gamma, and Delta. Some assignments will be carried out in class, some will require that you meet outside of class. One completed assignment will be submitted for each group. One member will be assigned the role of moderator. The moderator will rotate and be responsible for submitting the group's results. The moderator will collect signatures from each participant on the final draft of the assignment and turn in the results. The most important role of the moderator will be to ensure that each member of the team contributes. This may be accomplished in several ways depending on the project. For example, the project may lend itself to assigning portions of a problem to solve to present to the group. There may be "research" that will go faster if assigned to individuals. It may be as simple as being sure each person offers an opinion or point of view. After collecting

the signatures the moderator will write a comment on the division of labor. Note: these are NOT major projects. You should not have to meet more than once or maybe twice and will be due the second class period after they are assigned.

Tentative Timetable

Dates		Subject
8/30		Organization
8/31-9/3	(Ch. 1)	Introduction: Setting the Stage
9/7-10	(Ch. 2)	In an Aqueous Environment
9/13-21	(Ch. 4, 5)	It's Amino World
		Proteins: Structure and Function
		Proteins: In the Lab (expanded)
9/24-28	(Ch. 6)	Enzymes: How do they work?
9/28-10/1	(Ch. 7)	Enzymes: Kinetics
10/3-11	(extra mat)	Sugar (da da da da dit da) Ahhh, Honey,
Honey		
	(Ch. 8)	What Do You Mean It Won't Dissolve in
Water?		
		The Wall
		Breaching the Wall
10/12-15	(Ch. 9)	Bioenergetics: The Paths to Power
10/19-22	(Ch. 10)	Glycolysis: The Start of Something Big
10/25-29	(Ch. 11)	Round and Round We Go : The TCA Cycle
10/27-11/1	(Ch. 10)	The Rest of the Sugar Saga
11/2-11/9	(Ch. 12)	Where's the Beef?: Ox-Phos
11/12-15	(Ch. 14)	Butter Lovers Beware: The Catabolism of
Lipids		
11/16-22	(Ch. 15)	Nitrogen, Amino Acids, and You
		Interlude: Nucleotides
		Nucleotide Metabolism: A Scavenger's Tale
11/23	(Ch. 16)	Connections
11/29-12/7	(Ch. 3)	Tinker to Evers to Chance: The Central Dogma
		Nucleic Acids
	(Ch. 17)	Replication
	(Ch. 19)	Transcription
	(Ch. 3)	In the Lab: Sequencing 'N Stuff
	(Ch. 20)	Translation

Biochemistry Laboratory CHEM 332 Fall '03

Instructor: Dr. Kim K. Colvert Office: ASC 3098
Hours: MTF 9-9:50 R 1-1:50(or by appt.)

Textbook: Boyer, "Modern Experimental Biochemistry", Addison-Wesley, supplemental material will be provided.
Supplies: Gridded notebook with perforated carbon sheets, goggles, metric straight edge, graph paper (no larger than 10 divisions/in.), calculator (suggest a scientific), flexicurve (optional)

Grading: Grades will be based on as many lab reports as we complete, written as described in the following pages. Over the course of the term you must keep a notebook that documents everything you do. The carbon copies will be collected upon completion of an experiment for examination. There will be a final exam during the last laboratory period. All assignments are worth 100 pts, even if they take more than one lab period.
Absences/Make up Labs: There will be no make-up labs. Absence from lecture will not be counted against you but will be to your disadvantage. Absence from a lab which requires more than one lab period will result in a proportionate deduction. For example, if a lab requires 2 lab periods and you miss one you may obtain the data from your partner but 20% will automatically be deducted from the completed report. If you miss a lab that only requires one period an excused absence might be negotiated if the reasons are fully documented. Missing three labs for any reason will result in failure of the course.

LAB NOTEBOOKS AND REPORTS

Each of you will be required to keep a lab notebook in which you will record all the information necessary to write a report. It is a running account of everything done in an experiment—the procedure (suggested and what you actually did) errors, accidents, the conditions of the experiment, the data collected, the calculations, notes to yourself, lecture notes, literature references, errors and so on. For your own sake, it should include a table of contents and therefore each experiment should be titled and the pages numbered. It will not be graded but will be periodically checked. It is like a diary in many ways. You ought to be able to go back to your notebook, even years later, and know exactly what you did and why you did it. Theoretically, if you were to die, a fellow scientist could reconstruct your research from your notebooks.
It is helpful to prepare tables in advance for any data you need to collect so it is labeled and ready to fill in as you take your measurements. As you work record observations, any stray thought or question and any helpful hints you might receive. When you get ready to finish your report your notebook should have all the necessary data and maybe even a few ideas that will help with the discussion. Whatever you do don't take your data down on the odd piece of paper thinking you will enter it in your notebook later. Neatness is important, you must be able to tell exactly what each piece of data is. If you get sloppy you might not know what information to use where in your write- up.

Format for a report

TITLE PAGE

TITLE
NAME
DATE

INTRODUCTION: The introduction should not be more than a page or so long and should be in your own words. No cut and paste allowed. Strive for concise statements of only the pertinent information. It should include any specific background information necessary for a general understanding of the theories, procedures, techniques and calculations necessary for the successful completion of the experiment and report. Focus on what was actually done, don't reinvent the wheel. Any given data or literature values should be included here. It should not be detailed as to procedure but a general statement of the objective(s) without procedural details is necessary.

PROCEDURE: The procedure section pertains to what is done during the laboratory period. Do not copy the procedure handout or from the book. Distill the method provided down to a page or so of concise directions. Try to convey the necessary information in as few words as possible. When appropriate, a table or tables may be used to clearly show reagents, amounts, dilution factors, times, etc. Try to use passive, past tense

Ex. "I will then add some ammonium sulfate to the solution," is incomplete and incorrectly phrased

"Two milliliters of 0.3 M ammonium sulfate was added to one liter of the protein solution," provides much more information and avoids the use of 'I' and 'some'.

DATA: The data section should include tables and/or graphs of RAW DATA obtained from direct observation or with the aid of instruments. Some examples of raw data are colors, absorbances, pHs, degrees of observed rotation, chromatograms, measured distances, etc. Once a measurement or observation is manipulated (for example, by calculation, graphing) it is no longer RAW DATA but becomes results. ALL tables should be titled. They should have labels that can be understood by the casual reader. All raw data should be clearly and succinctly identified, whether machine recorded or experimenter recorded.

CALCULATIONS: The calculation section should include any mathematical formulas used to handle the data to obtain results. Define the formula, state the formula then show a set-up using actual experimental data. Repetitive use of the same formula using different data is unnecessary. One sample will do in this section. If more than one number is generated by the same calculation usually these numbers are presented in graphical or tabular form in the results section. The proper use of standard mathematical manipulations and symbols is expected.

RESULTS: The results of the experiment should be presented in a clear and concise form. Each type of data or manipulated data should be presented, whether in tables, graphs or smoothly integrated prose. For instance, suppose that you are asked in the analysis section to plot the absorbance of a solution as a function of time. You would make the graph, label it appropriately with a figure number and then discuss what the graph shows and to a limited extent what trend or principle it illustrates. You would use a phrase like "As can be seen in Figure 6 the rate of the reaction exhibited a maximum at pH 7.2.

DISCUSSION: In this section the individual observations from the results are integrated. This should include a comparison of the expected results (from text or literature or lecture) with your experimental results, whether favorable or unfavorable, and an explanation. This is where you prove you understood the principles enumerated in the introduction and relate them to the actual observations you have made. For example, if your results were as above the discussion might include a statement like "The optimum pH for the activity of the enzyme suggests that at least two amino acids are being titrated as the pH is changed. Protonation of one would be favored coupled with deprotonation of a second." This is where separate pieces of data are brought together to make a big picture (if that is part of the experiment).

General statements of conclusions go in this section. This section is also heavily weighted in the grading, along with the results and introduction.

LITERATURE CITED: Any references you used for literature values or other information should be listed in any accepted style.

General directions for writing the report.

1) The writing should be well constructed, concise and scientific,

2) all experimental work is to be reported thoroughly and accurately,

3) the report should not have to be reread to 'figure out' what the writer means,

4) the report, written in the passive mode, should be free of mechanical errors

5) For the first semester the report may be written in ink but you should try to produce them on a computer. For the second semester computer generated reports will be required. I have no preference as to the software so you may use what is familiar to you but you should have access to a versatile graphing program and a word processing program that can handle chemical symbols and integrate tables.

6) When it is not appropriate to use computer-generated graphs they should be done on standard graph paper with 20 squares to the inch. They must conform to the following format:
   a. *margins free of any writing*
   b. *a suitable and descriptive title*
   c. *x-axis (independent variable) label and units*
   d. *y-axis (dependent variable) label and units*
   e. *both axes conveniently and correctly scaled*
   f. *data points plotted clearly and precisely*
   g. *smooth curves or straight lines drawn when appropriate.*
   h. *one idea per graph (may be more than one line, however)*
   i. *neat and pleasing appearance*

Biochemistry Laboratory CHEM 333

Instructor: Dr. Kim K. Colvert Office: ASC 3098
Hours: MWF 11-11:50 W 2-2:50(or by appt.)

Textbook: Boyer, "Modern Experimental Biochemistry", Addison-Wesley, supplemental material will be provided.

Supplies: Gridded notebook with perforated carbon sheets, goggles, metric straight edge, graph paper (no larger than 10 divisions/in.), calculator (suggest a scientific), flexicurve (optional).

Grading: Grades will be based on as many lab reports as we complete, written as described below. Over the course of the term you must keep a notebook that documents everything you do. The carbon copies will be collected upon completion of an experiment for examination. There will be a final exam during the last laboratory period. All assignments are worth 100 pts, even if they take more than one lab period.

Absences/Make up Labs: There will be no make-up labs. Absence from lecture will not be counted against you but will be to your disadvantage. Absence from a lab which requires more than one lab period will result in a proportionate deduction. For example, if a lab requires 2 lab periods and you miss one you may obtain the data from your partner but 20% will automatically be deducted from the completed report. If you miss a lab that only requires one period an excused absence might be negotiated if the reasons are fully documented. Missing three labs for any reason will result in failure of the course.

The Lab Report

A streamlined version of 332 will be required. You will take notes, look up literature values, record all data and do calculations in the notebook. I will require the analysis portion only to be formally prepared. This will include all graphs, results tables or individual values and so on. Each must be presented and analyzed then evaluated with respect to the other results. You will turn in the carbon copy of your notebook and the analysis the week after completion of the experiment. Your notebook MUST be well-labeled, legible and complete--including a title. Follow good notebook form. The notebook will be approximately 30% of the grade, the Analysis 70%

PHYS 211 - Introductory Physics 1, Fall 2004

Instructor: Dr. Ali Abbasabadi, Professor of Physics.
Office Location and Phone Number: 3017 Arts & Sciences Commons Building, 591-3571.
Office Hours: M, W, F 2:00 - 2:50; F 3:00 - 3:50 (no appointment is necessary).
For other times, please make an appointment.
Lecture: M, W, F 1:00 - 1:50; Room 102 Science Building.
Lab Sections: 211, 212, 213, 214

Monday	3:00 - 5:50; Room 114, Science Building.
Wednesday	3:00 - 5:50; Room 114, Science Building.
Thursday	12:00 - 2:50; Room 114, Science Building.
Thursday	3:00 - 5:50; Room 114, Science Building.

Note: Syllabus will be followed exactly. No deviation from the syllabus will be allowed.

World Wide Web:
To access some of the information provided here and other materials related to this course, visit my homepage at www.ferris.edu/faculty/abbasabadia/

Required Materials:
- Textbook: College Physics, by Wilson & Buffa, 5th Ed. 2003.
- Laboratory Manual: Physics 211 Lab Manual, by Ali Abbasabadi, the current semester edition.
- Course syllabus, scientific calculator, ruler, protractor, pencil #2, and soft eraser.
- The Ferris State University Registration & Academic Guide. Please read and be aware of all the *General Information*. In particular, pay attention to: the *Calendar* (such as the last day to drop the class), the *Academic Policy Information*, regarding the grades I (Incomplete) and W (Withdraw), and the *Examination Schedule* (such as the final exam and its makeup date and time).

Course Objective:
Through lectures, laboratory experiments, and homework, to understand basic principles of physics, and be able to apply these principles to problems concerning physical phenomena.

Course Description:
- **Credit Hours:** 4 (3 Hours Lecture; 3 Hours Lab).
- **Prerequisite:** MATH 116 (C- or better) or MATH 120 (C- or better).
- **Description:** Basic concepts and applications of motion, force, energy, fluids, heat, and sound.
- **General Education Requirement:** This course meets General Education requirements: *Scientific Understanding Lab.*

Exam Schedule				
Monday	September	20	EXAM 1:	Chapters 1, 2, 3 (8 problems per chapter)
Monday	October	11	EXAM 2:	Chapters 4, 5, 6 (8 problems per chapter)
Monday	November	1	EXAM 3:	Chapters 7, 8, 9 (8 problems per chapter)
Monday	November	22	EXAM 4:	Chapters 10, 11, 12 (8 problems per chapter)
Wednesday 12:00-1:40	December	15	FINAL EXAM:	Chapters 1 - 12 (1 problem per chapter) Chapters 13, 14 (12 problems per chapter)

- Forty-eight (48) hours after each exam (including the final exam), grades and correct answers to exam problems will be posted outside the physics lab.
- No students, under any circumstances, shall be given a make-up exam before the regularly scheduled exam.
- Some of the final exam problems may be based on, similar to, or the same as the midterm exams problems (for more information, see the Exams' section of syllabus).

Attendance Policy:
You are required to attend all sessions of class and lab. Any absenteeism, no matter what the reason, shall result in under-performance in exams. There are penalties for missing lectures and labs, even if you have a legitimate excuse (see Grading Procedure and instructions for Quizzes and Laboratory). If you miss any class, you will be responsible for getting the lecture notes from fellow students (there are no lecture notes available from the instructor).

Grading Procedure:
Your grade will be determined, exclusively (no extra credit for any extra work), by the total points earned from exams, quizzes, homework, lab summaries, lab reports, lecture attendance, and lab attendance. (All grades will count. None will be dropped.) The grades will be computed, **exactly** (no rounding), from the following grading scale. The final grades, at the discretion of instructor, **may** be curved, resulting in a slight lowering of the grade boundaries. The decision, regarding whether there is a curve, and all its aspects, will be made by the instructor only **after** the final exam is graded. You should not count on the curve (if there is any curve at all) as a way of passing the course or getting higher grades. For the last 15 years, only few times this course was curved. The average grade for the class is expected to be between C and B-, depending on the class performance.

Exam 1	24	Points
Exam 2	24	Points
Exam 3	24	Points
Exam 4	24	points
Final Exam	36	points
15 quizzes	15	points (each 1 point)
15 lecture attendances	15	points (each 1 point)
13 homework	26	points (each 2 points)
13 lab summaries	13	points (each 1 point)
13 lab reports	13	points (each 1 point)
13 lab attendances	13	points (each 1 point)
Total	227	points

x = % of Total Score	Grade
$90\% \le x \le 100\%$	A
$87\% \le x < 90\%$	A-
$83\% \le x < 87\%$	B+
$80\% \le x < 83\%$	B
$77\% \le x < 80\%$	B-
$73\% \le x < 77\%$	C+
$70\% \le x < 73\%$	C
$67\% \le x < 70\%$	C-
$63\% \le x < 67\%$	D+
$60\% \le x < 63\%$	D
$50\% \le x < 60\%$	D-
$0\% \le x < 50\%$	F

Classroom Etiquette:

- Turn your cell phone off in class and lab.
- In class and lab, you are not allowed to consume food, drink, tobacco, etc.
- In class and lab, reading of materials not related to physics should not occur.
- All questions regarding exams, quizzes, and your grades, will be discussed and answered during office hours, not in class or in lab.
- You must be quiet in class at all times. If the instructor finds you loud, talking to other students, or disruptive, you will be asked to leave the class for that session.
- During class sessions, the questions must be referred to the instructor, not to other students. You are encouraged to discuss the course materials with other students, during the lab sessions or outside the class.

Homework and Study Guide:
Several problems from the Textbook are assigned (see the attached problem sets). Some of the homework problems will be collected in the lab (see the lab's instruction), but you must work on all of

them. The problem sets, by no means, are complete. Those of you that are interested to learn more and increase the possibility of getting higher grades, may need to work on additional problems from the Textbook. The amount of extra work depends on the individual. You need to keep working on the extra problems until you are confident that you understand the basic principles and are able to apply them to **new problems** concerning physical phenomena. This is a judgment that you need to make on your own. However, be forewarned that you should not deceive yourself into false confidence that you understand the problems by seeing their solutions in the Textbook, in class, or during office hours. You must be able to do problems on your own. You must develop problem-solving ability, not memorization of the solutions. The best way to learn how to do problems is to understand the materials and to do lots of problems. If you have any difficulty in doing the Textbook problems (assigned or unassigned) on your own, you will have difficulty in doing the exams problems..

For Students Having Difficulty in Solving Homework Problems:
If you have difficulty in solving homework problems, you may want to get the *Student Study Guide and Solution Manual* that you may find it at bookstores. This solution manual gives solutions to some of the end of the chapters' problems in your Textbook.

For Students That Want to Get Higher Grades:
Although different methods work for different students, the following could be helpful for many students:

- Attend all lectures and all lab sessions.
- If you are absent from a lecture, get the lecture notes from a student and study them.
- Read, very carefully, the Textbook and the lecture notes.
- Solve all assigned homework problems (not just those that are collected in the lab).
- Solve additional problems that are at the end of chapters of the Textbook.
- Solve all examples that are discussed in the lecture.
- Solve all examples that are given in the chapters of the Textbook.
- Solve all sample exam problems that are given on the Web for this course.
- Solve all sample exam problems that are given in the Lab Manual.
- Solve all quiz problems.
- For final exam, study all chapters for this course and solve all midterm exams' problems.

Exams:
The final exam, which is comprehensive, and the midterm exams are closed book and closed notes. They will consist of multiple choice problems. For the exams, no formulas will be given to you and you are not allowed to bring any formula and physics information (in any form, electronic, paper, or anything else) with you. Therefore, the calculator that you bring to the exams must be clear from any physics information and formula.

Some of the exams problems may be based on the materials from the lab, the examples and problems in the Textbook (assigned and unassigned), quizzes, or examples from the lectures. (Some of the final exam problems may be based on, similar to, or the same as the midterm exams problems.) The rest of the exams problems will be **new problems** and they will be based on the materials in the Textbook and the lectures. These new problems may not resemble and may not be at the same level of difficulty as the problems and examples in the Textbook and lectures. Many of the exams problems will involve calculations, but some may not involve any calculations. Each problem is worth 1 point (no partial credit). Your exams' grades will be based, **solely**, on what you mark on the answer sheets, not what you write on exams' papers. The exam papers will be returned to you, but not the original answer sheets.

You must bring to the exams a scientific calculator that you know how to use (no sharing is allowed), and it must be clear from any physics information and formula. Practice the operation of your calculator, since you are fully responsible for all of its operations. You also need a #2 pencil and a soft eraser to work out the problems and to mark answer sheets.

Make-ups for Exams:
If you are absent from an exam and present a valid excuse, you will be given a make-up exam. However, for the final exam, you must present your excuse within 24 hours after the final exam. Make-up will be given **after** the regularly scheduled exam, **not** before. **No students, under any circumstances, shall be given a make-up exam before the regularly scheduled exam.** The make-up will be given as soon as possible, during an office hour. In addition, for the final exam, the make-up not only will be given **after** the regularly scheduled final exam, but it will be on one of the dates that are specified in the *Schedule of Classes* for the make-up. The degree of difficulty, the distribution of questions among the chapters, the format, and the number of questions of the make-up exams may not be the same as the regular exams.

A **zero** will be recorded for each missing exam. If you do not make up an exam, whatever the reason is, you will get **zero** for that exam. No make-up exam paper will be returned to you. However, a copy of the regular exam will be given to you.

Quizzes:
Any lecture session may include a "pop" quiz. Quizzes are closed book and **unannounced** (the instructor, under any circumstances, will not let you know in advance when the quizzes are). No formulas will be given to you and you are not allowed to bring any formula sheet. There will be one multiple choice problem per quiz. A maximum of 2 points will be given for each quiz: 1 point for lecture attendance (you must be present in the class), 1 point for giving correct answer to the quiz. The 1 point credit for the attendance will be given **only** to those students that are present in the class. To get any credit, all your work must be shown on your paper. The quizzes may not resemble the homework, exam, or lecture problems.

You should bring to the class (for quizzes) a scientific calculator that you know how to use (no sharing is allowed), and it must be clear from any physics information and formula. Practice the operation of your calculator, since you are fully responsible for all of its operations.

Make-ups for Quizzes:
If you are planning to be absent from a quiz, you do not need to inform the instructor in advance. If you are absent from a quiz and you have no excuses, you will get 0 for that quiz. However, if you miss a quiz due to a personal, official, or medical excuse, you may make up the quiz (however, you will lose the 1 point credit for the lecture attendance) by writing a typed one-page paper to summarize a chapter (*any* chapter that you want) in the Textbook, and solve 6 problems from the end of a chapter (*any* chapter that you want) and attach the complete solutions (not just the answers) to the paper. The paper must be presented to the instructor **before** the next exam, otherwise a zero will be recorded for each missing quiz. No special make-up quizzes will be arranged (you will not be given a quiz to make up a quiz). Once again, if you miss a quiz and you have a valid excuse and make up the quiz by writing a paper (with the solutions to the 6 problems attached), you will get 1 point for that quiz, not 2 points. If you do not make up a quiz, whatever the reason is, you will get zero for that quiz.

Instructions for Laboratory:
Labs begin according to the attached schedule. Working in group of four, you will perform experiments. Never form a group more than four, unless the instructor tells you so. If you form a group

more than four, each one of you in that group will lose 1 point for that lab period. The instructor, at any time in lab, may rearrange the groups.

You must be quiet in lab at all times. If the instructor finds you loud or disruptive, you will be asked to leave the lab. In lab, you are not allowed to consume food, tobacco, etc. You are also expected, during the lab session, to stay in the lab at all times, except for few minutes.

For each lab session, there are 6 assigned homework problems (see the Lab Manual and Lab Schedule). You must solve these problems and write their complete solutions (not just the answers) in the provided spaces in the lab report sheets and attach them to the end of your lab reports. After the experiment, you should write a summary about the experiment and its results and attach it to the end of your lab reports. A maximum of 5 points will be given for each complete lab work: 1 point for lab attendance (you must be present in the lab), 1 point for lab report and answers to the lab questions, 1 point for lab summary & conclusion, 2 points for solutions to the homework problems. The 1 point credit for the attendance will be given **only** to those students that are present in the lab. A lab report will be graded only if you are present in the laboratory and perform all the lab work. Although there is no quiz or final exam for lab, some of the questions in the final and midterm exams may be based on the materials in the lab.

The lab reports will be prepared by each group (one lab report and solutions to the problems for each student) during the lab period and submitted **before** leaving the lab (a zero will be recorded for each missing part, regardless of the reason). You must leave the lab promptly at the end of the lab period. The graded lab reports will be returned in the next lab session. However, for the lab session before an exam, they will be returned in class on the Friday before exam.

You should bring to the lab the course syllabus, Textbook, Lab Manual, scientific calculator, ruler, protractor, and pencil.

Make-ups for Labs:

If you are planning to be absent from a lab, you do not need to inform the instructor in advance. If you are absent from a lab and you have no excuses, you will get 0 for that lab. However, if a lab period is missed due to a personal, official, or medical excuse, you may make up that lab by attending another lab session during the same week (in this case you will not lose the credit for the lab attendance). If this is not possible, you may make up that lab (however, you will lose the 1 point credit for the lab attendance) by writing a typed two-page paper to summarize the chapter in the Textbook that the homework is due for that chapter for the missing lab session (see the Lab Manual and Lab Schedule), and solve the first 6 assigned homework problems from that chapter and attach the complete solutions (not just the answers) to the paper. The paper must be presented to the instructor **before** the next exam, otherwise a **zero** will be recorded for each missing lab. **No** special make-up labs will be arranged. A maximum of three lab make-ups (with valid excuses) will be accepted. Once again, if you miss a lab and you make up that lab by writing a paper (with the solutions to the 6 problems attached), you will get 4 points for that lab, not 5 points. If you do not make up a lab, whatever the reason is, you will get **zero** for that lab.

Saving the Graded Quizzes and Graded Lab Reports:

After the instructor returns your graded quizzes and graded lab reports, you are advised to save them in case there is any dispute about the grading. If a quiz grade or a lab grade is missing from the posted grades (they will be posted outside the physics lab), you must report that to the instructor within one week after the posting. (Bring the missing graded quiz or the missing graded lab report with you.)

Lab Schedule			
Lab	Week Beginning	Experiment	Homework due for following chapters
1	August 30	Computer Graphics and Data Analysis	Chapter 1
×	**September 6**	**NO LABS THIS WEEK**	**No Homework Collection**
2	September 13	Free Fall	Chapter 2
3	September 20	Vectors and Reaction Time	Chapter 3
4	September 27	Projectile Motion	Chapter 4
5	October 4	Kinetic Friction	Chapter 5
6	October 11	Collision	Chapter 6
7	October 18	Equilibrium, Density, and Buoyancy	Chapter 7
8	October 25	Thermal Equilibrium	Chapter 8
9	November 1	Specific Heat	Chapter 9
10	November 8	Simple Harmonic Motion	Chapter 10
11	November 15	Simple Pendulum	Chapter 11
×	**November 22**	**NO LABS THIS WEEK**	**No Homework Collection**
12	November 29	String Vibration	Chapter 12
13	December 6	Speed of Sound in Air	Chapter 13
×	**December 13**	**NO LABS THIS WEEK**	**No Homework Collection**

Lecture and Exam Schedule			
Date			Lecture & Exam
Monday	August	30	Course Syllabus & Chapter 1
Wednesday	September	1	Chapter 1
Friday	September	3	Chapter 2
Monday	September	6	NO CLASS
Wednesday	September	8	Chapter 2
Friday	September	10	Chapter 2
Monday	September	13	Chapters 2 & 3
Wednesday	September	15	Chapter 3
Friday	September	17	Chapter 3 & Review
Monday	**September**	**20**	**EXAM 1: Chapters 1, 2, 3 (8 problems per chapter)**
Wednesday	September	22	Chapter 4
Friday	September	24	Chapter 4
Monday	September	27	Chapters 4 & 5
Wednesday	September	29	Chapter 5
Friday	October	1	Chapters 5 & 6
Monday	October	4	Chapter 6
Wednesday	October	6	Chapter 6
Friday	October	8	Chapter 6 & Review
Monday	**October**	**11**	**EXAM 2: Chapters 4, 5, 6 (8 problems per chapter)**
Wednesday	October	13	Chapter 7
Friday	October	15	Chapter 7
Monday	October	18	Chapters 7 & 8
Wednesday	October	20	Chapter 8
Friday	October	22	Chapter 8
Monday	October	25	Chapters 8 & 9
Wednesday	October	27	Chapter 9
Friday	October	29	Chapter 9 & Review
Monday	**November**	**1**	**EXAM 3: Chapters 7, 8, 9 (8 problems per chapter)**
Wednesday	November	3	Chapter 10
Friday	November	5	Chapter 10
Monday	November	8	Chapters 10 & 11
Wednesday	November	10	Chapter 11
Friday	November	12	Chapter 11
Monday	November	15	Chapters 11 & 12
Wednesday	November	17	Chapter 12
Friday	November	19	Chapter 12 & Review
Monday	**November**	**22**	**EXAM 4: Chapters 10, 11, 12 (8 problems per chapter)**
Wednesday	November	24	Chapter 13
Friday	November	26	NO CLASS
Monday	November	29	Chapter 13
Wednesday	December	1	Chapter 13
Friday	December	3	Chapters 13 & 14
Monday	December	6	Chapter 14
Wednesday	December	8	Chapter 14
Friday	December	10	Chapter 14 & Review
Monday	December	13	NO CLASS
Wednesday 12:00-1:40	**December**	**15**	**FINAL EXAM: Chapters 1 - 12 (1 problem per chapter) Chapters 13, 14 (12 problems per chapter)**
Friday	December	17	NO CLASS

What Sections of the Chapters to Study for Exams and Quizzes:

Although few of the following sections may not be covered in the class, and those that are covered may not be presented in their entirety, you are still responsible for studying all the Insights of the following chapters and the entire content (including examples) of **all** of the following sections. In addition, you are also responsible for studying **all** materials presented in class (including the last session of the class before exam) and in lab.

Course Outline

Chapter	Section
1	1: Why and how we measure. 2: SI units of length, mass, and time. 3: More about the metric system. 4: Dimensional analysis and unit analysis. 5: Unit conversions. 6: Significant figures. 7: Problem solving.
2	1: Distance and speed: scalar quantities. 2: One-dimensional displacement and velocity: vector quantities. 3: Acceleration. 4: Kinematics equations (constant acceleration). 5: Free fall.
3	1: Components of motion. 2: Vector addition and subtraction. 3: Relative velocity: applying vector addition 4: Projectile motion.
4	1: The concept of force and net force. 2: Inertia and Newton's first law of motion. 3: Newton's second law of motion. 4: Newton's third law of motion. 5: More on Newton's laws: free-body diagrams and translational equilibrium. 6: Friction.
5	1: Work done by a constant force. 3: The work-energy theorem: kinetic energy. 4: Potential energy. 5: The conservation of energy. 6: Power.
6	1: Linear momentum. 2: Impulse. 3: The conservation of linear momentum. 4: Elastic and inelastic collisions. 5: Center of mass. 6: Jet propulsion and rockets.
7	1: Angular measure. 2: Angular speed and velocity. 3: Uniform circular motion and centripetal acceleration. 4: Angular acceleration. 5: Newton's law of gravitation.
8	1: Rigid bodies, translations, and rotations. 2: Torque, equilibrium, and stability. 3: Rotational dynamics (not parallel axis theorem.) 4: Rotational work and kinetic energy. 5: Angular momentum.
9	1: Solids and elastic moduli. 2: Fluids: pressure and Pascal's principle. 3: Buoyancy and Archimedes' principle. 4: Fluid dynamics (not Bernoulli's equation.)
10	1: Temperature and heat. 2: The Celsius and Fahrenheit temperature scales. 3: Gas laws and absolute temperature. 4: Thermal expansion.
11	1: Units of heat. 2: Specific heat. 3: Phase changes and latent heat. 4: Heat transfer.
12	1: Thermodynamics systems, states, and processes. 2: The first law of thermodynamics. 3: Thermodynamic processes for an ideal gas. 4: The second law of thermodynamics and entropy (no formula for entropy.) 5: Heat engines and thermal pumps (no formula for thermal pumps). 6: The Carnot cycle and ideal heat engines.
13	1: Simple harmonic motion. 2: Equations of motion. 3: Wave motion. 4: Wave properties. 5: Standing waves and resonance.
14	1: Sound waves. 2: The speed of sound. 3: Sound intensity and sound intensity level. 4: Sound phenomena. 5: The Doppler effect. 6: Musical instruments and sound characteristics.

Note: Only complete solutions for the first 6 assigned homework problems in each chapter will be collected at the end of each lab session. Solutions to the rest of problems will not be collected. The solutions to the assigned homework problems should be written in the provided spaces in the report sheet pages of the Lab Manual.

Problem Sets		
Chapter	Problem The first 6 assigned homework problems, which will be collected in the lab, are in **bold** face.	Due Date for the first 6 problems (at the end of lab session)
1	**17,19,29,65,79,91**,2,5,10,11,13,27,55,59,81,83	Lab 1
2	**10,21,37,41,51,55**,4,43,47,49,61,63,71,77,85,87,99,107	Lab 2
3	**7,9,19,23,29,45**,31,55,57,61,63,73,75,79,85,101	Lab 3
4	**15,23,25,27,33,35**,1,5,17,19,39,41,45,49,77,85,87	Lab 4
5	**9,10,11,37,39,43**,1,3,45,47,51,53,55,65,67,81,85	Lab 5
6	**7,11,13,15,17,21**,1,5,29,31,39,45,47,49,51,61,65	Lab 6
7	**7,9,11,27,29,33**,1,3,31,35,39,41,49,61,63,65,67,77,99	Lab 7
8	**9,11,13,15,26,27**,1,3,7,33,43,71,73,88,89,106,111	Lab 8
9	**7,9,11,13,29,35**,41,43(a),49,53,55,59,63,67,69	Lab 9
10	**27,33,35,37,55,57**,3,17,18,19,43,63,87,93(a,b),97,103	Lab 10
11	**19,23,25,29,41,83**,8,9,15, 31,35,37,45,59,63,67	Lab 11
12	**21,59,61,63,83,95**,7,9,13,18,25,53,75,87,111	Lab 12
13	**9,11,13,33,35,43**,3,4,31,45,47,59,63,65,67,69,71,83	Lab 13
14	2,3,7,11,17,31,33,35,39,43,49,53,69,71,79,81,95	No homework collection

Answers to Assigned Even-numbered Problems:
(Answers to odd-numbered problems are given at the end of Textbook)

1.2: c
1.10: d
2.4: c
4.4: c
5.8: 1.8×10^3 J
8.26: 1.1×10^2 m.N
8.88: c
8.106: 6.3×10^4 N, 5.5×10^4 N
10.18: d
11.8: a
12.18: 5.5×10^5 J
13.4: a
14.2: a

Frequently Asked Questions:
For questions and answers regarding this course, see the section "Frequently Asked Questions" in the Lab Manual.

CHEM 121 General Chemistry I (Sec 241-243; 251-253)

Fall 2004

Course Instructor: Malapati, Sunil
ASC 1015D x 2551
malapats@ferris.edu

Office Hours: MR 2:00 – 4:30 PM
W 10:00 – 11:00 AM
Contact Instructor for other possible times.

Lecture Hours (SCI 126)
Sec 241-243 MTWR 5:00 – 5:50 PM
Sec 251-253 MTWR 6:00 – 6:50 PM

Laboratory Hours (SCI 333)
SEC 241 W 12 – 2:50 PM Malapati
SEC 242 T 12 – 2:50 PM Malapati
SEC 243 M 12 – 2:50 PM Jacobs
SEC 251 W 3 – 5:50 PM Bacon
SEC 252 W 8 – 10:50 AM Bacon
SEC 253 M 3 – 5:50 PM Bacon

Lab Instructors:
Jacobs, Rebecca (Sec 243) x 5290
Bacon, Mary (Sec 251-253) x 2586

Credits: 5
Prerequisite: CHEM 103 or equivalent

Required Materials

Text: *General Chemistry*, 7th Edition, by Whitten, Davis, Peck & Stanley.
Must be packaged with OWL (Online Web-based Learning System).
Laboratory Manual: *CHEM 121 Laboratory Manual*, available in Ferris bookstore.
Scientific Calculator: Absolutely no programmable or graphing calculators allowed.
Safety Glasses: Instructor approved.

Learning Objectives: After successful completion of this course, the student should be able to understand and apply the fundamental laws and theories in a significant majority of the following topics (see Lab Manual for a detailed list):

- Chemical basis of matter
- Atomic structure and the periodic table
- Molecules and chemical bonding
- Chemical reactions and interpretation of chemical equations. Stoichiometry.
- States of matter and changes between states.
- Gases and gas laws
- Solutions and solution chemistry
- Acids and Bases: theory
- Thermochemistry

Course Practices Required: Students are expected to read the assigned text in advance of the class session. College level reading and writing skills will be needed as well as arithmetic and elementary algebra skills. The class will regularly include the following activities:

- Classroom discussion
- Analysis and problem solving
- Individual & group problem solving
- Computer and web use

Attendance Policy

It is expected that students attend all the lectures. There are no make-up tests or assignments. Late work will not be accepted. Attendance will be taken randomly.

Five unexcused absences from the lecture portion of the course will result in the reduction of the final points tally by 20 points.
Eight unexcused absences from the lecture portion of the course will result in a letter grade reduction.
Two unexcused absences from the lab portion of the course will result in a course grade of F.
Three absences from the lab portion of the course for any reason will result in a course grade of F.

If possible, inform me in advance so that you will not be penalized. Excused absences must be documented no later than the day after return to class. Excused absences are defined by the Office of the Dean (see attachment). Illness is NOT considered an excused absence. Arriving late to class or leaving early without permission is considered an absence.

Grading

The final course grade for each student will be determined by a point accumulation as follows:

Activity	Points
6 tests @ 100 pts. each	600
Comprehensive Final Exam	250
Laboratory	350
Homework (OWL)	120
In-class Work	180
TOTAL (possible)	1500

Suggested percentage distribution for grades:

Percent	Grade
>92	A
89-91.9	A-
86-88.9	B+
83-85.9	B
80-82.9	B-
76-79.9	C+
73-75.9	C
69-72.9	C-
66-68.9	D+
62-65.9	D
58-62.9	D-
<58	F

TESTS. Tests will consist of problems and short answer questions. There will also be multiple choice questions that test both concepts and problem solving. All tests must be taken on the scheduled dates (see Schedule) unless special arrangements have been made with the instructor. There will NOT be any make-up tests. Students are required to take the Comprehensive Final and will automatically get an F if they fail to do so. The Comprehensive Final is a standardized ACS test consisting of multiple-choice questions. You can substitute the lowest score on your individual tests with your score in the final.

HOMEWORK. The homework assignments and due dates are posted on OWL. Late submissions will not be accepted.

LABORATORY. Points will be awarded both based on your reports and your experimental abilities. There will be worksheets associated with certain labs. Your instructor will explain the points system.

IN-CLASS WORK. Your in-class evaluation will consist of 2 minute surprise quizzes, individual and group problem solving assignments. Some problems may be assigned in advance to be submitted in the next class.

Students should maintain all graded and returned course materials together along with their journals to present at anytime to the instructor for review or in case of any dispute.

Schedule for Labs & Tests

8/30 – 9/1	Check-in & Expt 1
9/7, 9/8	Expt 2 (No Labs Mon)
9/13 – 9/15	Expt 3
Thu 9/16	**TEST ONE**
9/20 – 9/22	Expt 6
9/27 – 9/29	Expt 4
10/4 – 10/6	Expt 5
Thu 10/7	**TEST TWO**
10/11 – 10/13	Expt 9
10/18 – 10/20	Expt 8
Thu 10/21	**TEST THREE**
10/25 – 10/27	Expt 7
11/1 – 11/3	Expt 10
11/8 – 11/10	Expt 11
Tue 11/9	**TEST FOUR**
11/15 – 11/17	Expt 12
11/22	Expt 2 (only Mon)
Tue 11/23	**TEST FIVE**
11/29 – 12/1	Expt 13
12/6 – 12/8	Expt 14
Thu 12/9	**TEST SIX**
FINAL	12/14 6:00 – 7:50 PM (Sec 251-253)
	12/16 4:00 – 5:50 PM (Sec 241-243)

CHEM 122
General Chemistry 2
Winter 2004 (5 credits)

Instructor:	Dr. Prabhakara Shetty
Office:	ASC 3097
Office Hours:	MWF 9:00 AM -10:00 AM, and R 2:00 PM - 3:00 PM
Telephone:	591 2589
Text Book:	'GENERAL CHEMISTRY', By Ebbing and Gammon, 7th Edition.
Lab Manual:	Lab Workbook for CHEM 121 & 122 Laboratory Manual for Qualitative Analysis

Lecture Outline:

Chapter #	Topics
14	Rates of reaction: definition, dependence, reaction order, collision and transition-state theories, energy diagrams catalysis.
15	Chemical equilibrium: equilibrium constant, predicting the direction of reaction, dependence on physical conditions.
16-17	Acids and bases: definitions, relative strengths, autoprotolysis of water, solutions of acids and bases, pH, buffers, acid-base titrations.
18	Solubility and complex-ion equilibria: solubility, solubility product, common-ion effect, ion-product and precipitation, dependence of solubility on physical parameters, separation by selective precipitation, complex ions, qualitative analysis.
19	Thermodynamics and Equilibrium: enthalpy, enthalpy change, free energy and spontaneity, standard free energy change and equilibrium constant
20	Electrochemistry: redox reactions, half reactions, voltaic cells, emf, standard electrode potentials, cell emf, cell emf and equilibrium constant, commercial cells and electrolysis of molten metals and solutions.
21	Nuclear chemistry

22	Chemistry and Metallurgy of main group of elements
23	Chemistry of Coordination Compounds
24	Organic Chemistry (time permitting)

Requirements:

Four hourly tests	100 pts each (first test will be given in two parts, first part will be worth 20 points, and the second part 80 points.)
Final exam	100 pts (this will be a 2 hr standardized exam covering both CHEM 121 and CHEM 122)
Laboratory	120 pts

Grading Scale:

Numerical grades will be converted to letter grades at the end of the semester using the following scale.

Grading Scale:

92.5 % and above	A
89.5 to 92.4 %	A-
86.5 to 89.4 %	B+
82.5 to 86.4 %	B
79.5 to 82.4 %	B-
76.5 to 79.4 %	C+
72.5 to 76.4 %	C
69.5 to 72.4 %	C-
66.5 to 69.4 %	D+
62.5 to 66.4 %	D
59.5 to 62.4 %	D-

Attendance Policy: If a student misses more than three lectures in a semester, he/she loses one percentage point from the final numerical grade for each missed lecture. One percentage point will be added to the final numerical grade if a student maintains a perfect attendance

Policy on Tardiness: Students are expected to be on time and stay till the end of the lecture. If a student comes late or leaves early, he/she will be marked absent for that day.

CHEM 122 LAB SCHEDULE (WINTER 2004)

Week of Jan 12:	Balancing redox equations (expt # 18)
Week of Jan 19:	Iodine Clock (expt # 20)
Week of Jan 26:	Copper Sequence (expt # 19)
Week of Feb 2:	Graphing (expt # 17, Glass Bead)
Week of Feb 9:	Acid dissociation constant, K_a (expt # 21)
Week of Feb 16:	Complex-ion formation constant, K_f (expt23)
Week of Feb 23:	Graphing (expt # 17, BB's)
Week of Mar 1:	Dry lab
WEEK OF MARCH 8:	No lab (Spring Break)
Week of Mar 15:	Qualitative Analysis (Gr I anal/unk)
Week of Mar 22:	Qualitative Analysis (Gr II analysis)
Week of Mar 29:	Qualitative Analysis (Gr II unk/Gr III)
Week of Apr 5:	No lab (Easter Recess)
WEEK OF APR 12:	Qualitative Analysis (Gr III unk)
Week of Apr 19:	Qualitative Analysis (General Cation Unknown)
Week of Apr 26:	Qualitative Analysis (General Anion Analysis/unknown)

SYLLABUS ATTACHMENT

COLLEGE OF ARTS AND SCIENCES -- FERRIS STATE UNIVERSITY

Winter 2004

IMPORTANT DATES

First day of classes.....1/12/04
Last day for schedule adjustment (drop/add).....1/15/04
Martin Luther King Day (no classes).....1/19/04
Spring recess (no classes).....3/6 - 3/14/04
Summer/fall early registration begins.....3/22/04
Last day to DROP or withdraw with "W".....3/26/04
Easter recess (no classes).....4/8 - 4/11/04
Last day of winter semester classes.....4/30/04
FINAL EXAMS.....5/3 - 5/7/04
Summer/fall early registration closes.....5/5/04
Winter semester commencement.....5/7-8/04

LIBRARY HOURS

Regular hours for the (FLITE) library are as follows:

Monday-Thursday ..... 8:00 a.m. - 12:00 a.m.
Friday ..... 8:00 a.m. - 9:00 p.m.
Saturday ..... 9:00 a.m. - 6:00 p.m.
Sunday..... 1:00 p.m. - 12:00 a.m.
(For verification of hours, call 591-3733)

COMPUTER LAB HOURS

Computer lab hours in the (FLITE) library are as follows:

Monday - Thursday.....8:00 a.m. - 12:00 a.m.
Friday.....8:00 a.m. - 9:00 p.m.
Saturday.....9:00 a.m. – 6:00 p.m.
Sunday ..... 1:00 p.m. to 12:00 a.m.
(For verification of hours, call 591-3733)

CLASS ATTENDANCE IS IMPORTANT!

There is significant research to show that students with daily attendance earn significantly higher grades than students who miss even a few class periods. Many instructors have mandatory attendance policies by which your grade will be affected by absences. Some instructors also have policies about class tardiness, to encourage students to be present for the full class period. Check your course syllabus or talk to your instructor about his/her policies.

HOW TO CONTACT A FACULTY MEMBER

If you have questions or need help, talk to your instructor. Faculty office locations, phone numbers, and office hours can be obtained from the class syllabus, or the department office or through the College of Arts and Sciences web page. A faculty directory notebook is also located in the dean's office (ASC 3052).

DROPPING CLASSES OR WITHDRAWING

If you need to drop a class, you must do so **OFFICIALLY**, through your dean's office, in order to avoid receiving an "F" grade in the course. If you need to totally withdraw from school, you must do so **OFFICIALLY** at Admissions and Records in CSS 201. The last day to withdraw or drop a class may be different for different classes. See dates listed under "Important Dates". In case of extenuating circumstances after these dates (e.g., a serious illness requiring you to withdraw from school), contact Admissions and Records at 591-2792.

INCOMPLETES

The intent and appropriate use of the "I" grade is NOT to avoid student probation, dismissal, or unacceptable grades, nor should it be considered as an extended alternative to withdraw from a class (W). The "I" is only considered for extenuating circumstances that have led to a student's missing a portion of the course. Extenuating circumstances are generally defined as those situations over which the student has little or no control--e.g., illness, birth, jury duty, death of a parent, serious injury. Instructors may require suitable documentation.

Students must have completed at least 75% of the coursework at passing levels before an "I" will be considered, and they may be required to sign an agreement regarding course completion. An "I" grade automatically changes to an "F" after one semester (not counting summer) unless the faculty member files another grade or extends the incomplete.

WHERE TO GO FOR HELP

Successful students are often those who seek help early, before little problems become big ones. Ferris State University offers a variety of services, **FREE OF CHARGE**, to help you. Details are on the next page.

(over)

CHEM 231
Quantitative Analysis
4 Credits

Instructor :	Dr. Prabhakara Shetty	Fall 2004
Office:	ASC 3097	STR 233
Telephone:	591 2589	MWF 10:00 to 10:50 AM
Office Hours:	M 1:00 to 2:00 PM, WF 9:00 to 10:00 AM, T 10:00 to 11:00 AM	

Goals and Objectives:

To enable students to understand the concepts of classical and modern quantitative analysis involving both wet and instrumental methods.

To develop the ability to draw reasonable inferences from observations, and to improve problem solving skills

Requirements:

Four hourly tests	400 points (100 pts. each)
Final Exam	100 points (cumulative)
Laboratory	120 points.

Grading Scale:

92.5 % and above	A
89.5 to 92.4 %	A-
86.5 to 89.4 %	B+
82.5 to 86.4 %	B
79.5 to 82.4 %	B-
76.5 to 79.4 %	C+
72.5 to 76.4 %	C
69.5 to 72.4 %	C-
66.5 to 69.4 %	D+
62.5 to 66.4 %	D
59.5 to 62.4 %	D-

Text book: Quantitative Chemical Analysis by Daniel C. Harris, sixth edition

Laboratory Manual: Laboratory Manual for Chemistry 231

Topics:

1. Introduction to chemical analysis
2. Statistical approaches to error in analysis and data handling.
3. Chemical equilibrium: concept and calculations.
4. Acids, bases and buffers
5. Volumetric analysis: titrations and equivalence points.
6. gravimetric analysis: the limits of solubility
7. Introduction to Instrumentation.
8. Molecular spectroscopy.
9. Chromatography.
10. Electrochemistry.

Lab Schedule:

Check in and Experiment # 1, Making Measurements (week of August 30, 04)
Experiment # 2, Acid-Base Titrations (week of Sept 13, 04)
Experiment # 3,Determination of Acid-NeutralizingStrength of Antacids (Week of September 20, 04)
Experiment # 4, Standardization of Thiosulfate (week of September 27, 04)
Experiment # 5, Analysis of Vitamin C (week of October 4, 04)
Experiment # 6, Gravimetric Analysis of Chloride (week of October 11, 04)
Experiment # 6, Gravimetric Analysis of Chloride (week of October 18, 04)
Experiment # 7, Measuring pH (week of October 25, 04)
Experiment # 8, Introduction to Spectrophotometry (week of November 1, 04)
Experiment # 9, Reverse Phase HPLC Analysis of Hydrocarbons (week of Nov 8, 04)
Experiment # 10, HPLC Analysis of Sugars (week of November 22, 04)
Experiment # 11, UV/VIS Analysis of a Binary mixture (week of December 6, 04)

Attendance Policy: If a student misses more than three lectures in a semester he/she loses one percentage point from the final numerical grade for each missed lecture.

Policy on Tardiness: Students are expected to be on time, and stay till the end of the lecture. If a student comes in late or leaves early, he/she will be marked absent for that day. Due to health hazards associated with some of the chemicals used in the lab, if a student misses even a part of the pre-lab lecture, he or she will not be allowed to work in the lab that day.

SYLLABI

BIOL 121 General Biology I **2004**
Lecture: SCI 126 MWF 8 – 9am, Lab in SCI 212 or 216

Instructor: Dr. Karen Strasser
Office hours: MW 9 to 11am or by appointment Office: 2120 ASC
Contact info: Phone: 591-2543 email: strassek@ferris.edu

Required Materials:

Lecture Materials: Biology, 6th edition by Campbell, 3 ringed binder

Laboratory Materials: General Biology Laboratory Manual, notebook, calculator, 3 ringed binder

Required test materials: Packet of SCANTRON cards (form 882-E), 2 #2 pencils, student ID

Notes and Recording: Class material will be presented during the lectures. It is your responsibility to attend class, take notes, and become informed of any announcements made during your absence. GET TO KNOW OTHER STUDENTS IN THE CLASS! The questions for the exams will be taken from the material presented in class and the chapters assigned in the textbook. You may use a tape recorder for the lectures.

Attendance: Attendance in lecture is expected. Please BE ON TIME!!!! Random bonus quizzes may be given during the semester, you must be present to get these points!
Attendance in lab is MANDATORY. Labs can not be made up.
More than 2 missed laboratories (for any reason) will result in a failing grade in the class.

Course objectives:
This course is the first of a two part introductory biology sequence, thus it will lay the foundation for further study in biology. See the lecture schedule for a list of topics covered.

Exams: Examinations will be given during the normal lecture period on the dates are listed on the class schedule. Exams will include material covered in lecture and assigned readings in the textbook. Failure to take an exam at the scheduled time (see class schedule) will result in a grade of 0 for the exam. If you have a valid excuse, inform me ahead of time (except for hospitalization etc.), and provide written documentation within 2 weeks of the missed exam (proof of funeral, hospitalization, etc) the points missed will be added to the cumulative final exam. For example, if you missed exam 2 (with a valid excuse), the comprehensive final would be worth 300 points instead of 200 points. If given at least 2 weeks notice, you may be able to take an exam early if you have a school sponsored activity (with documentation).You will not receive your exams back but you may stop by my office (during my office hours/by appointment) to look them over. Exam grades will be posted on WebCT.
***Bring a scantron sheet (Form 882-E), 2 #2 pencils, and your student ID to each exam.

Grading: Final grades will be based on points earned in lecture (75%) and laboratory (25%).
The Lecture grade (500 points) will be comprised of the average of 3 exams (100 points each) and a CUMULATIVE final (200 points) as well as any bonus quiz points earned during the semester. The final exam will include two parts, part one new material covered since the last exam (similar to a regular exam, 100 points) , and part 2 Cumulative material (material from the whole semester!: 100 points).
Lab grades will be based on the score earned on lab quizzes (10 points each) and lab participation (assessed by your lab instructor). See lab section for more detail

Grading Scale:

A (≥94%)	C (73 - 76.9%)
A- (90 - 93.9%)	C- (70 - 72.9%)
B+ (87- 89.9%)	D+ (67 - 69.9%)
B (83-86.9%)	D (63 - 66.9%)
B- (80-82.9%)	D- (60 - 62.9%)
C+ (77 - 79.9%)	F (≤ 59.9%)

Academic Integrity: Any form of cheating will not be tolerated, and will result in a 0 for the assignment or exam in question.

To do well in this course:

Attend all lectures and labs, and BE ON TIME
Exhibit professional behavior
Take good notes, and organize them
Read the assigned sections of the text book both before class
Study your notes EVERY WEEK, not just before the exam
Ask questions when there is something you don't understand
Do the weekly study questions posted on web CT(every week!)

Lecture Schedule: (subject to change)

Week		Dates	New Topic	Chapter reading
1	M	Aug 30	Introduction to the Science of Biology	1
	W	Sept 1	Ecology	50
	F	Sept 3	Population Ecology	52
2	M	Sept 6	Labor Day (no class)	
	W	Sept 8	Community Ecology	53
	F	Sept 10	Ecosystems	54
3	M	Sept 13		
	W	Sept 15	The Cell Cycle	12
	F	Sept 17	Meiosis and sexual life cycles	13
4	M	Sept 20		
	W	Sept 22	**Exam 1**	
	F	Sept 24	Mendel and the Gene Idea	14
5	M	Sept 27	Chromosomal Basis of Inheritance	15
	W	Sept 29		
	F	Oct 1	Evolution	22
6	M	Oct 4	Evolution of Populations	23
	W	Oct 6		
	F	Oct 8	Origin of Species	24
7	M	Oct 11	Phylogeny and Systematics	25
	W	Oct 13		
	F	Oct 15	**Exam 2**	
8	M	Oct 18	Origin of Life on Earth	26
	W	Oct 20	Viruses	18(328-340)
	F	Oct 22	Prokaryotes	27
9	M	Oct 25		
	W	Oct 27	Protists	28
	F	Oct 29		
10	M	Nov 1	Fungi	31
	W	Nov 3	(last day to drop is R Nov 4)	
	F	Nov 5	Plant diversity I	29
11	M	Nov 8	Plant Diversity II	30
	W	Nov 10		
	F	Nov 12	**Exam 3**	
12	M	Nov 15	Plant Structure and Growth	35
	W	Nov 17		
	F	Nov 19	Plant Transport	36
13	M	Nov 22		
	W	Nov 24	Plant Nutrition	37
	F	Nov 26	Thanksgiving break (no class)	
14	M	Nov 29		
	W	Dec 1	Plant Reproduction	38
	F	Dec 3		
15	M	Dec 6	Plant response to stimuli	39

	W	Dec 8		
	F	Dec 10		
16	W	Dec. 15 Wednesday 8:00 -9:40am	2 Part Final (Part 1 new material, Part 2 cumulative)	

Lab information

Lab Grades: The points earned in lab will count for **25%** of your final course grade.

Lab participation:

You can earn up to 5 points each lab period for participation. You can lose these 5 points by being late to lab, leaving lab early, not participating in the activity, being disruptive in class. It is up to the discretion of your lab instructor to assign these points so make sure you know what he or she expects from you. (you are given one grace day)

Labs, and thus participation points earned, can not be made up for any reason. However, if you have a valid reason for missing your section (school – sponsored activity etc) you may request to attend another lab section in its place (within the same week)and still get credit for the lab. Bring the lab makeup form (available on webct) to the instructor of the replacement lab and request their permission to attend that section. To get credit, you must provide written documentation (with explanation) within 2 weeks of the missed lab to Dr. Strasser.

*****Missing more than 2 labs will result in a failing grade in the course**

Lab Quizes::

Quizzes are worth 10 points and may be given at the beginning or end of the lab period, depending on the exercise covered (ask your lab instructor). The lowest quiz score will be dropped. There are no make-ups for lab quizzes.

Lab Schedule: (subject to change)

	Week of	**Topic**
1)	August 30	Introduction: the Scientific Method
2)	Sept 6	Labor day: No labs
3)	Sept 13	Predation & Population Growth I
4)	Sept 20	Population Growth II & Mendelian Genetics I
5)	Sept 27	Mendelian Genetics II
6)	Oct 4	Mendelian Genetics III, ABO and Rh Blood types
7)	Oct 11	Adaptive Mutants in Yeast
8)	Oct 18	Microscope, Evolution
9)	Oct 25	Bacteria and Protists
10)	Nov 1	Protists and Fungi
11)	Nov 8	Survey of Plants

12)	Nov 15	Plant Anatomy
13)	Nov. 22	Thanksgiving, No Lab
14)	Nov 29	Plant Physiology I
15)	Dec 6	Plant Physiology II

BIOL 122 General Biology II **2004**
Lecture: SCI 126 MWF 8 – 9am, Lab in SCI 212 or 216

Instructor: Dr. Karen Strasser
Office hours: MW 9 to 11am or by appointment Office: 2120 ASC
Contact info: Phone: 591-2543 email: Karen_Strasser@ferris.edu

Required Materials:
Lecture Text: Biology, 6th edition by Raven and Johnson, 3 ringed binder
Laboratory Materials: General Biology Laboratory Manual, notebook, calculator, 3 ringed binder
Required test materials: Packet of SCANTRON cards (form 882-E), 2 #2 pencils, student ID

Notes and Recording: Class material will be presented during the lectures. It is your responsibility to attend class, take notes, and become informed of any announcements made during your absence. GET TO KNOW OTHER STUDENTS IN THE CLASS! The questions for the exams will be taken from the material presented in class and the chapters assigned in the textbook. You may use a tape recorder for the lectures.

Attendance: Attendance in lecture is expected. Please BE ON TIME!!!! Random bonus quizzes may be given during the semester, you must be present to get these points!
Attendance in lab is MANDATORY. Labs can not be made up.
More than 2 missed laboratories (for any reason) will result in a failing grade in the class.

Course objectives:
As this course is the second of a two part introductory biology sequence, it will continue to lay the foundation for further study in biology. See the lecture schedule for a list of topics covered.

Exams: Examinations will be given during the normal lecture period on the dates are listed on the class schedule. Exams will include material covered in lecture and assigned readings in the textbook. Failure to take an exam at the scheduled time (see class schedule) will result in a grade of 0 for the exam. If you have a valid excuse, inform me ahead of time (except for hospitalization etc.), and provide written documentation within 2 weeks of the missed exam (proof of funeral, hospitalization, etc) the points missed will be added to the cumulative final exam. For example, if you missed exam 2 (with a valid excuse), the comprehensive final would be worth 300 points instead of 200 points. If given at least 2 weeks notice, you may be able to take an exam early if you have a school sponsored activity (with documentation).You will not receive your exams back but you may stop by my office (during my office hours/by appointment) to look them over. Exam grades will be posted on WebCT.
***Bring a scantron sheet (Form 882-E), 2 #2 pencils, and your student ID to each exam.

Grading: Final grades will be based on points earned in lecture (75%) and laboratory (25%).
The Lecture grade (500 points) will be comprised of the average of 3 exams (100 points each) and a CUMULATIVE final (200 points) as well as any bonus quiz points earned during the semester. The final exam will include two parts, part one new material covered since the last exam (similar to a regular exam, 100 points) , and part 2 Cumulative material (material from the whole semester!: 100 points).
Lab grades will be based on the score earned on lab quizzes (10 points each) and lab participation (assessed by your lab instructor). See lab section for more detail

Grading Scale:

A (≥94%)	C (73 - 76.9%)
A- (90 - 93.9%)	C- (70 - 72.9%)
B+ (87- 89.9%)	D+ (67 - 69.9%)
B (83-86.9%)	D (63 - 66.9%)
B- (80-82.9%)	D- (60 - 62.9%)
C+ (77 - 79.9%)	F (≤ 59.9%)

Academic Integrity: Any form of cheating will not be tolerated, and will result in a 0 for the assignment or exam in question.

To do well in this course:

Attend all lectures and labs, and BE ON TIME
Exhibit professional behavior
Take good notes, and organize them
Read the assigned sections of the text book both before and after class
Study your notes EVERY WEEK, not just before the exam
Ask questions when there is something you don't understand
Do the weekly study questions posted on web CT(every week!)

Lecture Schedule: (subject to change)

Week		New Topic	Readings (chp)
1)	Jan 12, 14, 16	Introduction Chemistry review, Biological molecules	 2, 3
2)	Jan 19, 21, 23	Martin Luther King Day, no classes Jan 19 Cells (Jan. 21-23)	 5
3)	Jan. 26, 28, 30	Biological Membranes	6
4)	Feb. 2, 4, 6	Energy and Metabolism **Exam 1 Friday Feb. 6**	8
5)	Feb. 9, 11, 13	Cellular respiration	9
6)	Feb. 16, 18, 20	Photosynthesis DNA structure	10 14
7)	Feb. 23, 25, 27	genes, gene expression	15-16
8)	Mar. 1, 3, 5	**Exam #2 Fri March 5**	
9)	Mar. 8, 10, 12	**SPRING BREAK**	
10)	Mar. 15, 17, 19	Noncoelomate animals Mollusks and Annelids	44 45
11)	Mar. 22, 24, 26	Mollusks and Annelids Arthropods Last day to drop with a "W" March 26	45 46
12)	Mar. 29, 31 Apr. 2	Echinoderms Chordates	47 48
13)	Apr. 5, 7, 9	**Exam #3 Wednesday April 7** No class Friday April 9	
14)	Apr. 12, 14, 16	Animal organization Digestion	49 51
15)	Apr. 19, 21, 23	Respiration Circulation	53 52
16)	Apr. 26, 28, 30	Reproduction Homeostasis/ Immune system (time permitting)	59 57/58
17)	May 5	2 Part Final (200 Points!) Part 1 New Material (100 points), Part 2 Cumulative Final (100 points) **Wednesday May 5, 8:00 – 9:40am**	

Lab Information

Lab Grades: The points earned in lab will count for 25% of your final course grade.

Lab participation: 60points

You can earn up to 5 points each lab period for participation. You can lose these 5 points by being late to lab, leaving lab early, not participating in the activity, being disruptive in class. It is up to the discretion of your lab instructor to assign these points so make sure you know what he or she expects from you. (you are given one grace day)

Labs, and thus participation points earned, can not be made up for any reason. However, if you have a valid reason for missing your section (school – sponsored activity etc) you may request to attend another lab section in its place (within the same week)and still get credit for the lab. Bring a card with your name, section number (regular lab section), and lecture instructor (Dr. Strasser) to the instructor of the replacement lab and request their permission to attend that section. To get credit, you must provide written documentation (with explanation) within 2 weeks of the missed lab to Dr. Strasser.

***Missing more than 2 labs will result in a failing grade in the course

Lab Quizes: 100 points:

Quizzes are worth 10 points and may be given at the beginning or end of the lab period, depending on the exercise covered (ask your lab instructor). Dates of each quiz are listed on the Lab schedule. The best 10 (of 11) quiz scores will count towards your lab grade. There are no make-ups for lab quizzes.

Lab Schedule: (subject to change)

Week of	**Lab manual (Second half)**	**Topic Page in**	
1) Jan. 12-16	Macromolecules	1	
2) Jan. 19-23	No lab this week: Martin Luther King Day		
3) Jan. 26-30 (macromolecules)	Osmosis	15	Quiz 1
4) Feb. 2-6	Enzymes I	21	Quiz 2 (Osmosis)
5) Feb. 9-13 (Enzymes)	Enzymes II	31	Quiz 3
6) Feb. 16-20 2)	Energy	35	Quiz 4 (Enzymes
7) Feb. 23-27	DNA isolation and bacterial transformation I	42	Quiz 5 (energy)
8) Mar. 1-5 and II)	DNA isolation and bacterial transformation II	44	Quiz 6 (DNA I

9) Mar. 8-12	No lab this week: Spring Break		
10) Mar. 15-19	Invertebrate lab 1	51	
11) Mar. 22-26 material)	invertebrate lab 2	64	Quiz 7 (Invert 1
12) Mar 29- Apr 2 material)	Vertbrate Anatomy I	75	Quiz 8 (invert 2
13) Apr. 7-11	No lab this week: Easter Break		
14) Apr 12-16 anatomy 1)	Vertebrate Anatomy II	85	Quiz 9 (Vert
15) Apr 19-23 anatomy 2)	Kinesis in Pill bugs	88	Quiz 10 (Vert
16) Apr. 26 30 in pill bugs)	Environmental factors and macroinvertebrates	92	Quiz 11 (Kinesis

HUMAN ANATOMY AND PHYSIOLOGY
BIOL 321
COURSE SYLLABUS
FALL SEMESTER 2004

Instructor: Dr James Scott
Office: 2018 Arts and Science Commons
Telephone: FSU Office: 591-2620 if no ans. leave message on phone mail.
Clinic 796-3507 Monday and Wednesday all day only in case of emergency.
Home: 796-7583 evenings
E-Mail: James_Scott@ferris.edu

Office Hours: Tues. 8:00am – 9:50am
Thurs. 8:00am– 9:50 am
All other office hours by appointment*
*It is my desire to be available to you at all times and therefore I have offered several ways for you to contact me if necessary. If you need to meet with me I will be happy to work something out will my schedule and yours

Required Materials:
Seeley, R., Stephens, T., and Tate, D., 2003, Anatomy and Physiology, 6th Ed., WCB/McGraw-Hill, Boston, MA
Wise, E, 2002 Anatomy and Physiology Laboratory Manual, 6th Ed., WCB/McGraw-Hill, Boston, MA

Course Description: BIOL 321 4 credits
First of two semesters of a comprehensive, integrated course in anatomy-physiology, developing logical correlations between structures and their functions with emphasis on the molecular and cellular basis of organ system structure and function. Topics: cell physiology; control mechanisms; nervous, muscle, and endocrine systems. Laboratories include cadavers in anatomical studies and animal experimentation demonstrating physiological principles. Designed for students in science baccalaureate degree programs.

Prerequisites:
BIOL 121 and BIOL 122, CHEM 122

Class Schedule:

Lecture:		MWF	11:00AM -11:50AM
Lab:	Sec 211	R	3:00PM – 5:50PM
	Sec 212	W	1:00PM – 3:50PM
	Sec 213	R	12:00PM - 2:50PM
	Sec 214	T	1:00PM - 3:50PM

Course Objectives:
It is my goal that by the end of the second semester in the sequence of Human Anatomy and Physiology the student would have a basic understanding of the structures that make up the human body, how each of them function and how each are interrelated. Since most of those that will finish this course will continue on in some field of biology, you will find that this course will provide a good foundation for your future studies and professions

WebCT:

During the semester you will be required to log on to WebCT for many purposes such as to download and copy lecture outline materials, read notes from your instructor, retrieve exam and quiz scores and to check current course grades. Please check the WebCT BIOL 321 home page often so that you will not miss any of this important material. If you have any difficulty logging on and retrieving materials please let me know as soon as possible so that I or someone on our computer support staff can help you.

Grading Policies:

There will be 3 scheduled lecture exams each worth 100 points and a final exam which will include one portion, worth 100 points, covering new material since the previous exam and another portion, worth 100 points, that will be comprehensive covering material from the entire semester. I also anticipate giving periodic, unannounced, lecture quizzes covering material from the previous two lectures. Knowing that these quizzes can be given at any time will require you to keep current on your text reading and lecture note review.

Lab quizzes will be given weekly. Each quiz will be worth approximately 20 points. Quizzes will cover materials from the previous lab period and will be given at the beginning of each lab session. There will also be a comprehensive lab practical worth 50 points near the end of the semester.

Lecture will account for approximately 550 points and laboratory will account for approximately 250 points of your final percentage.

GRADING SCALE:

The total points achieved by the student in this course will be converted into a percent total and the final grade will be determined according to the following scale:

92 - 100 = A	73 - 76.9 = C
90 - 91.9 = A-	70 - 72.9 = C-
87 - 89.9 = B+	67 - 69.9 = D+
83 - 86.9 = B	63 - 66.9 = D
80 - 82.9 = B-	60 - 62.9 = D-
77 - 79.9 = C+	Below 60 = F

Attendance:

Laboratory attendance is mandatory for all students and each unexcused absence from lab will result in a reduction in your course point total by 20 points. Missing greater than two labs is grounds for failure of the course regardless of what your overall percentage is. If you must miss a lab please contact me early in the week so that we can place you into another lab session that same week. **There will be no make-up labs or lab quizzes.**

Lecture attendance is not mandatory (i.e. roll will not be taken) although you must be aware that there is a direct link between good attendance and good grades. Do not depend on others to take good notes. If you hear the lecture, take good notes, and study your own notes you will be much more successful in this course.

Lecture period attendance on exam days is mandatory. If you miss a lecture exam, you must contact me within 24 hours with an acceptable, verifiable excuse. **Only then will a make up exam be considered.**

Lecture exams and Lab quizzes:

Lecture exams will be based on material presented in lecture and lab and will consist of multiple choice, true and false, short answer, and essay.

Lab quizzes will consist of short answer, essay and calculations that are obtained from the previous lab period.

BIOLOGY 321 HUMAN ANATOMY AND PHYSIOLOGY
LECTURE SCHEDULE
FALL SEMESTER 2004

Week	Day	Date	Lecture Topic	Reading (Seeley, Stephens, Tate)
1	M	Aug 30	The Human Organism The Chemical Basis for Life	Chapter 1 Chapter 2
	W	Sept 1	Cell Structure and Function	Chapter 3
	F	Sept 3	Cell Structure and Function	Chapter 3
2	M	Sept 6	**Labor Day – No Class Today**	
	W	Sept 8	Histology	Chapter 4
	F	Sept 10	Histology	Chapter 4
3	M	Sept 13	The Integumentary System	Chapter 5
	W	Sept 15	The Integumentary System	Chapter 5
	F	Sept 17	Ligands and Membrane Bound Receptors	Chapter 9
4	M	Sept 20	Membrane Transport and Potential	Chapter 9
	W	Sept 22	The Resting Membrane Potential	Chapter 9
	F	**Sept 24**	**Exam 1**	
5	M	Sept 27	Action Potential and Propagation	Chapter 9
	W	Sept 29	Functional Organization of the Nervous System	Chap 12
	F	Oct 1	Synaptic Transmission	Chap 12
6	M	Oct 4	Neuronal Pathways and Circuits	Chap 12
	W	Oct 6	Central Nervous System	Chap 13
	F	Oct 8	Central Nervous System	Chap 13

Week	Day	Date	Lecture Topic	Reading (Seeley, Stephens, Tate)
7	M	Oct 11	Central Nervous System	Chap 13
	W	Oct 13	Peripheral Nervous System	Chapter 14
	F	Oct 15	Peripheral Nervous System	Chapter 14
8	**M**	**Oct 18**	**EXAM 2**	
	W	Oct 20	The Special Senses Sensation, Olfaction	Chapter 15
	F	Oct 22	Special Senses Taste, The Visual System	Chapter 15
9	M	Oct 25	Special Senses Visual System, Hearing	Chapter 15
	W	Oct 27	Special Senses Static/dynamic Equilibrium	Chapter 15
	F	Oct 28	Autonomic Nervous System	Chapter 16
10	M	Nov 1	Autonomic Nervous System	Chapter 16
	W	Nov 3	Autonomic Nervous System	Chapter 16
	F	Nov 5	Skeletal System Struc/Function	Chapter 6
11	M	Nov 8	Skeletal System Struc/Function	Chapter 7
	W	Nov 10	Articulations and Movement	Chapter 8
	F	**Nov 12**	**Exam 3**	
12	M	Nov 15	Muscle Gross Anatomy	Chapter 10
	W	Nov 17	Muscle Histology	Chapter 9
	F	Nov 19	Muscle Physiology	Chapter 9
13	M	Nov 22	Muscle Physiology Cont.	Chapter 9
	W	Nov 24	Cardiac and smooth muscle	Chapter 9
	F	**Nov 26**	**Thanksgiving No Class**	

Week	Day	Date	Lecture Topic	Reading (Seeley, Stephens, Tate)
14	M	Nov 29	Organization of the Endocrine System	Chapter 17
	W	Dec 1	Hypothalamus and Pituitary Gland	Chapter 17 -18
	F	Dec 3	Pituitary Gland Cont.	Chapter 18
15	M	Dec 6	Thyroid/Parathyroid Glands	Chapter 18
	W	Dec 8	Adrenal/Pancreas/Gonads	Chapter 18
	F	Dec 10	Other Endocrine Glands	Chapter 18
16		**Final Examination Date and Time to be announced**		

Laboratory Schedule

Week	Dates	Subject	Reading (Eric Wise lab Manual)
1	Aug 31-Sept 2	Organs, Systems Microscopy Cell Structure/Function	Lab 1 Lab 2 Lab 3
2	Sept 7- Sept 9	Tissues	Lab 4
3	Sept 14 – Sept 16	Tissues Continued Integumentary System	Lab 4 Lab 5
4	Sept 21 – 23	Cell Membrane Permeability	Lab 3 + Handout
5	Sept 28 – 30	Compound Action Potential	Handout
6	Oct 5 – 7	Introduction to the Nervous System Central Nervous System	Lab 16 Lab 17
7	Oct 12 – 14	Stimuli and Reflexes Intro to Sensory Receptors Taste and Smell Eye and Vision	Lab 19 Lab 20 Lab 21 Lab 22
8	Oct 19 – 21	To Be Announced	
9	Oct 26 – 28	Skeletal System	Labs 6,8,9
10	Nov 2 – 4	Skeletal System	Lab 7
11	Nov 9 – 11	Muscle Anatomy	Labs 12-15 List Provided
12	Nov 16 – 18	Muscle Physiology	Lab 11
13	Nov 22-24	Open Labs – Lab Practical Review	
14	**Nov 30 – Dec 2**	**Final Comprehensive Lab Practical**	

CATALOGUE LISTING:

A study of the fundamental principles of development and the mechanisms responsible. An examination of the morphological changes which occur during development in vertebrates. Designed for students in science bachelor's degree programs. Prerequisite: BIOL 122. Semester offered: W

FACULTY INFORMATION:

Instructor: **Dr. Jack Buss**
Office: **2009 Arts and Sciences Commons**
Telephone: **231-591-5639**
e-mail: **bussj@ferris.edu**

Office hours:

Monday	9:00 am - 950 am; 12:00 noon - 12:50 pm
Wednesday	9:00 am - 950 am; 12:00 noon - 12:50 pm

MAJOR OBJECTIVES OF THE COURSE:

1. The student will demonstrate knowledge concerning experimental design.
2. The student will demonstrate an understanding of the basic concepts associated with gamete production and fertilization.
3. The student will demonstrate an understanding of the basic concepts regarding the control of developmental events.
4. The student will demonstrate knowledge of anatomical terminology and of vertebrate anatomical structure.
5. The student will demonstrate knowledge concerning the relationships between developmental events and the definitive adult structure.
6. The student will identify web sites on the internet relating to topics in developmental biology.

COURSE FORMAT:

The study of development not only attempts to answer the question "Where did I come from?" but also, "Why am I like I am?" As we explore the basic concepts of embryonic development we will investigate not only the morphological changes that occur during development, but also the mechanisms responsible for these changes. Particular emphasis will be placed on the experimental framework upon which our understanding of developmental processes is based. The laboratory will focus primarily on the morphological changes that take place during development. Students will be required to demonstrate their ability to identify structures on serial sections. On occasion, living materials will be used to observe the progression of morphological changes during development.

It is important that you attend every class session, read the textbook and laboratory manual assignments in advance, and review course material on a daily basis. Many

studies have shown that class attendance is one of the most important factors in obtaining academic success.

As a student in this course, you should recognize that embryonic development is complex and that numerous new terms and concepts will be introduced during this semester. A strong emphasis in the exams will be placed on knowledge of the terminology used in this course. If for some reason you find that you are having problems with the material covered in discussions or in the laboratory, please do not hesitate to ask your instructor for assistance. It is not uncommon for a student to feel overwhelmed by the volume of information presented in this course, however, with diligent effort, the seemingly unrelated concepts will fall together into a coherent pattern and the study of development will become a fascinating and rewarding endeavor.

TEXTS:

Carlson, B.M., Patten's Foundations of Embryology, McGraw-Hill, Inc., 1996.
Schoenwolf, G.C., Laboratory Studies of Vertebrae and Invertebrate Embryos, 7th ed., Prentice Hall, 2001.

EXAMINATIONS:

There will be **three lecture examinations** based on the discussion topics and **three laboratory examinations** will be given during the course of the semester. The dates of these exams are listed in the course schedule. A written **final examination** will be given during finals week. Each **lecture exam** score will be **converted to a percentage** and will account for **100 points**. The **lecture exams** will account for a total of **300** points.

Laboratory practical examinations will consist primarily of identification of embryonic structures and demonstration of knowledge of their function and their relationship to adult structures. Each laboratory exam score will be **converted to percentage** and will account for **100 points**. The **laboratory exams** will account for a total of **300** points.

The **final exam** will consist primarily of questions taken from previous exams and the study questions. The score on the final examination will be **converted to a percentage** and account for **100 points**.

Points may be awarded for completion of laboratory exercises and for other activities such as outside written assignments. The points for such activities will be added to the total possible for the course. **No corrections on the grade sheet will be made concerning points awarded for such activities after the Friday before finals week.**

All points accumulated during the semester will be **totaled,** converted to **percentage** and a course grade assigned will be based on the **scale listed below**. The instructor will not raise the following standards but retains the option to lower the standard required to achieve a particular grade.

The total possible points for lecture exams, laboratory exams, and the lecture final exam, is approximately **700 points**.

GRADING SCALE:

92 - 100 = A	72 - 77.99 = C
90 - 91.99 = A-	70 - 71.99 = C-
88 - 89.99 = B+	68 - 69.99 = D+
82 - 87.99 = B	62 - 67.99 = D
78 - 81.99 = B-	60 - 61.99 = D-
78 - 79.99 = C+	Below 60 = F

OTHER POLICIES:

Students are responsible for any assignments made during the class session whether they are in attendance or not. If you must miss a class, please notify the instructor in advance if possible.

Unexcused absences may result in the loss of points.

For an absence to be excused, the student's name must appear on a memo from the office of the Vice-President of Academic Affairs (e.g. field trip, sporting event, concert tour) or on a memo from the Associate Dean of Students of the College of Arts and Sciences explaining the reason for the absence. The instructor reserves the right to excuse an absence if the reason is justified.

Only in cases of extreme emergency will a student be allowed to make up a **laboratory examination.** In cases in which the absence from a laboratory exam is considered justified by the instructor, a different exam, typically more difficult and in the form of an oral examination will be given.

It is expected that each student will come to the **laboratory session** prepared to maximize his/her learning experience. This can only be accomplished by reading the laboratory materials and studying the appropriate illustrations in the laboratory text prior to the start of the laboratory session.

Out of class assignments must be submitted on the due date. Failure to do so may result a zero on the assignment or a significant point deduction from the total achieved.

It is a University policy that children are not permitted in the laboratories.

Date			Topic	Text	Pages
Jan	12	Lec	1a - Historical Background	C*	001-008
		Lab	Mitosis		WebCT
	14	Lec	1b - The Cell	C	008-014
		Lab	33 hour chick embryo whole mount	S**	053-055
	16	Lec	1c - Extracellular matrix	C	014-020
		Lab	33 hour chick embryo serial cross sections	S	055-058
Jan	19		NO CLASS - M. L. KING BIRTHDAY		
	21	Lec	1d - Cell Cycle; Gene Expression	C	020-030
		Lab	33 hour chick embryo serial cross sections	S	055-058
	23	Lec	1e - Fundamental Concepts in Development	C	030-040
		Lab	33 hour chick embryo serial cross sections	S	055-058
Jan	26	Lec	1f - Methods in the Study of Embryonic Development	C	041-056
		Lab	33 hour chick embryo serial cross sections	S	055-058
	28	Lab	Embryo recovery - 33 hour chick	S	298-299
	30		LECTURE EXAMINATION I	C	001-056
Feb	02	Lec	2a - Reproductive Organs	C	057-064
		Lab	33 hour chick embryo serial saggital sections	S	058-060
	04	Lec	2b - The Sexual Cycle	C	065-073
		Lab	Review 33 hour chick embryo	S	053-060
	06		LABORATORY EXAMINATION I	C	034-039
Feb	09	Lec	3a - Gametogenesis	C	075-085
		Lab	Meiosis Lab	S	WebCT
	11	Lec	3b - Spermatogenesis	C	085-094
		Lab	Frog Testis; Mammalian testis		WebCT
	13	Lec	3c and 3d - Oogenesis	C	094-103
		Lab	Frog ovary, Mammalian ovary		WebCT

*Carlson, B.M., 1996, Patten's Foundations of Embryology, 6th edition, McGraw-Hill, Inc.,
**Schoenwolf, G.C., 2001, Laboratory Studies of Vertebrate and Invertebrate Embryos, 8th ed.,Prentice-Hall

Date			Topic	Text	Pages
Feb	16	Lec	3e - Accessory Membranes	C	103-113
		Lab	18, 24-hour chick embryo	S	074-101
	18	Lec	4a - Invertebrate Fertilization	C	121-131
		Lab	18, 24-hour chick embryo	S	074-101
	20		LECTURE EXAMINATION II	C	057-113
Feb	23	Lec	4b - Mammalian Fertilization	C	131-141
		Lab	Ascaris fertilization	S	WebCT
	25	Lec	4c - Sex Determination and Polarity	C	141-149
		Lab	48-hour chick embryo whole mount	S	104-106
	27	Lec	5a - Invertebrate Cleavage	C	151-161
		Lab	Sea Urchin cleavage and gastrulation	S	WebCT
Mar	01	Lec	5b - Amphibian and Mammalian Cleavage		161-175
		Lab	48 hour chick embryo serial x.s	S	106-111
	03		5c - Experimental Embryology	C	175-189
		Lab	48 hour chick embryo serial x.s	S	106-111
	05		6a - Gastrulation	C	189-204
		Lab	48 hour chick embryo serial x.s	S	106-111
Mar	08		SPRING BREAK		
	10		SPRING BREAK		
	12		SPRING BREAK		
Mar	15	Lec	6b - Germ Layer Formation	C	204-214
		Lab	48 hour chick embryo serial x.s	S	106-111
	17	Lec	7a - Neural Induction; Neurulation in Amphibians	C	226-240
		Lab	48 hour chick embryo serial x.s	S	106-111
	19		LECTURE EXAMINATION III	C	131-204
Mar	22	Lec	7b - Mesoderm and Axial Structures	C	240-254
		Lab	48 hour chick embryo serial x.s	S	106-111
	24	Lec	10a - Cell diversity	C	311-320
		Lab	48 hour chick embryo serial x.s	S	106-111
	26	Lec	10b - Gene Expression	C	320-328
		Lab	48 hour chick embryo serial x.s	S	106-111

Date			Topic	Text	Pages
Mar	29	Lec	10c - Muscle Cytodifferentiation		339-353
		Lab	48 hour chick embryo serial sag.s.	S	111-112
Mar	31	Lec			
		Lab	48 hour chick embryo serial sag.s.	S	111-112
Apr	02		Embryo recovery - 48 hour chick		
Apr	05		LECTURE EXAMINATION IV	C	204-254
				C	311-328
	07		LABORATORY EXAMINATION II		
	09		EASTER RECESS		
				S	138
Apr	12	Lec	10d - Formation of Skeletal Tissue		355-365
		Lab	72 hour chick embryo whole mount	S	138-142
	14	Lec	11a - Skin Formation		
		Lab	72 hour chick embryo serial cross sections	S	138-142
	16	Lec	11b - Tissue Interactions in Integument	C	365-375
		Lab	72 hour chick embryo serial cross sections		
Apr	19	Lec	11c - Epidermal Differentiation	C	375-391
		Lab	72 hour chick embryo serial cross sections	S	138-142
	21	Lec	13a - Nervous System	C	427-438
		Lab	72 hour chick embryo serial cross sections	S	138-142
	23	Lec	13b - Neural Tube Formation	C	438-451
		Lab	72 hour chick embryo serial cross sections	S	138-142
Apr	26	Lec	13c - Peripheral Nerve Development	C	451-467
		Lab	72 hour chick embryo serial saggital sections	S	142-143
	28	Lec	- Eye Development		
		Lab	72 hour chick embryo serial saggital sections	S	142-143
			Embryo recovery - 72 hour chick		
	30		LECTURE EXAMINATION V	C	329-391
					427-467
May	05		LABORATORY EXAMINATION III		8:00 am

BIOL 375
Principles of Genetics
Fall 2004

Instructor: Mary R. Murnik, Ph. D. *Office*: ASC 2117 *Phone*: x2546

e-mail: **murnikm@ferris.edu** *Office Hours*: M W 11:00-11:50am, T R 8:30-9:20am

Course Objectives:

BIOL 375 introduces genetics to students who are science majors. The purpose of this course is to increase your understanding of the mechanisms of the transmission and expression of genetic information. You will gain factual knowledge about genetics and learn to apply genetic concepts and principles. After completion of this course, you should have a good understanding of inheritance patterns and the molecular mechanisms by which genes control cell metabolism, growth and differentiation, and the evolutionary implications of genes in populations. Problem solving and critical thinking are emphasized.

Prerequisites: Biology 122 or equivalent and a course in biological chemistry

Text: *Genetics*, Benjamin Pierce, W.H.Freeman & Co., 2003

Lecture Guide: *Genetics: A Lecture Guide for BIOL 375*, Mary R. Murnik, 2004
(Available only at Great Lakes Book and Supply)

Attendance and Participation:

Attendance and participation at all lectures is expected.
Students will reason and solve genetics problems during class. Your course participation will be reflected in your grade. Students will be selected randomly to respond to a genetics question or problem during lecture. If you miss a lecture, it is your responsibility to obtain information which was presented. You are expected to read relevant text material before class and to do related problems in the lecture guide. Lectures will not repeat all text and problem material.

About this course:

Principles of Genetics is a rigorous course which involves analysis, critical thinking and steady effort. I want you to succeed. Completing the assigned problem sets should help you to build your knowledge of the genetic topics. The lecture sessions will explore analysis of different types of genetic problems. By attending all lecture sessions, you should learn how to perform the genetic analyses that will be expected on the assigned

work and exams. By doing these assignments well, you will learn to apply the major genetic concepts, and also earn a good grade in genetics.

Class Decorum:

The College of Arts and Sciences strives to maintain a positive learning environment and educational opportunity for all students. Patterns of behavior which obstruct or disrupt the learning environment in the classroom will be dealt with under the College of Arts & Sciences *Disruptive Behavior Policy.* ***Cell phones must be turned off, and interpersonal conversations cease, during the class period.***

Tests, assignments and grades:

There will be daily assigned problems, a 100 point participation grade (50 pts assigned at mid-term and 50 at the end of the course), four scheduled 100-pt. tests and a 100 pt. final examination, which is optional. The final exam grade would replace the lowest test score, if the final exam score is higher.

Participation grades will be determined by the average of your responses when called upon in class. Responses will be graded 10 (very good), 8 (good), 6 (non-responsive) or 0 (not present).

The grading scale is:

A	93% and above	C	73-76%
A-	90-92%	C-	70-72%
B+	87-89%	D+	67-69%
B	83-86%	D	63-66%
B-	80-82%	D-	60-62%
C+	77-79%	F	below 60%

Make-Up Tests:

Make-up tests will be offered only to students with documentation for valid reasons for missing the regular exam (e.g. illness, death in the family.)

Cheating:

The FSU policy on cheating is described in the Student Handbook. Cheating on a test or quiz usually results in *automatic failure in the course.* If a grade of zero is given as a penalty for cheating, it may not be dropped from the calculation of the grade average.

Help:

I will be happy to help you during regular office hours or during any other available time. You are also encouraged to attend the scheduled *tutoring sessions*, which will be announced in class. You will probably find that it helps to study in a group, so seek out some other students in the class who are interested in studying together.

BIOL 375 Lecture Schedule

Date	*Topic*	***Chapter/Pages in Text***
Aug. 31	Introduction to Mendelian Genetics	**1**, 45-54
Sept. 2	Probability, the Chi-Square Test & Independent Assortment	54-69
Sept. 7, 9	Modification of Mendelian Ratios	67-68;101-111; 620-621
Sept. 14	Sex Linkage and Pedigree Analysis	**4**,132-140
Sept. 16	Polygenic Inheritance and Quantitative Traits	**22**, 141-145
	Sept. 21 Test 1	
Sept. 23	Mitosis and Meiosis; Aneuploidy & Polyploidy	**2**, 247-260
Sept. 28, 30	Chromosomal Structural Changes	234-247
Oct. 5	Linkage	**7**
Oct. 7	Population Genetics: genetic equilibrium	669-690
Oct. 12	Population Genetics and Evolution	691-699
Oct. 14	**Test 2**	
Oct. 19	DNA	**10**, 322-338
Oct. 21	Genes and Proteins; Transcription	404-411; 353-366
Oct. 26	Translation	411-428
Oct. 28	Transcription and its control in Prokaryotes	438-455
Nov. 2, 4	Gene Structure and Expression in Eukaryotes	289-298;340-343; 366-373; 434-438;455-465;610-621
Nov. 9	Mutations	**17**
	Nov. 11 Test 3	
Nov. 16	Genetics of Bacteria and Viruses	198-220;223-5
Nov. 18	Transposable Elements	301-315
Nov. 23, 30	Genetic Engineering and Genomes	507-529;538-42 **19**
Dec. 2	Extranuclear Inheritance	**20**, 225-227
Dec. 7	Genes and Cancer	621-630
Dec. 9	**Test 4**	
Dec. 13 (Mon.)	**Final Exam 10:00-11:40 am**	**STR 136**

MICROBIOLOGY AND IMMUNOLOGY

Biol 386
5 CR. (4+3)

Winter,

PREREQUISITES: BIOL 332 AND PREVIOUS OR CONCURRENT BIOCHEMISTRY

COURSE SYLLABUS

DATE	TOPIC	REFERENCE
1. Mon. 1/12	Introduction and History	**Brock** ch. 1
2. Tues. 1/13	Prokaryotic and Eukaryotic Cells	B. pages 1,6, 63-68,473-4
3. Wed. 1/14	Bacterial Structure and Function	B. ch. 2 & 4
4. Thrs. 1/15	Bacterial Structure and Function	B. ch. 2 & 4
5. Mon. 1/19	M.L.K. DAY--NO CLASSES	
6. Tues. 1/20	Bacterial Structure and Function	B. ch. 2 & 4
7. Wed. 1/21	Bacterial Growth and Sporulation	B. ch. 6 & p. 56, 95-100
8. Thrs. 1/22	Bacterial Taxonomy	B. ch. 12, 13 & 14
9. Mon. 1/26	Viral Structure and Replication	B. ch. 9 & 16
10. Tues. 1/27	Viral Structure and Replication	B. ch. 9 & 16
11. Wed. 1/28	Fungal Structure and Taxonomy	B. p. 486-490
12. Thrs. 1/29	EXAM I	
13. Mon. 2/2	Microbial Metabolism	B. ch. 5, 17 & 19
14. Tues. 2/3	Microbial Metabolism	B. ch. 5, 17 & 19
15. Wed. 2/4	Microbial Metabolism	B. ch. 5, 17 & 19
16. Thrs. 2/5	Microbial Genetics	B. ch. 7, 8, 10 & 15
17. Mon. 2/9	Microbial Genetics	B. ch. 7, 8, 10 & 15
18. Tues. 2/10	Microbial Genetics	B. ch. 7, 8, 10 & 15
19. Wed. 2/11	Microbial Control	B. ch. 20
20. Thrs. 2/12	Microbial Control	B. ch. 20
21. Mon. 2/16	Sterilization and Disinfection	B. ch. 20
22. Tues. 2/17	Host Parasite Interactions	**Schaechter**. ch.1,2,& 3
23. Wed. 2/18	Mech. of Bacterial Pathogenicity	S. ch. 8, 9, & 10
24. Thrs. 2/19	Mech. of Bacterial Pathogenicity	S. ch. 8, 9, & 10
25. Mon. 2/23	Mech. of Viral Pathogenicity	S. ch. 31
26. Tues. 2/24	Mech. of Viral Pathogenicity	S. ch. 31

27. Wed. 2/25	EXAM II	
28. Thrs. 2/26	Respiratory Tract Infections	S. ch.13,19,21,23 & 59
29. Mon. 3/1	Respiratory Tract Infections	S. ch.13,19,21,23 & 59
30. Tues. 3/2	Respiratory Tract Infections	S. ch.13,19,21,23 & 59
31. Wed. 3/3	Skin & Mucous Membrane Infections	S. ch. 48 & 61
32. Thrs. 3/4	Oral Cavity Infections	S. ch. 57
33. 3/8 – 3/12	SPRING RECESS NO CLASSES	
34. Mon. 3/15	G.I. Tract Infections	S.ch.16,17,22,32,37,73
35. Tues. 3/16	G.I. Tract Infections	S.ch.16,17,22,32,37,73
36. Wed. 3/17	Wound Infections	S. ch 11, 15 20 & 35
37. Thrs. 3/18	Wound Infections	S. ch 11, 15 20 & 35
38. Mon. 3/22	Viral Hepatitis	S. ch. 42
39. Tues. 3/23	STD's - Bacterial	S. ch. 14,24, 27 & 66
40. Wed. 3/24	STD's - Viral	S. ch. 40, 41 & 66
41. Thrs. 3/25	AIDS	S. ch. 38 & 68
	LAST DAY FOR A "W" GRADE IS FRIDAY MARCH 26th	
42. Mon. 3/29	Childhood Infections	S. ch. 34 & 69
43. Tues. 3/30	Nosocomial Infections	S. ch. 72
44. Wed. 3/31	EXAM III	
45. Thurs. 4/1	Immune System, Innate Immunity	**Kuby** ch. 1 & 3
46. Mon. 4/5	Phagocytosis, Humoral Immunity	K. ch. 4-6,8-13
47. Tues. 4/6	Humoral Immunity, Acute Inflammation	K. ch. 4-6,8-13,15
48. Wed. 4/7	Humoral Immunity, Acute Inflammation	K. ch. 4-6,8-13,15
49. Thrs. 4/8 - Fri. 4/9	NO CLASSES - EASTER RECESS	
50. Mon. 4/12	Complement	K. ch. 14
51. Tues. 4/13	Cellular Immunity/Chronic Inflamm.	K. ch. 15-16
52. Wed. 4/14	Cellular Immunity/Chronic Inflamm.	K. ch. 15-16
53. Thrs. 4/15	Cellular Immunity/Chronic Inflamm.	K. ch. 15-16
54. Mon. 4/19	Hypersensitivity	K. ch. 17,20,21
55. Tues. 4/20	EXAM IV	

56. Wed. 4/21	Hypersensitivity	K. ch. 17,20,21
57. Thrs. 4/22	Hypersensitivity	K. ch. 17,20,21
58. Mon. 4/26	Hypersensitivity	K. ch. 17,20,21
59. Tues. 4/27	Immunological Diseases	K. ch. 18-22
60. Wed. 4/28	Autoimmunity	K. ch. 20
61. Thrs. 4/29	Transplantation Immunity	K. ch. 23
62. TUES. 5/4	☞FINAL EXAMINATION - COMPREHENSIVE ☜	**4-5:40pm**

TEXTS: 1) **Brock: BIOLOGY OF MICROORGANISMS**, 10TH edition, 2000, by Madigan, et.al.
NOTE: Working Glossary at beginning of each chapter and G-1 to G-15 at end of book

2) **MECHANISMS OF MICROBIAL DISEASE**, 3RD edition, 1998, by Schaechter, et.al.
NOTE: Excellent case studies in most chapters

3) **Kuby: IMMUNOLOGY**, 4TH EDITION, 2000, by Goldsby et.al. (Glossary p. 609-624)

EXAMS: There will be 4 regularly scheduled exams plus a **comprehensive final**. Each of these exams is worth 100 points and **will**
be individually curved, if necessary, to 75%. In addition laboratory will be worth 100 points for a total of 600 points in the course. Exam format may include multiple choice, matching, essay, and problem solving. **Make up exams**, for valid and documented absences,
are essay. ALL EXAM DATES are tentative and may be changed to accommodate the **majority** of the class.

SCALE: 100-93 = A, 92-90 = A-, 89-87 = B+, 86-83 = B, 82-80 = B-, 79-77 = C+, 76-73 = C, 72-70 = C-, 69-67 = D+, 66-63 = D,
62-60 = D-, 59- = F

ATTENDANCE: You are **EXPECTED** to attend every lecture and to explain any absence. Attendance will be taken at our option and unexcused absences may result in a loss of points.

INSTRUCTORS:

M. Ryan, Ph.D., ASC-2115, extension #5892. Office hours are NOON - 12:50 PM and 3:00 - 3:50 PM on T& R or by appointment. E-mail: **ryanm@ferris.edu**

W. Hoeksema, Ph.D., ASC-2013, extension #2555. Office hours are 12 noon - 12:50 PM on M, T, W & R or by appointment. E-mail: **hoeksemw@ferris.edu**

If the instructor is **not available**, please leave a message on his telephone answering machine.

LEARNING OBJECTIVES:

1) To learn how professionals in microbiology and immunology use the scientific method to gain new knowledge and modify or eliminate existing paradigms.

2) To learn collaborative skills by working in groups for some assignments.

3) To learn how to apply certain course material to develop problem solving and critical thinking skills in microbiology.

4) To learn the language/terminology of microbiology.

5) To learn the fundamental principles of microbial structure and function, microbial metabolism, microbial growth and reproduction, microbial genetics, and the control of microbial growth.

6) To learn the principles, mechanisms, and theories of microbial pathogenicity in humans.

7) To learn the structure, function, and control of the immune system and the mechanisms of hypersensitivity.

World Wide Web Sites Related To Microbiology and Immunology

1. Microbiology http://www.ch.ic.ac.uk/medbact/microbio.html

2. Virology http://www.tulane.edu/~dmsander/garryfavweb.html

3. Hepatitis http://cpmcnet.columbia.edu/dept/gi/disliv.html

4. AIDS/HIV http://www.yahoo.com/Health/Diseases_and_Conditions/AIDS_HIV/

5. AIDS/Treat. http://carebase2.jri.org/infoweb/treatment/library/beta/beta26.htm
   http://www.yamanashi-med.ac.ip/~microbio/microbiology.html

6. Herpes http://racoon.com/newhpx.html
   http://www.herpescontrol.com/

7. Influenza(WHO) http://www.who.ch/programmes/emc/flu/flu.htm

8. CDC Home Page http://www.cdc.gov./

9. WHO Home Page http://www.who.ch/Welcome.html

10. Medical News http://www.pslgroup.com/mednews.htm (also see Infect. Diseases web site below for medical news)

11. Infect.Disease http://www.medscape.com/ (**NOTE**:you will have to register,it's free)

12. Infect.Disease gopher://gopher.health.state.ny.us/11/.consumer/.factsheets

13. Clinical Med. http://www.avicenna.com/ (**NOTE:**you will have to register, it's free)

14. Immunology http://www.primenet.com/~vohnout/immunology.html

15. Immunology http://www.cc.emory.edu/WHSCL/medweb.immunology.html

16. Immunology http://www-micro.msb.le.ac.uk/immunology.html

17. Antibody Page http://www-chem.ucsd.edu/Faculty/goodman/antibody.html/abpage.html

18. Cytokines http://www.ocms.ox.ac.uk/~smb/cyt_web/

19. Autoimmunity http://web.cps.msu.edu/~keyesdav/ms/

20. Vaccines http://www.eden.com/~via/

21. Vaccine Weekly http://www.holonet.net/homepage/1v.htm

22. Test Banks http://fiona.umsmed.edu/~yar/tests.html (mainly virology questions)

23. Case Studies http://edcenter.med.cornell.edu/Pathopysiology_Cases/Pulmonary/Pulm_TOCs.html (lower respiratory tract infections)

24. Search Program http://www.google.com/

If you need help in accessing these sites, please check with us for instructions. Remember to capitalize where ever you see capital letters in a web address

BIOL 386 Laboratory Schedule Winter 2004

Dates	*Description*	*Page Number(s)*
Jan 12/13	Laboratory Objectives, Check-in	
14/15	Medium Preparation & Microscopy	3, 21
Jan 19/20	No labs on Monday or Tuesday	
21/22	Pure Cultures & Environmental Surveillance	15, 9
Jan 26/27	Simple Stain & Environmental Surveillance Follow-up	29, 11
28/29	Gram Stain	35
Feb 2/3	Acid-fast & Capsule Stains	47, 41
4/5	Fungal Slide Culture & Bacterial Endospore/Flagella Stain Demo Slides	69, 51, 57
Feb 9/10	Fungal Slide Culture Follow-up	71
11/12	Aseptic Pipetting/Viable Count	77
Feb 16/17	Aseptic Pipetting/Viable Count Follow-up & Bacterial Commensalism	79, 99
18/19	Bacterial Commensalism Follow-up	100
Feb 23/24	Bacteriophage Assay	85
25/26	Bacteriophage Assay Follow-up	87
Mar 1/2	Antiseptics and Disinfectants & Antibiotic Susceptibility	117, 125
3/4	Antiseptics and Disinfectants & Antibiotic Susceptibility Follow-ups	119, 127
Mar 8/9, 10/11	**Spring Break – No Labs**	
Mar 15/16	Metabolic Inhibition	133
17/18	Metabolic Inhibition Follow-up	135
Mar 22/23	Genetic Transformation I & Ouchterlony Double Immunodiffusion	141, 167
24/25	Genetic Transformation II & Radial Immunodiffusion	143, 175
Mar 29/30	Gen.Transform.III & Ouchterlony/Radial Immunodiffusion Follow-ups	143, 169, 177
Mar 31/Apr 1	Identification of Gram Positive Cocci	159
Apr 5/6	I.D. of Gram-positive Cocci Follow-up & Staph Latex Agglutination	161, 183
7/8	No labs on Wednesday or Thursday	
Apr 12/13	Identification of Enterobacteriaceae	151
14/15	ID of Enterobacteriaceae Follow-up	153
Apr 19/20	Inoculate Unknowns	
21/22	Identify Unknowns & Lab Check-out	
Apr 26/27	Lab Practical Exam Review	
28/29	Lab Practical Exam - 90 pts.	

Lab Manual : *Microbiology for the Health Care Sciences* **(Fourth Edition)**, Hartley, et. al.
Purchase: laboratory coat
Grading: 90 pts. for Lab Exam + 10 pts. instructor evaluation = 100 pts.
Attendance: Mandatory; unexcused absence from the lab may result in course failure
Objectives: See page "v" of your lab manual

Winter, 2004

BIOL 470: MOLECULAR GENETICS

Instructor: Dr. C. Boogaard

Pre- or Co-requisite: BIOL 375, & either PHCH 320 or CHM 364

Office: ASC 2116; X2544; office hours M, F 10-11; W 10-12; or by appointment.

Course Objectives: To understand genetic phenomena at the molecular level, including replication, recombination, mutation, and repair, the structures of the DNA, the genome and the chromatin; and the control of gene activity through transcription and splicing of RNA; to understand the experimental basis of scientific discovery as it applies to molecular genetics.

Text: Benjamin Lewin, **GENES VIII**, 2003, Oxford, N.Y.

Lecture Notes and Study Guide are available at Great Lakes Books and Supply.

Grading: 4 lecture exams; exam format: short-answer essay, problems.

This class is scheduled to meet Tuesdays and Thursdays, from 9:00 to 10:50 in SCI137.

Grading:

Grading is based on four exams, each contributing 25% of the mark. The final exam will not be comprehensive. In addition, extra credit points may be given for especially insightful classroom participation and discussions. (This does not apply to simple "please clarify"-type questions.) Optional extra credit quizzes may be given without warning.

At the end of the term, the students total (out of 400 points) will be calculated, and grades will be assigned on a curve.

The following is a tentative outline. The instructor reserves the right to vary the outline, including the right to change the order of topics, and the right to insert new experiences.

Week	Day	Date	Topic	Chapter
DNA as a Store of Information				
1	T	1/13	Genes are DNA	1
	R	1/15	From Genes to Genomes	
2	T	1/20	How Many Genes?	
	R	1/22	Clusters and Repeats: Gene Families	4
3	T	1/27	Clusters and Repeats: Satellites	4
Translation:				
	R	1/29	Messenger RNA	5
4	T	2/3	Protein Synthesis	6
	R	2/5	EXAM (Chapters 1-6)	
5	T	2/10	Using the Genetic Code	7
Prokaryotic Gene Expression:				
	R	2/12	Transcription	9
6	T	2/17	Transcriptional Initiation and Control	9
	R	2/19	The Bacterial Operon	10
7	T	2/24	Regulation of Operons	10
	R	2/26	Phage Strategies: Lysis and Lysogeny	11
8	T	3/2	EXAM (Chapters 7, 9-11)	
Perpetuation of DNA: Change and Stability				
	R	3/4	The Replicon	12
9	T	3/9	Spring Break	
	R	3/11	Spring Break	
10	T	3/16	DNA Replication	13
	R	3/18	Recombination	14
11	T	3/23	Repair	14
	R	3/25	Transposons	15
12	T	3/30	Retroviruses and Retrotransposons	16
	R	4/1	EXAM (Chapters 12-16)	
Eukaryotic Genome Organization: The Nucleus				
13	T	4/6	DNA Techniques	
	R	4/8	Easter Break	
14	T	4/13	Chromosome Structure	18
	R	4/15	Nucleosome Structure	19
15	T	4/20	Initiation of Transcription	20
	R	4/22	Initiation of Transcription	20
16	T	4/27	Regulation of Transcription	21
	R	4/29	Nuclear Splicing	22
	T	5/4	FINAL EXAM (Chapters 18-22)	

BIOLOGY 471: RECOMBINANT DNA LAB

Instructor: Dr. Roger Mitchell

Office hours: ASC (Commons) 2118: Monday 10:00 AM - 12:00 noon and Thursday 3:00 - 5:00 PM. Make an appointment, or drop by to see if I am available at some other time. Knock if the door is closed! You may call my office at any time: 591-5879. email: mitchelr@ferris.edu

Course objectives:

To learn professional-quality, hands-on lab techniques in molecular genetics.

To understand the principals behind these techniques.

To extend the ability to prepare and organize lab documentation.

To carry out lab work while maintaining a professional environment.

Materials you are required to have:

lab manual: "Laboratory DNA Science" by Bloom, Freyer, and Micklos.

additional materials: purchase a lab notebook, a three-ring binder, lab coat and other materials as necessary.

Final exam time and place will be announced

Lab reports will be assigned that will be prepared by computer.

Dropping with the "W" grade must be done on or before **March 26.**

Incompletes will be given only at my discretion and will require proof of exceptional need. Consistent with university policy, the student must have passed 75% of the class prior to being forced to stop attending due to circumstances beyond their control. The "I" grade must be cleared or it will become an "F."

Attendance policy. Attendance is mandatory. Missing more than 2 labs may result in course failure. I reserve the right to treat tardiness as an absence, or require additional work from tardy, disruptive, or absent students.

Due to the nature of these labs you will occasionally need to come in at additional times for brief periods.

Grades will be 25% from your lab notebooks, which may be checked at any time, 25% subjective (including following directions, time management, preparation, effort, lab safety, professional attitude, punctuality, etc.), and approximately 50% for reports, quizzes, and other assignments. Poor lab safety will lead to lower grades.

THE FOLLOWING SCHEDULE IS HIGHLY TENTATIVE:

DATE	TOPIC	CHAPTER
Jan. 12	transformation: $CaCl_2$, plant DNA preparation	2
13	transformation: frozen cells, plant DNA extraction	handout
16	lecture: safety and introduction	
20	bacterial DNA purification: inoculation	handout
23	bacterial DNA purification: harvest. computer training: photoshop	handout
26	bacterial DNA purification: centrifugation. PCR 1. plant cytogenetics 1	handout
27	PCR 2, plant cytogenetics 2	handout
30	lecture: computer training: word	
Feb. 2	bacterial DNA purification: precipitation. recombination: digests	Handout, 7
3	bacterial DNA purification: characterization. recombination: ligation transformation	7, 8
6	lecture: computer training: excel	
9	recombination: replica plate. λ library: digests	9, 14
10	recombination: miniprep. λ library: transformation	10, 15
12	lecture: working with DNA libraries	
16	recombination: clone identification. λ library: replica transfer	16
17	λ library: hybridization	16
20	. lecture: restriction mapping and RFLP analysis	
23	gel purification, making probes. AFLP 1	handout
24	λ library: probing. AFLP 2	16
27	lecture: computer training: drawing	
Mar. 1	λ library: minipreps. AFLP 3	17
2	λ library: restriction analysis. AFLP 4	17
5	lecture: computer training	
15	sequencing: setup.	NEB manuals
16	sequencing: setup	NEB manuals
19	lecture: sequencing I	
22	sequencing: gel practice	NEB manuals
23	sequencing: gel pouring	NEB manuals
26	lecture: sequencing II	
29	sequencing: reactions	NEB manuals
30	sequencing: run gels	
Apr.2	lecture: computer training	NEB manuals
5	lecture: the final report	NEB manuals
6	sequencing: run gels	
12	sequencing: data analysis 2	handout
13	RNA isolation 1	handout
16	lecture: working in a lab	
19	RNA isolation 2	handout
20	characterization of RNA product	handout
23	lecture: computer training	
26	use of RNA isolate	handout
27	RNA continued	handout
30	lecture: a DNA overview	

Syllabus 2004
BIOLOGY 472
PROTEINS

INSTRUCTOR: Dr. C. Boogaard

OFFICE: ASC 2116; X 2544; hours: M & W 9:30 to 11:00 & F 10-11, or by appointment. Call to make an appointment.

COURSE OBJECTIVES:

1. To increase the students understanding of the theoretical basis of various techniques used in protein purification and isolation, and
1. The basic structural elements of proteins.
2. To increase the students ability to interpret graphical representations of data
3. To increase the students ability to understand equations describing experimental phenomena

PRE-REQUISITES: completion of PHCH 320, or of CHEM 364.

TEXT: A required lecture notes booklet and a study guide are available at Great Lakes Books and Supply. No text is required. However, students may find it helpful to reference Alberts et al, Molecular Biology of the Cell, 4th Ed, Garland Scientific, 2002. (This book is a required text for BIOL 474-Advanced Cell.).

MEETING TIME: This class is scheduled to meet Tuesdays and Thursdays, from 9:30 to 10:45 am in SCI 144. However, there may also be out-of-scheduled-class time activities such as seminars, which students will be required to attend.

GRADING:

Grading is based on three exams, worth 50 points each, and a final exam worth 100 points. The final exam will not be comprehensive. However, some topics apply to the entire course and can and will be represented on every exam. These topics include: calculating a purification table, interpreting a purification table, Beer's Law calculations, extinction coefficient calculations, buffer design, and enzyme kinetics. In addition, extra credit points may be given for especially insightful classroom participation and discussions. (This does not apply to simple "please clarify" type questions.) Optional extra credit quizzes may be given without warning.

At the end of the term, the students' total (out of 250 points) will be calculated, and grades will be assigned on a curve.

The following is a ***tentative*** outline. The instructor reserves the right to vary the outline, including the right to change the order of topics, and the right to insert new experiences.

Tentative Lecture Schedule

WEEK	DAY	DATE	TOPIC	
1	T	8/31	Amino Acid Biochemistry, pH, Buffers	
	R	9/2	Extinction Coefficients; General Calculations	
2	T	9/7	Basic Structure: α helices; β sheets; β turns	
	R	9/9	Overview of Purification; Assays	
3	T	9/14	Enzyme Kinetics	
	R	9/16	Purification Tables and Calculations	
4	T	9/21	Buffer Design; Cell Characteristics and Research Uses	
	R	9/23	Exam	
5	T	9/28	Cell Rupture: Liquid & Solid Shear; Sonication; Chemical & Enzymatic Techniques; Results	
	R	9/30	Protein Concentration Techniques	
6	T	10/5	Salting In and Salting Out; Ionic Strength Calc; pH, T and Salt changes	
	R	10/7	Precipitation Zones and Back Extractions; Calculating salt additions; data;	
7	T	10/12	Results and Troubleshooting	
	R	10/14	Ion Exchange Chromatography: Principles	
8	T	10/19	Gradient Ion Exchange Columns; Data	
	R	10/21	Exam	
9	T	10/26	Gel Permeation: Formulae, Techniques; Data	
	R	10/28	Data Interpretation and Troubleshooting	
10	T	11/2	Ultracentrifugation: Principles and Formulae	
	R	11/	Sedimentation Coefficients; Rotor Conversions	
11	T	11/9	Density Gradients; Ultracentrifugations; Data	
	R	11/11	Exam	
12	T	11/16	Chromatofocusing;	
	R	11/18	Electrophoresis: Principles, Rates of Movement; Buffer Systems; Discontinuous Gels; Tryptic digests	
13	T	11/23	Zonal, Denaturing, Isoelectricfocusing	
	R	11/25	Results and Troubleshooting	
14	T	11/30	Radioactivity and Radioisotopes	
	R	12/2	Interactions of Radiation with Matter	
15	T	12/7	Analysis of Protein-Protein Interactions: Epitope Tagging and Flourescence Resonance Energy Transfer	
	R	12/9	Yeast Two-Hybrid System; Phage Display	
16	T	12/14	Final Exam	

BIOL 473 Proteins Laboratory Fall '04 Wed 9:00-6:00

Dr. Kim Colvert

Office: ASC 3098 MTF 9:00-9:50 R 1-1:50 Other hours by appt.
Ext 5851 Home Phone 796-2058

colvertk@ferris.edu

Text: *Protein Methods*, Bollag and Edelstein, Wiley-Liss 1991 (or most recent edition)
Supplies: Approved eye protection, notebook with carbon copies.

Objectives:
To provide direct and hands-on experience in

1) *methods of protein analysis and purification*
2) *researching methods in the biochemical literature*
3) *designing and adapting purification and analysis protocols from the literature*
4) *maintaining accurate and complete records of work*

Your task this semester is to isolate and purify a protein. You will be directed to a protein then you must go to the literature to find a method to purify that protein that is 'feasible' given the resources of the lab, the availability of source material and, unfortunately, the cost of isolation. Once a method has been approved you must develop a list of materials needed, check supplies and submit a list of materials to be purchased. You will then develop a procedure and carry out the isolation. You will also wish to assay the protein and determine as much information about its physical properties as possible. You may need to go to several literature sources to complete your project. All facets of your work must be documented in an orderly and legible fashion in your notebook, including your sources, your exact actions, where you deviated from published methodology and why, etc. 85% of your grade will be based on this notebook. I will periodically call for you to turn in the carbon copies (without warning).
The other 15% of your grade will be based on the 'final'. The final will be a semi-formal presentation of your work to the class that will be jointly presented by you and your partner. Your presentation will be by PowerPoint and is expected to include a flow chart, data and results tables where appropriate. You should also include a bibliography. A copy of your disk must be submitted with your notebook. The 'semi-formal' part refers to the fact that it will be a discussion and you will be asked questions and encouraged to explain in detail or ask questions of your own. This will take place during the last lab period of the semester. The final exam period will be devoted to lab clean-up.

Chemistry 321: Organic Chemistry I
Course Syllabus: Fall 2004

Instructor: Dr. Peter Balanda, Associate Professor of Chemistry
ASC 3012, 591-5870, balandap@ferris.edu
Office Hours: MTW 9:00-8:50, R 12:00-1:50, and by appointment.
Lecture: MTW F 8:00-8:50 Lab: See Schedule.

University Catalog: Modern bonding theory in organic molecules, theory of reactions, stereochemical principles, chemistry of alkanes, cycloalkanes, alkenes, dienes, alkynes, aromatics, and alcohols, with special emphasis on reaction mechanisms. Concurrent laboratory includes basic laboratory techniques, synthesis, TLC and GC, stereochemistry and spectroscopy workshops. This course meets General Education Requirements: Scientific Understanding Lab.

Required Textbooks: McMurry, J. ***Organic Chemistry***, 6th Ed. with ***Organic Chemistry Direct Powered by OWL.***
McMurry, S. ***Study Guide and Solutions Manual for McMurry's Organic Chemisty.***

Required Materials: ***HSG Molecular Structure Model C Set for Organic Chemistry***
Instructor approved safety glasses (sold in the bookstore).
Three ring binder *and* a bound laboratory notebook (composition book)
Scientific calculator (nonprogrammable).

Recommended Materials: Molecular drawing software (a free versions of ChemSketch and ISIS Draw are available for download on the WEB)

Attendance: Attendance and class participation are mandatory components of both the laboratory and lecture portions of this course. Students will be expected to work individually and to work in groups. Missed laboratory assignments may not be made up. If you know you must miss a lab, make arrangements with the instructor to attend another section—in advance. Excused absences (verifiable and in writing: extenuating medical reason, funeral, subpoena to testify, or university excused absence) *may* allow for the waving of an assignment, but do not lower the expectations for learning. See the instructor *immediately*. If a test or quiz is missed (excused absences only), it must be made up *before* the next class meeting by arrangement with the instructor (exceptions will be made only when extenuating circumstances prevent timely return). Three unexcused absences, or five absences of any kind, in the laboratory portion of the course will result in failure of the course. Failure to take the final exam will result in failure of the course.

Homework: Regularly log into WEB-CT for updates on assignments, due dates, etc. Complete all web-based (OWL) assignments. http://owl1.thomsonlearning.com/owl-c/register/owlmgr.cgi?Mode=2&ArchivedDatabaseID=39&CategoryID=187
Complete, with understanding, all *Problems* in the chapter, as well as many *Additional Problems* as time will allow. Unless specifically stated, these problems will not be graded. However, the *Problems* found within the body of the text will provide guidelines for a large number of test questions, and similar problems will be presented in regular quizzes. It is expected that you will spend a minimum of 30 hours per week reviewing lecture notes, reading the text, solving problems in the text and on-line, and otherwise preparing for

upcoming lectures, quizzes and tests. Become familiar, very familiar, with the *organic chemistry direct* web site; it will be your cyber-home away from home: http://www.brookscole.com/cgi-brookscole/course_products_bc.pl?fid=M20b&product_isbn_issn=0534389996&discipline_number=12. If you master this material, and master the material presented in the OWL assignments, you will have mastered the lecture portion of this course.

Portfolio: This syllabus, all class notes, tests, projects and handouts must be kept together in a well-organized binder which will be made available for inspection at any time. Do not simply stuff everything into the side pockets of a folder. Class notes should be dated and numbered in the upper right hand corner of each page. For example, first page of notes taken on September 1 might be labeled: 8/1-1. The portfolio is meant to be a study aide, but it provides an opportunity for you to showcase your homework.

Laboratory: Laboratory assignments must be completed and turned in on time in order to receive credit. Where appropriate, laboratory grades will be partially determined by product yield and purity, or by the accuracy to which an unknown compound was identified. Students will be expected to make revisions at the instructor's request. Students repeating the class may, at the instructor's discretion, abstain from repeating the laboratory portion. In such cases, the entire course grade will be based on the current lecture performance (see note).

Grading:
Tests (3 x 120 points each)
Lecture Quizzes (100 points total)
Final Exam (1 x 240 points)
Owl Homework (100 points)
Laboratory Notebook, Reports, and Projects (195 points total)
Portfolio (5 points)
Total: 1000 points

Grade	Percent	Grade	Percent	Grade	Percent
A	93.0	B-	80.0	D+	67.0
A-	90.0	C+	77.0	D	63.0
B+	87.0	C	73.0	D-	58.0
B	83.0	C-	70.0	F	<58.0

Course Schedule

Week of	McMurry Chapter	Lab	Special Events
M 8/30	1	Check in; Melting point/mixed melting point.	
T 8/31		Check in; Melting point/mixed melting point.	
W 9/1		Check in; Melting point/mixed melting point.	
F 9/3		Check in; Melting point/mixed melting point.	
M 9/6	2	*No Lab*	No class M
T 9/7		Thin Layer Chromatography	
W 9/8		Thin Layer Chromatography	
F 9/10		Thin Layer Chromatography	
M 9/13	3	Thin Layer Chromatography	
T 9/14		Recrystallization and TLC (1)	
W 9/15		Recrystallization and TLC (1)	

F 9/17		Recrystallization and TLC (1)	
M 9/20	4	Recrystallization and TLC (1)	Test 1 (Ch. 1-4) F
T 9/21		Recrystallization and TLC (2)	
W 9/22		Recrystallization and TLC (2)	
F 9/24		Recrystallization and TLC (2)	
M 9/27	5	Recrystallization and TLC (2)	
T 9/28		Intro. to Chemical Reactivity: Hydrocarbons	
W 9/29		Intro. to Chemical Reactivity: Hydrocarbons	
F 10/1		Intro. to Chemical Reactivity: Hydrocarbons	
M 10/4	6	Intro. to Chemical Reactivity: Hydrocarbons	
T 10/5		Distillation, BP, Refractive Index, and GC (1)	
W 10/6		Distillation, BP, Refractive Index, and GC (1)	
F 10/8		Distillation, BP, Refractive Index, and GC (1)	
M 10/11	7	Distillation, BP, Refractive Index, and GC (1)	
T 10/12		Distillation, BP, Refractive Index, and GC (2)	
W 10/13		Distillation, BP, Refractive Index, and GC (2)	
F 10/16		Distillation, BP, Refractive Index, and GC (2)	
M 10/18	8	Distillation, BP, Refractive Index, and GC (2)	Test 2 (Ch. 5-8) F
T 10/19		Dehydration of Alcohols, IR spectroscopy	
W 10/20		Dehydration of Alcohols, IR spectroscopy	
F 10/22		Dehydration of Alcohols, IR spectroscopy	
M 10/25	9	Dehydration of Alcohols, IR spectroscopy	Midterm grades due
T 10/26		Acid/base extraction (1)	
W 10/27		Acid/base extraction (1)	
F 10/29		Acid/base extraction (1)	
M 11/1	10	Acid/base extraction (1)	
T 11/2		Acid/base extraction (2)	
W 11/3		Acid/base extraction (2)	
F 11/5		Acid/base extraction (2)	11/4 last day for W
M 11/8	11	Acid/base extraction (2)	
T 11/9		Extraction of caffeine from tea and sublimation	
W 11/10		Extraction of caffeine from tea and sublimation	
F 11/12		Extraction of caffeine from tea and sublimation	
M 11/15	12	Extraction of caffeine from tea and sublimation	Test 3 (Ch. 9-12) F
T 11/16		Oxid. of fluorene and column chromatography (1)	
W 11/17		Oxid. of fluorene and column chromatography (1)	
F 11/19		Oxid. of fluorene and column chromatography (1)	
M 11/22	13	Oxid. of fluorene and column chromatography (1)	
T 11/23		*No Lab*	
W 11/24		*No Lab*	
F 11/26		*No Lab*	*No lecture F*
M 11/29	14	Oxid. of fluorene and column chromatography (2)	
T 11/30		Oxid. of fluorene and column chromatography (2)	
W 12/1		Oxid. of fluorene and column chromatography (2)	
F 12/3		Oxid. of fluorene and column chromatography (2)	
M 12/6	15	Check out and clean-up	
T 12/7		Check out and clean-up	
W 12/8		Check out and clean-up	
F 12/10		Check out and clean-up	
W 12/15		*Exam Week: No lab*	FE: W 8:00-9:40 am

To ensure that the needs of individual students are met the instructor reserves the right to make any necessary changes.

The model kit can be ordered directly from the manufacturer for $25 plus S&H. The package is a bit different, and you'll have to wait. Model: 1003 Student Organic Chemistry C-Set at http://www.maruzenusa.com/hgs/

Professor Balanda's schedule for Fall 2004

Time	Monday	Tuesday	Wednesday	Thursday	Friday
8:00	CHEM 321 SCI 102	CHEM 321 SCI 102	CHEM 321 SCI 102	CHEM 321 Lab Sec 212	CHEM 321 SCI 102
9:00	Office Hour	Office Hour	Office Hour	SCI 336/328	
10:00					
11:00		Meetings		Meetings	
12:00	CHEM 321 Lab Sec 215		CHEM 321 Lab Sec 213	Office Hour	CHEM 321 Lab Sec 211
1:00	SCI 336/328		SCI 336/328		SCI 336/328
2:00					
3:00		CHEM 321 Lab Sec 214			
4:00		SCI 336/328			
5:00					

Chemistry 322: Organic Chemistry 2
Course Syllabus: Winter 2004

Instructor: Dr. Peter Balanda, Associate Professor of Chemistry
ASC 3012, 591-5870, balandap@ferris.edu
Office Hours: M 10-11:50, WR 10:00-10:50, and other by appointment.
Lecture: M WRF 9:00-9:50 Lab: See Schedule.

Course Objectives: Students should be able to demonstrate an understanding of the structure, nomenclature, physical properties, and chemical properties of the major classes of organic compounds: Arenes and aromatic heterocycles; alcohols and phenols; ethers and epoxides; thiols and sulfides; aldehydes and ketones; carboxylic acids and their derivatives. Students should be able to demonstrate similar familiarity with common classes of biomolecules: carbohydrates, proteins, lipids and nucleic acids. In the concurrent laboratory sessions, students will demonstrate the ability to plan and carry out experiments designed to gain a better understanding of organic structure/property relationships, with special emphasis on experimental design; isolation spectroscopic analysis of products; and evaluation and presentation of results.

Required Textbooks: McMurry, J. ***Organic Chemistry***, 6th Ed. with ***Organic Chemistry Direct Powered by OWL.***
McMurry, S. ***Study Guide and Solutions Manual for McMurry's Organic Chemisty.***

Required Materials: ***HSG Molecular Structure Model C Set for Organic Chemistry***
Instructor approved safety glasses (sold in the bookstore).
Three ring binder *and* a bound composition style laboratory notebook
Scientific calculator (nonprogrammable).
NMR tube (at least one)

Recommended Materials: Molecular drawing software (a free versions of ChemSketch and ISIS Draw are available for download on the WEB)

Attendance: Attendance and class participation are mandatory components of both the laboratory and lecture portions of this course. Students will be expected to work individually and to work in groups. Missed laboratory assignments may not be made up. Excused absences (verifiable and in writing: extenuating medical reason, funeral, subpoena to testify, or university excused absence) may allow for the waving of an assignment, but do not lower the expectations for learning. If a test or quiz is missed (excused absences only), it must be made up before the next class meeting by arrangement with the instructor (exceptions will be made only when extenuating circumstances prevent timely return). Three unexcused absences, or five absences of any kind, in the laboratory portion of the course will result in failure of the course. Failure to take the final exam will result in failure of the course.

Homework: Regularly log into WEB-CT for updates on assignments, due dates, etc. Complete all web-based (OWL) assignments on time. Complete, with understanding, all *Problems* in the chapter, as well as many *Additional Problems* as time will allow. Unless specifically stated, these problems will be not be graded. However, the *Problems* found within the body of the text will provide guidelines for a large number of test questions, and similar problems will be presented in regular quizzes. It is expected that you will spend a minimum of 12 hours per week reviewing lecture notes, reading the text, solving problems in the text and on-line, and otherwise preparing for upcoming lectures, quizzes and tests.

Portfolio: This syllabus, all class notes, tests, projects and handouts must be kept together in a well-organized binder which will be made available for inspection at any time. Do not simply stuff everything into the side pockets of a folder. Class notes should be dated and numbered in the upper right hand corner of each page. For example, first page of notes taken on September 1 might be labeled: 8/1-1. The portfolio is a study aide that provides you the opportunity to showcase your study efforts.

Laboratory: Laboratory assignments must be completed and turned in on time in order to guarantee that credit is received. Laboratory grades will be based on instructor, peer and self evaluation. Students will work in groups. Each group will assemble and maintain a well organized Research Project Portfolio which includes copies of

experimental plans and laboratory notebook entries, as well as all instrument request sheets, spectral data and data analysis forms. Students will be expected to make revisions at the instructor's request. Students repeating the class may, at the instructor's discretion, abstain from repeating the laboratory portion. In such cases, the entire course grade will be based on the current lecture performance (see note).

Grading:

Tests (3 x 100 points each)
Lecture Quizzes and Assignments (13 x 10 points)
Final Exam (1 x 200 points)
Owl Homework (100 points)
Laboratory (250 points)
Lecture Portfolio (1 x 20 points)
Total: 1000 points

Lab: 25% **Lecture 75%**

Test, quiz and final exam points are adjusted to 75%.
All other assignments are adjusted to 25%.
Note: Students who do not take the lab: Lecture 100%.

Grade	Percent	Grade	Percent	Grade	Percent
A	93.0	B-	80.0	D+	67.0
A-	90.0	C+	77.0	D	63.0
B+	87.0	C	73.0	D-	58.0
B	83.0	C-	70.0	F	<58.0

Course Schedule

Week of		McMurry readings	Topic/ Special Events	Lab	Due
1/12	M		Introduction	Introduction; Check in; NMR Demo.; Activity	
	W	528-539	Electrophilic arom. sub.		
	R	Handout	Research Topics		
	F	Handout	Research Topics		
1/19	M		*No class*	Identification of an unknown by NMR	Choose project (by end of week)
	W	539-550	EAS substituent effects		
	R	551-559	Benzyne; side-chain rxns; reductions		
	F	559-end	Synthesis; *Q1*		
1/26	M	578-586	Review of organic reactions	3 Week Research Project	-NMR Report -experimental plan
	W	587-596	ROH & ArOH: naming; physical &acid/base properties		
	R	596-605	Preparation of alcohols		
	F	605-615	Reactions of alcohols, *Q2*		
2/2	M		***Synthesis: alcohols***		
	W	615-end	Phenols & spectroscopy		
	R	***Ch. 16-17***	***Test 1***		
	F		NMR review, *Q3*		
2/9	M	639-644	Ethers: naming & preparation		
	W	644-647	Ethers: reactions		
	R	648-654	Epoxides		
	F		***Synthesis: ethers***		
2/16	M	654-end	Crown ethers; thiols; sulfides; spectroscopy	Team presentations and class critique	-power point presentation -presentation critiques -research portfolio -group evaluations
	W				
	R	672-681	Carbonyl preview		
	F	682-688	Aldehydes & ketones: naming; preparation; oxidation; *Q4*		
2/23	M	688-696	Nucleophilic addn: H_2O, HCN, RMgX	7 Week Research Project	-experimental plan
	W	696-706	Nuc. addn: amine, hydrazine, alcohol		
	R	706-716	Wittig; Cannizzaro; conj. addition		
	F		***Synthesis: aldehydes & ketones***		

3/1	M W R F	716-end *Ch. 18-19* 737-746 746-749	R(CO)R & RCHO: Spectroscopy *Test 2* RCOOH: naming; phys. prop.; acidity RCOOH: Preparation; *Q5*	"	
3/8			*Spring break*		
3/15	M W R F	749-end 770-778 779-788	RCOOH: Rxns & spectroscopy R(CO)X: naming; nuc. acyl sub. R(CO)X: naming; nuc. acyl sub., cont. ***Synthesis: carboxylic acid derivatives***	"	
3/22	M W R F	788-802 802-end 820-828 828-835	Amides; bio. derivatives; polymers Spectroscopy of R(CO)X Carbonyl α-substitution: Enols Carbonyl α-substitution: Enolates; *Q6*	" *Last day to Withdraw*	
3/29	M W R F	835-end 854-865 865-871	Alkylation of enolates Carbonyl condensation rxns: aldols Claisen condensation; Michael, Stork, and Robinson; *Q7*	"	
4/5	M W R F	871-end *Ch. 20-23*	***Synthesis: enolate chemistry*** ***Test 3*** *No class* *No class*	"	
4/12	M W R F	892-903 903-912 912-922	Amines: naming; phys. prop.; basicity Amines: preparation Amines: reactions ***Synthesis: amines***	"	
4/19	M W R F	922-end 942-961 967-971 985-994 998-1000 1009-1011 1027-1037 1045-1049	Amines: spectroscopy Carbohydrates Amino acids; peptides; proteins Lipids	Team presentations and class critique	-power point presentation -presentation critiques -research portfolio -group evaluations
4/26	M W R F	1060-1075	Nucleic acids Lab Post-Test Conclusion	Cleanup and checkout	Final Poster Presentation: Thursday Evening
5/3	M		***Final Exam 8:00-9:40***		

To ensure that the needs of individual students are met the instructor reserves the right to make any necessary changes.

The model kit can be ordered directly from the manufacturer for $25 plus S&H. The package is a bit different, and you'll have to wait. Model: 1003 Student Organic Chemistry C-Set at http://www.maruzenusa.com/hgs/

Professor Balanda's Schedule balandap@ferris.edu ext. 5870

Time	Monday	Tuesday	Wednesday	Thursday	Friday
8:00		CHEM 322 Lab Sec 223			
9:00	CHEM 322 SCI 102	SCI 336/328	CHEM 322 SCI 102	CHEM 322 SCI 102	CHEM 322 SCI 102
10:00	Office Hour		Office Hour	Office Hour	
11:00		Meetings		Meetings	
12:00			CHEM 322 Lab Sec 222	CHEM 322 Lab Sec 212	
1:00			SCI 336/328	SCI 336/328	
2:00					
3:00	CHEM 322 Lab Sec 224				
4:00	SCI 336/328				
5:00					
6:00					

Professor Adsmond's Schedule: adsmondd@ferris.edu ext. 5867

Time	Monday	Tuesday	Wednesday	Thursday	Friday
8:00		CHEM 322 Lab Sec 223			
9:00		SCI 336/328			
10:00					
11:00		Meetings		Meetings	
12:00		Office Hour		CHEM 322 Lab Sec 212	
1:00				SCI 336/328	
2:00					
3:00	CHEM 211 STR 233	CHEM 211 Lab Sec 213	CHEM 211 STR 233	CHEM 211 Lab Sec 212	
4:15	Office Hour 4:15-5:00	SCI 336/332	Office Hour 4:15-5:00	SCI 336/332	
5:00					
6:00					

Section 7: Surveys

Graduates
Employers
Current Students
Faculty
Advisory Committee

GRADUATE PERCEPTIONS OF THE BIOTECHNOLOGY PROGRAM

This survey was sent out to the sixteen graduates that could be contacted. Six responses were received. All responses were very positive. Most expressed satisfaction with the program and the laboratory experience. No one course was more or less valuable. Some found COMM 105 more relevant, others COMM 121. There was some indication that an increase in math requirements and more experience with databases would be helpful. One graduate expressed concern that some of our graduates were not up to the usual standards of our program. Most were appreciative of the flexibility the program gave them and depth of laboratory experience.

Graduate Survey of the FSU Biotechnology Program

Dear Graduate: The Biotechnology Program is being reviewed this academic year, and the Program Review Panel would appreciate your candid responses to the following questions. Please **circle your responses** and **return** this form **as soon as possible** in the post paid envelope. Thank you very much. You can elaborate on your responses, if you wish, on the backside of the questionnaire.

I graduated in 199 , 200 . *1998, 1998, 2000, 2002, 2002, 2002, 2003*

I entered Biotechnology as: (circle one)
a. a freshman? *3*
b. from another program at Ferris? If so, which one? Medical Technology, Biology Education (after only 1 semester), From the pre-vet med program, between sophomore and junior years.
c. a transfer student? *1*

	Excellent (Top 10)	**Good** (Top 1/3)	**Acceptable** (Middle 1/3)	**Below Expectation** (Lowest 1/3)	**Poor** (Bottom 10%)	**Unknown**	**Ave**
1. Compared to other BSc entry- level lab personnel or graduate students, my background in **chemistry** was:	**1** 1	**2** 3	**3** 1	**4**	**5**	**U**	
2. Compared to other BSc entry- level lab personnel or graduate students, my background in **biology** was:	**1** 2	**2** 3	**3**	**4**	**5**	**U**	**1**
3. Compared to other BSc entry- level personnel or graduate students, my **laboratory experience** was:	**1** 3	**2** 1	**3** 1	**4**	**5**	**U**	**1**
4. Compared to other BSc entry- level lab personnel or graduate students, my **problem solving** and **critical thinking** ability was:	**1** 1	**2** 3	**3** 1	**4**	**5**	**U**	
5. Compared to other BSc entry-level lab personnel or graduate students, my background in **computer usage** was:	**1** 1	**2** 3	**3** 1	**4**	**5**	**U**	
6. Compared to other BSc entry-level lab personnel or graduate students, my	**1**	**2**	**3**	**4**	**5**	**U**	**2**

background in **math** was:	2		3				
7. Compared to other BSc entry-level lab personnel or graduate students, my background in **technical writing** was:	1 1	2 3	3 1	4	5	U	
8. Compared to other BSc entry-level lab personnel or graduate students, my experience in **oral and interpersonal communications** was:	1	2 4	3 1	4	5	U	2
9. Compared to other BSc entry-level lab personnel or graduate students, my back-ground in **general education** (social awareness and cultural enrichment) was:	1 1	2 2	3 2	4	5	U	2
10. My opinion of the level of expertise of the biotechnology program faculty in their professional areas is:	1 4	2 1	3	4	5	U	1
11. My overall opinion of the biotechnology program is:	1 3	2 2	3	4	5		1

12. Would COMM 105 (Interpersonal Communication) or COMM 121 (Public Speaking) be most helpful? (circle one)

You can never get too much experience in communicating/presenting effectively to others, it is essential to the modern work environment. Despite this fact, I believe it should be an elective as it is something that each individual will know whether they are competent in this area, for the field they plan to enter.

Comm 105

I took COMM121 and it was valuable. I make presentations at least monthly in my position. I recommend as much public speaking as possible for the degree.

Public Speaking would be more helpful.

Of the two I think COMM 121 would be most helpful because in this field we encounter lots of situations where it is necessary to give oral presentations.

13. Was there any one course which you can identify as being least beneficial to you in your career?

Introductory Physics 2.

No, but I think that calculus should be required. Almost every grad program requires calculus in undergrad, and those who continue their education are forced to take this class before being admitted. A course in Logic would also be a good requirement.

None of the courses detracted from the programs goals in my opinion. The need for well-rounded scientists is so great. I look back at the program requirements and wonder; wow, that's all we had to do? Wasn't there more to it than that? It is a solid program and I would not recommend dropping any of the science courses if that is ever considered.

Microbiology

All were beneficial in their own way.

14. Was there any one course which you can identify as being most beneficial to you in your career?

Molecular Genetics

Any and all of Dr. Colvert's and Dr. Boogaard's classes.

It is difficult to pick one course that was most beneficial. All the laboratory intensive courses at FSU were what put me so much further ahead of anyone else coming out of other biology programs (from major Universities) with interest in biotech lab work. The science class work provided the many areas for learning but experiences in the lab guaranteed comprehension and assimilation of concepts.

Biochemistry

In my career I would say molecular genetics and the biochemistry labs were the most beneficial.

15. Have you **received** or **accepted** a job offer in a biotechnology-related area?

Yes *5* **No** *1*

I received a job at Assay Designs within a few months of graduation.
I accepted a job offer within months after graduation in a young Biotech company and have been developing and producing valuable research tools for over five years now.
No, I am currently working in the bioinformatics field building databases and websites designed to help researchers analyze their data.
Yes, I currently work in a biotech-related area. I currently work in the Hermelin Brain Tumor Center along with 2 other Ferris biotech graduates.

In the space below, please make any comments you feel would be helpful.

In a time where not many people want to work hard for their money, this program challenges students to get their money's worth out of their education. Not only is it expected that you work hard for your grade, but in the professional courses if you do not work hard you will not pass. I have a great respect for most of the professors in this program; they truly work hard and do their best to prepare their students for a field that is so vast and so technologically difficult. This program gave me the skills and knowledge to choose what I wanted to do within the realm of science.

The professors who taught while I was in the program were exceptional. I know that my fellow classmates & myself have prided ourselves on how hard we worked while in the Biotechnology program at Ferris. However, it really seems like the program is slipping. A student from the program came to my place of employment 2 years ago for a summer

internship and I was shocked with what I saw. He did not have the necessary communication skills or lab skills for this job ... not even close. He only had one class to go before he graduated. I only wonder how he made it that far. When contacted about this, we were told by the biotech advisor that if we had contacted her she would have told us that he didn't have the necessary skills. This should not be an issue!! It left us in the very uncomfortable position of having to not pass him for his internship. He was a very nice person and we felt awful, but the fact was that he performed terribly. It seems to me that the program is allowing people to graduate who are simply not ready!! This is not the only example I know of ... I can think of 2 more similar instances off the top of my head.

As I mentioned, I think that the professors themselves are wonderful. They were all extremely intelligent, helpful and friendly. I feel fortunate to have learned from them. However, I think that they are often times given impossible situations to deal with. Many students were not ready to enter the program but were let in anyways. I understand that the program needs bodies to continue, but please consider that you are doing a discredit to all of us who worked very hard to get our degrees. By allowing students who do not have the necessary skills to enter-- much less finish the program, you are tarnishing the names of the alumni and professors.

The FSU Biotech Program is a valuable resource for any ambitious person looking for a career in life science research. It will provide them with an education that they can use anywhere in the world. They will be equipped with the know-how to excel with researchers with advanced degrees (M.S. or Ph.D.). There is so much work available in plant and biomedical research that (serious) students should really consider FSU Biotechnology.

I would suggest that more time be spent working with computers and specifically websites like NCBI.

As a recent graduate, I have realized in my nearly 2 years on the job that I can apply nearly every aspect of what I learned in the Biotech Program to my job. I have been told by management that I have the most flexible degree of everyone that has been hired for our department and that my large range of laboratory experience makes me a very valuable employee. I am usually the person that gets the "here's a new assay that we don't know what it is...figure it out!" I am very grateful that I decided to change my program so early in my college career.

I found the biotech program at Ferris very beneficial to my chosen direction of occupation. The wide course of classes and special attention to actual lab work has really added to my knowledge of the working field and has definitely given me an upper hand in my current job. People in my department are amazed that us Ferris biotech grads have such a wide variety of hands on experience from everything from cell culture to proteins to molecular genetics. All of the classes in the biotech program have a benefit and none should be excluded. I definitely would not have been able to get where I currently am without the great experiences accumulated in the biotech program.

EMPLOYER PERCEPTIONS OF THE BIOTECHNOLOGY PROGRAM

We were able to determine the first supervisors of twelve graduates. The following survey was sent out. Only two responses were received but one was for more than one graduate. Both are included and are very favorable indicating our graduates are well above average.

BIOTECHNOLOGY PROGRAM REVIEW
EMPLOYER SURVEY

1. **Compared to other BS entry-level laboratory personnel, how has our graduate performed in the lab? Very well – above average**

2. **Compared to other BS entry-level laboratory personnel, how was our graduate's academic preparation? Above average; good broad knowledge of biochemistry**

3. **Compared to other BS entry-level laboratory personnel, how were our graduate's oral and written communication skills? Above average**

4. **Compared to other BS entry-level laboratory personnel, how were our graduate's computer skills? Same as others**

5. **In what area was our graduate best prepared for the job? All the graduates we have hired have a solid working knowledge of biochemistry and are prepared to do a variety of tasks in the lab with less training than those from other institutions. Therefore they become productive in less time.**

6. **In what area was our graduate least prepared for the job? Touch question and I don't have a good answer.**

7. **Would you hire another of our graduates? Absolutely and I would actively seek them out. We've hired about six all together (my numbers may be off).**

8. **For our information, is professional behavior at the BS entry-level position a matter of concern to you? Absolutely – very important What aspects of professional behavior do you consider important for entry-level personnel? When entering into an industrial environment, they need to realize that while at work they need to really work (i.e. time is money). Also, we send staff to conferences and they need to be prepared to represent our company in a professional manner.**

BIOTECHNOLOGY PROGRAM REVIEW
EMPLOYER SURVEY

1. **Compared to other BS entry-level laboratory personnel, how has our graduate performed in the lab? Outstanding. Better than any other research Technicians I have had.**

2. **Compared to other BS entry-level laboratory personnel, how was our graduate's academic preparation? Outstanding. Better than any other research Technicians I have had.**

3. **Compared to other BS entry-level laboratory personnel, how were our graduate's oral and written communication skills? Outstanding. Better than any other research Technicians I have had.**

4. **Compared to other BS entry-level laboratory personnel, how were our graduate's computer skills? Excellent**

5. **In what area was our graduate best prepared for the job? Please see letter attached.**

6. **In what area was our graduate least prepared for the job?**

7. **Would you hire another of our graduates? Absolutely**

8. **For our information, is professional behavior at the BS entry-level position a matter of concern to you? What aspects of professional behavior do you consider important for entry-level personnel? Certainly. First above all else is the individual's communication skills, second is organization, followed closely by clear thinking, and understanding of basic molecular biology and biochemistry.**

March 15, 2003

Kim K. Colvert, Ph. D.
Professor of Chemistry
Physical Sciences Department
Ferris State University
ASC 3021, 820 Campus Drive
Big Rapids, Michigan 49307-2995

Re: Kelly Suino

Dear: Dr. Colvert

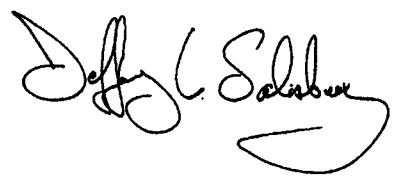
It is with pleasure that I write this letter on behalf of Kelly Suino who is a graduate from your program. Kelly came to work for me in 2001 after graduating from a Research Technologists program at Ferris State University (Grand Rapids, MI). She spent the first few months getting her 'lab feet' on the ground working on several straight-forward experiments. Within a short period she demonstrated outstanding laboratory skills and from that time, until she left my laboratory two years later she was my lead technician. I have had a dozen or so technicians over the past 25 years and Kelly is by far the very best overall. She kept a detailed notebook and she paid particular attention to the finest points in every experiment. She has excellent skills in tissue culture, indirect immunofluorescence, and SDS PAGE and western blots. She has burgeoning molecular biology skills that are only hindered by my own limits in this area. She has successfully mastered plasmid preparation, site-directed mutagenesis, PCR, and transfection and selection of mammalian cells. On a recent project using siRNA, Kelly designed the dsRNA based on our selected target and perfected their use in an exquisite series of experiments that resulted in a key paper for the laboratory late in 2002. What is more important, however, is that Kelly gets it – she gets it sooner and her understanding is deeper than most graduate students and many postdocs that I have had in the laboratory. She thinks deeply about the science. She reads! She mines the Web for relevant information before embarking on an experiment, and the time between our discussions and her first time through an experiment simply amazed me – she seemed only to be limited by the time it took to grow the cells. She made important critical observations that altered our experimental path on several occasions, and she has recognized the implications of her own observations before we have had the opportunity to speak about them. Kelly is organized and she has a strong work ethic – she works a full day with only modest breaks and she is often in the laboratory on weekends to tend to cultures, complete a prolonged time-course, or to simply get the result because she wants to know the answer. Once or twice a day she came to my office or stopped me in the laboratory to show me results, discuss progress, or query an opinion or my advice.

In summary, Kelly's strengths are her keen ability to organize, her follow-through and ability to trouble shoot, her writing skills and her willingness to tackle any experiment that she is presented with. Her weaknesses are minor and will be overcome as she gains experience in the real world – mainly they relate to the provincial view that one can have a real life and excel in this business (or is it only my own failure to manage one of these goals?). She is truly one-of-a-kind! As for her interpersonal skills – she has a most pleasant personality; she is easy to get along with and she defines boundaries in a most appropriate manner.

By the way, Kelly is the second individual from the Farris program who has worked in my laboratory; Greg Poynter was the other. Both of Kelly and Greg where outstanding representatives of your excellent program.

Please feel free to contact me directly if you would like to discuss Kelly Suino further.

Sincerely yours,



Jeffrey L. Salisbury, Ph.D.
Professor

STUDENT EVALUATION OF THE BIOTECHNOLOGY PROGRAM

This survey was sent out to the 36 students currently enrolled in the Biotechnology program. A total of twelve responses were received. While the responses were in general favorable there was one extremely dissatisfied respondent and one less than impressed. Not all respondents provided the information necessary to identify the background and level of these students so it is difficult relate the results to any common experience and thus pinpoint a particular issue. On the whole the least enthusiastic responses were recorded to the Communications requirement, Computer skills, and Career Placement.

Dear Student: The Biotechnology Program is being reviewed this academic year, and the Program Review Panel would appreciate your candid responses to the following questions. Please circle your responses and return this form as soon as possible in the post paid envelope. Thank you very much.

I will graduate with a BS in Biotechnology in 200 . *(please fill in) 2004, 2004, 2005, 2006, 2006*

I entered Biotechnology as:
a. a freshman? *3*
b. from another program at Ferris? If so, which one? *prepharm, Pre-medicine, pre-science*
c. a transfer student? *1*

The courses in the Biotechnology Program:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Unknown	Averag
1. Are based on realistic pre-requisites.	1 4	2 8	3	4	5	U	1.67
2. Are arranged logically in a progressive manner.	1 4	2 4	3 2	4 1	5 1	U	2.25
3. Meet your occupational needs and objectives.	1 4	2 7	3	4 1	5	U	1.83
4. Provide supervised training for developing lab skills.	1 4	2 6	3 2	4	5	U	1.83
5. Offer sufficient opportunities to develop critical thinking and problem-solving skills.	1 2	2 8	3 2	4	5	U	1.83
6. Offer sufficient opportunities to learn and practice relevant calculations.	1 4	2 5	3 3	4	5	U	1.92
7. Offer sufficient opportunities to develop cooperative teamwork skills.	1 4	2 5	3 3	4	5	U	1.92
8. Offer sufficient opportunities to develop independent lab skills.	1	2	3	4	5	U	2.17

	3	6	1	2			
9. Offer sufficient opportunities to manipulate and interpret data.	1 3	2 6	3 2	4 1	5	U	2.08
10. Offer sufficient opportunities to understand experimental design.	1 2	2 8	3 2	4	5	U	1.83
11. Offer sufficient opportunities to learn time management skills.	1 4	2 6	3	4 1	5 1	U	2.08
12. Offer sufficient opportunities to develop oral and written communication skills.	1	2 6	3 5	4 1	5	U	2.58
13. Offer sufficient opportunities to develop computer skills.	1 2	2 4	3 2	4 3	5	U	2.33
14. The laboratory facilities meet the needs of the group.	1 2	2 5	3 2	4 1	5 1	U	2.08

The courses in the Biotechnology Program:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Unknown	Averag
15. Biotechnology classes are taught by faculty with expertise in their professional areas.	1 5	2 5	3	4 2	5	U	1.92
16. The required communications courses are pertinent to your career goals.	1	2 3	3 6	4 3	5	U	3.0
17. Is Public Speaking or Interpersonal Communications more relevant to your goals? (Circle one)	PS 1	IP 6	None				
18. The Career Placement Services meets your needs and interests.	1 1	2 3	3 5	4 1	5 1	U	2.82
19. My overall rating of the biotechnology program is...	Excellent 1 3	Above averag e 2 7	Average 3 1	Below Average 4 1	Poor 5		2.0

In this space please make any comments on the program which you feel would be helpful.

I feel that the courses are very adequate, but the teaching of the courses could vastly improve. Also treating students equally and with the same amount of respect, would make a more suitable learning environment.

I just wanted to say that I'm only a freshman so my answers are not based on Biotech. specific classes.

As a recent graduate, I have realized in my nearly 2 years on the job that I can apply nearly every aspect of what I learned in the Biotech Program to my job. I have been told by

management that I have the most flexible degree of everyone that has been hired for our department and that my large range of laboratory experience makes me a very valuable employee. I am usually the person that gets the "here's a new assay that we don't know what it is...figure it out!" I am very grateful that I decided to change my program so early in my college career.

I think we should make a better pamplet and provide high school students with information about our program. We take people who are med. bound, pharm. bound and so on and students in all levels dont realize that.

By offering all classes every semester would benefit a lot more students and see an increase in graduates.

I am kind of discouraged at the recent changes that have been made, however, I know that they were made with the best of intentions. So far, I do not think the changes have affected me too negatively, but I won't be able to say for sure until the end of the semester.

It is a great program. It's strength is in the laboratory experience it provides it's students.

Faculty Perceptions

James M. Epperson, Biotechnology Review Board Alumnus Panel Member

Introduction:

The Biotechnology Review Board conducted a survey to ascertain information about perceptions of the Biotechnology program from the faculty of the Department of Biology at Ferris State University. The percentages below represent the responses of five faculty members that completed the survey. A summary of the responses was prepared that also includes comments that were submitted with the returned surveys.

Results of Survey of Faculty Perceptions:

Survey Statement

1) The Biotechnology Program is consistent with the FSU Mission Statement
80% strongly agree 20% agree

2) The Biotechnology Program is consistent with the objectives and goals of the Biology Department. **80% strongly agree 20% neutral**

3) The Biology Faculty supports the Biotechnology program.
40% strongly agree 40% agree 20% neutral

4) FSU Administration supports the Biotechnology Program.
100% agree

5) I would like to be provided more information about the Biotechnology program.
20% agree 80% neutral

6) The Biotechnology Program offers students an opportunity to pursue academic and technological excellence. **60% strongly agree 20% agree 20% neutral**

7) The program trains students in current technological and lab management skill needed for success in a laboratory. **60% strongly agree 20% agree 20% disagree**

8) The program courses are arranged in a logical sequence from least expertise required to greatest. **20% strongly agree 60% agree 20% neutral**

9) The program offers sufficient opportunity for students to develop good oral and written communication skills.
20% strongly agree 40% agree 20% neutral 20% unknown

10) The program offers sufficient opportunity for students to develop critical thinking and problem solving skills.
60% strongly agree 20% neutral 20% unknown

11) The program offers sufficient opportunity for students to master a broad knowledge of the major areas of biotechnology, in reasonable depth.
60% strongly agree 20% agree 20% disagree

12) The program responds to the needs of a growing industry.
60% strongly agree 40% neutral

13) The program is limited by the lack of sufficient lab support personnel.
20% strongly agree 60% agree 20% neutral

14) The program is limited by lack of sufficient storage space.
40% strongly agree 20% agree 20% neutral 20% unknown

Summary statement:

In general the biology faculty appears to think the biotechnology program is a good program that provides students with a strong laboratory and theoretical background in biotechnology. Also, this program fulfills a niche in providing for a growing demand for individuals with this specialized training. The program is also consistent with Ferris State Universities Mission and the goals and objectives of the Department of Biology. However, according to this survey the faculty thinks that the program is most limited by the lack of support personnel and lack of storage space. Comments submitted stated the biotechnology program is unique at least in the Midwest in that it offers hands on laboratory training as other even graduate programs no laboratory training is offered. It was also stated that students on campus and abroad are not as aware of this program as they are of pre-med and pre-opt. and that the program should consider an additional program to offer post-graduate or M.S. studies to biology students so as to gain an expertise in biotechnology thus increasing the enrollment. Other comments stated that there are not enough students in the program and that it is too costly.

EXTERNAL ADVISORY COMMITTEE PERCEPTIONS OF THE BIOTECHNOLOGY PROGRAM

This survey was sent out to the six members of the external advisory committee. All members returned the survey. All responses were very positive. Most expressed satisfaction with our student interns, indicating that they are well prepared for working in the laboratory. Two reviewers indicated that the program could be strengthened by adding more requirements in math and computer science. When reviewers had prior experience with interns, they expressed great satisfaction with their lab skills, and rated them very high in performance compared to graduates from other programs.

	Strongly Agree	Agree	Neutral	Strongly Disagree	Disagree	Unknown	Average
1. Compared to other BS-level programs, the Ferris State biotechnology program is technologically strong	1	4	1				
2. Compared to other BS-level programs, the Ferris State biotechnology program is academically strong	1	3	1				1
3. Compared to other BS-level programs, the FSU biotechnology program includes sufficient instruction in oral and written communication skills.	1	3	1				1
4. Compared to other BS-level programs, the FSU biotechnology program includes sufficient math instruction.		3	1		2		
5. Compared to other BS-level programs, the FSU biotechnology program offers sufficient instruction in computer skills.		2	2		1	1	
6. Compared to other BS-level programs, the FSU biotechnology program offers quality laboratory instruction that is not available at most undergraduate institutions.	2	2			1	1	

In this space, please comment below on any of your responses. We are most interested in identifying what you perceive as strengths, weaknesses and problems in the Biotechnology Program. Thank you very much! Please email this form via email to hoerterj@ferris.edu by February 15th.

Abouzed
I had the opportunity in the past to higher in my lab one of Ferris Biotechnology Program. It might be right to judge a whole system based on one graduate but I also Attended in the past few meeting as review panel member. The program is unique by itself and hopefully more hands on were inserted into the program and any university budget cut did not affect the program quality.
In general it is a very good program but it needs more of cooperation and participation of student in intern programs with biotechnology companies.

Duesbery
I have not had an opportunity to evaluate your program for a few years so my responses are based upon my impressions from an earlier visit and may not reflect the current status of your program.

Linz
It has been several years since I visited Ferris and the Biotech program. I was not able to answer the last two questions based on the description of the program on the University homepage or based on my recollection of the program based on discussions with faculty and students

Rempel
We have had several graduates from your program and all have been outstanding compared to the BS graduates form other universities. If I could staff my whole lab with your graduates I would be very happy.

Students from your program are independent, and after basic direction they can initiate well-controlled experiments.
They develop ownership of a project, reading extra reference information to gain further insights into project.
They come to their positions as scientists, rather than technicians.

Scheuer
Historically the program's strengths have been the hands-on lab experience your graduates have; not only do they have the experience but they have a diverse overview. This is way above the majority of our other BS-level graduates and is something we strongly prefer when hiring. Not only does it shorten the training we have to do, but I feel that your graduates also have a better understanding of what their job duties will be and whether they have long term interest in the field. I would see that your program would benefit somewhat by strengthening the math skills of your graduates.

Section 8: Conclusions

These are the conclusions of the program review panel regarding the specified criteria for review.

- **Centrality to FSU Mission**

The Biotechnology Program fulfills the mission of "innovative teaching and learning in career-oriented technological and professional education" by graduating students prepared to move quickly and productively into biotechnology laboratory environments. The depth of their laboratory experience most especially has made them valuable resources in firms both in Michigan and across the country.

- **Uniqueness and Visibility**

For many years the Biotechnology degree at Ferris was the only undergraduate program in the state. The growth in the field has prompted the formation of a number of two- and four- year degrees at other Michigan institutions. The efforts of Dr. Hoerter to promote the program and operate summer workshops and to work with our advisory committee has kept the program familiar to employers and prospective students. The summer workshops especially have recruited a number of students into the program. With the competition increasing even more effort should be made to recruit and guide our Biotechnology students. The program is recognized by BioLink, a national organization that is linking the community and 4-year programs in biotechnology across the nation.

- **Service to State and Nation**

The need for qualified technologists in the life sciences will continue to increase across the nation. Michigan is nationally recognized as a leader in the growth of life-science based companies. Our students are contributing to this development by serving as technicians and eventually in management in both large pharmaceutical firms and small but growing biotechnology companies.

- **Demand by Students**

Enrollment in the program has shown steady increases over the past eight years. Though the attrition rate is somewhat high and there have been some bumps in the graduation rate, the number of program graduates per year is on the rise. This trend is expected to increase as Ferris continues to improve its appeal to academically successful students in general. The panel would like to increase Biotechnology' s share of these students to graduate 12 per year.

- **Quality of Instruction/Demand for Graduates**

The best indicator of quality of instruction is the success of our students. The quality of courses is not limited to those specific to the program. The auxiliary courses have provided solid foundations for advanced courses which is absolutely necessary for success. The students have consistently rated the instructors in the program as above average to excellent. There have been very few instances of dissatisfaction with our graduates. With the expected increase in demand and the competition for those positions it is very important that the causes of such dissatisfaction be determined and rectified as completely as possible.

- **Placement Rate and Average Salary of Graduates**

Of the students pursuing employment upon graduation (rather than graduate or professional school) the placement rate has been approximately 90 % . Starting salaries have ranged from the high $20 K to the mid $40 k and averaged $33.8K over the last five years

- **Service to Non-Majors**

Until recently very few of the upper level courses have had non-Biotechnology enrollment, partially because of the extensive prerequisites. This is beginning to change as Forensics majors, Biochemistry majors, pre-Pharm and Chemistry Education majors begin to enroll in the classes for which they have the prerequisites. The numbers are still small but could grow.

- **Facilities and Equipment**

While currently sufficient there is concern that equipment repair and replacement costs will seriously tax the annual S/E budgets of both the Biology and Physical Sciences Departments. The program requires an administrative commitment to an on-going budget line item for equipment repair and replacement.

- **Library Information Services**

The journal and book collection of FLITE is adequate but could be better. Faculty have worked with library representatives to improve holdings and the availability of on-line resources. Accessibility to current journals has improved and students are finding it much easier to obtain publications. Interlibrary loan times have decreased on average making it more effective support for research and literature presentations required in several courses.

- **Cost**

Biotechnology is an expensive program. The program is very laboratory intensive and the classes small. Laboratory supplies and equipment for biotechnology are more expensive than for lower level laboratory classes and require direction from highly qualified instructors. Space is limited and extensively utilized. While the total cost per SCE for Biotechnology may seem high the recent productivity

classes and require direction from highly qualified instructors. Space is limited and extensively utilized. While the total cost per SCE for Biotechnology may seem high the recent productivity studies have ranked both the Biology Department and the Physical Sciences Department as two of the most productive. This suggests that both departments have the means to support some higher cost programs for the benefit of the university. The academically rigorous nature of the program may diminish the enrollments in upper level classes but is necessary to maintain a reputation among employers. As can be seen from the Enrollment trends the Biotechnology Program attracts students to Ferris, many of whom stay even if they do not graduate from Biotech which partially offsets the cost.

- **Faculty: Professional and Scholarly Activities**

The faculty most closely associated with the Biotechnology Program are: Dr. Kim Colvert (Physical Sciences), Dr. Roger Mitchell (Biology), Dr. Connie Boogaard (Biology), Dr. Kemi Adewusi (Biology), Mr. Frank Hartley (Biology) and Ms. Mary Bacon (Physical Sciences). They have all maintained a variety of professional and scholarly activities including research, publications professional associations, workshops. and student organization mentoring. Vitae are available upon request.

- **Administrative effectiveness**

The role of program coordinator is vital to efficient operation of the program. Due to personnel changes, resignations and reduction of release time for program coordination the administrative effectiveness has been diminished since the last review. There are numerous projects and improvements that have been suggested that do not come to pass due to the lack of that central, focused, coordinating presence. While high quality instruction is not affected the overall quality of the program can be significantly enhanced under the direction of a committed program administrator that can actualize the contributions from the faculty, students and Advisory Board.

Section 9: Recommendations

In this section the programs strengths and challenges are reviewed. Recommendations are made regarding the continuation of the program.

Strengths.

1. The high rate of growth of the biotechnology industry throughout the United States and especially in Michigan (over 500 biotech related companies in the state) insures graduate opportunities.

2. While we do not have large numbers of expensive equipment the program has an impressive array of instrumentation compared to other undergraduate institutions and small class sizes provides opportunities for hands-on experience.

3. Placement rates are high largely due to ties to the Michigan Biotech industry.

4. Salaries are competitive and advancement for our graduates is often rapid.

5. The quality of instruction across the program is high.

6. Biotechnology major numbers are on the rise.

Challenges.

1. Low enrollment in upper division courses continues to be a concern. This is an issue that may resolve itself if the increases in enrollment continue. In addition, the implementation of a Biochemistry Major with the possibility of a Cell Biology Minor may increase enrollment in historically under enrolled courses.

2. It is vital that an ongoing equipment repair and replacement budget be provided by the University. This becomes even more critical as the equipment ages and enrollments increase

3. The program must attract and retain more students without loss of quality.

4. A way must be found to increase the familiarity of students with biotechnology related databases.

5. The role and duties of the Program Coordinator must be clearly delineated and a suitable person found to assume this role.

Proposed Actions.

1. The low enrollment in upper division courses is already being addressed by a trial of alternate year offerings, significantly decreasing FTE. A Cell Biology Minor will be advertised to eligible students, especially Biochemistry majors. The minor consists mostly of lecture courses so will not increase S/E budgets

2. The need for the line-item budget for equipment repair and replacement will continue to be presented and lobbied for in the Planning process.

3. More students are being attracted by the workshops for high school students and these should continue. Other strategies include: identifying and targeting highly qualified freshmen through the honors program, revising the Intro to Biotechnology Course to motivate, recruit and evaluate potential majors, expanding the role of the Student Professional Organization ΔNA and faculty in campus informational events.

4. While some effort is being made by faculty to incorporate appropriate computer work more could be encouraged. We recommend identifying the specific programs and data bases being used by our graduates and investigating the possibility of hosting a workshop for faculty.

5. Given the workloads of most faculty finding someone willing to take on the role of Program Coordinator is quite difficult. Possibilities for resolution might include a team approach or the hiring of additional faculty to offset the load issues. We recommend a concerted effort on the part of the advisory committee and the department head to resolve the issue within the next year.

Program Review Panel Evaluation Form

(PRP: complete this form and include with your report)

Program: BIOTECHNOLOGY

Instructions: Circle the number which most closely describes t he program you are evaluating.

1. Student Perception of Instruction **Average Score** 4.3

5	4	3	2	1

Currently enrolled students rate instructional effectiveness as extremely high.

Currently enrolled students rate the instructional effectiveness as below average.

2. Student Satisfaction with Program **Average Score** 4.7

5	4	3	2	1

Currently enrolled students are very satisfied with the program faculty, equipment, facilities, and curriculum.

Currently enrolled students are not satisfied with program faculty, equipment, facilities, or curriculum.

3. Advisory Committee Perceptions of Program **Average Score** 4.0

5	4	3	2	1

Advisory committee members perceive the program curriculum, facilities, and equipment to be of the highest quality.

Advisory committee members perceive the program curriculum, facilities, and equipment needs improvement.

4. Demand for Graduates **Average Score** 4.3

5	4	3	2	1

Graduates easily find employment in field.

Graduates are sometimes forced to find positions out of their field.

5. Use of Information on Labor Market **Average Score** 3.3

The faculty and administrators use current data on labor market needs and emerging trends in job openings to systematically develop and evaluate the program.

The faculty and administrators do not use labor market data in planning or evaluating the program.

Program Review Panel Evaluation Form (page 2)

6. Use of Profession/Industry Standards **Average Score** 3.3

5	4	3	2	1

Profession/industry standards (such as licensing, certification, accreditation) are consistently used in planning and evaluating this program and content of its courses.

Little or no recognition is given to specific profession/industry standards in planning and evaluating this program.

7. Use of Student Follow-up Information **Average Score** 4.3

5	4	3	2	1

Current follow-up data on completers and leavers are consistently and systematically used in evaluating this program.

Student follow-up information has not been collected for use in evaluating this program.

8. Relevance of Supportive Courses **Average Score** 5.0

5	4	3	2	1

Applicable supportive courses are closely coordinated with this program and are kept relevant to program goals and current to the needs of students.

Supportive course content reflects no planned approach to meeting needs of students in this program.

9. Qualifications of Administrators and Supervisors **Average Score** 3.3

5	4	3	2	1

All persons responsible for directing and coordinating this program demonstrate a high level of administrative ability.

Persons responsible for directing and coordinating this program have little administrative training and experience.

10. Instructional Staffing **Average Score** 5.0

5	4	3	2	1

Instructional staffing for this program is sufficient to permit optimum program effectiveness.

Staffing is inadequate to meet the needs of this program effectively.

Program Review Panel Evaluation Form (page 3)

11. Facilities **Average Score** 4.7

5 4 3 2 1

Present facilities are sufficient to support a high quality program.

Present facilities are a major problem for program quality.

12. Scheduling of Instructional Facilities **Average Score** 3.7

5 4 3 2 1

Scheduling of facilities and equipment for this program is planned to maximize use and be consistent with quality instruction.

Facilities and equipment for this are significantly under-or-over scheduled.

13. Equipment **Average Score** 4.7

5 4 3 2 1

Present equipment is sufficient to support a high quality program.

Present equipment is not adequate and represents a threat to program quality.

14. Adaption of Instruction **Average Score** 3.0

5 4 3 2 1

Instruction in all courses required for this program recognizes and responds to individual student interests, learning styles, skills, and abilities through a variety of instructional methods (such as, small group or individualized instruction, laboratory or "hands on" experiences, credit by examination).

Instructional approaches in this program do no consider individual student differences.

15. Adequate and Availability of Instructional Materials and Supplies **Average Score** 4.0

5 4 3 2 1

Faculty rate that the instructional materials and supplies as being readily available and in sufficient quantity to support quality instruction.

Faculty rate that the instructional materials are limited in amount, generally outdated, and lack relevance to program and student needs.

Appendix

"Michigan Moves from Motors to Molecules" ***The Scientist (16[1]:57, Han. 7, 2002)***

MichBio Home Page

The Scientist 16[1]:57, Jan. 7, 2002

PROFESSION

E-mail article

Michigan Moves from Motors to Molecules

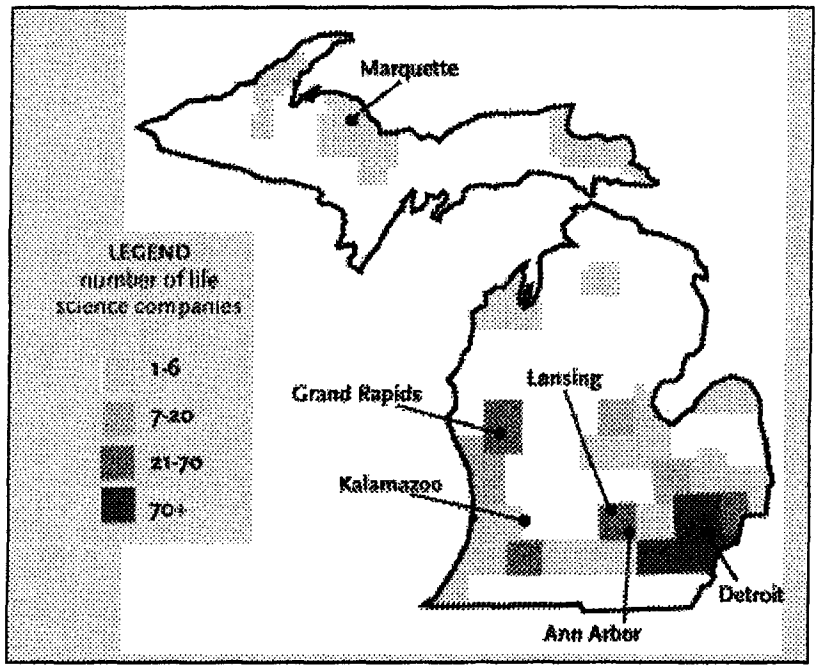
State lawmakers put billions into life science research and development

By Ted Agres

Michigan can call to mind images of the Great Lakes or of canoe trips through freshwater marshes. The city of Detroit may evoke the clanging of a car-part conveyor belt or the odor from smokestacks. But now Michigan officials and entrepreneurs also want investors around the world to envision hubs of high-tech collaborations that will transform the state into a biotechnology hotspot within the decade.

Surprising to many, Michigan already has built a vigorous life science community. The state boasts more than 300 biotech companies, a handful of pharmaceutical giants, and a triad of world-class research universities. This lineup helped create 16,800 life science jobs in 2000, making the state the 11th largest supplier of such positions in the United States, according to the Michigan Economic Development Corp. (MEDC). The workers generate $1.6 billion (US) in sales, placing the state 10th among those that produce life-science revenues. Michigan also compares favorably to the new biotechnology clusters in Britain, Sweden, and Germany.

Courtesy of Michigan Economic Development Corporation



A Bio Hotbed: More than 300 life science firms and institutes span this Midwestern state

The total number of biotechnology companies nearly matches those found in the region surrounding the National Institutes of Health in Maryland, but Michigan officials concede the state cannot boast of a large concentration of these companies, as can Boston, San Francisco, Metropolitan Washington D.C., or Research Triangle Park, N.C. The state also lacks sufficient numbers of people experienced in managing entrepreneurial startups and in obtaining finance. Compounding matters, Michigan's manufacturing history—involving the oft-struggling US automotive industry—creates an image problem. "It's difficult to attract CEOs and CFOs for our startup companies because we don't have yet the critical mass of biotech, so that somebody coming here knows that he will find something else if it doesn't work out," says **Michelle van de Walle**, life sciences business development manager for the MEDC.

Investing in Biotechnology

To promote the region, Michigan legislators earmarked $1 billion for life sciences business development from the $8.25 billion the state collected in settlement of lawsuits claiming public health damages from the tobacco industry. The two-year-old biotech initiative is called the Michigan Life Sciences Corridor (MLSC). The proceeds allow MEDC to grant $50 million a year for 20 years to state universities and research institutions.

By law, $20 million is designated for basic research at universities and nonprofit institutions; $25 million is appropriated for applied research, often involving collaboration between private companies and universities; and $5 million is earmarked for technology transfer commercialization and company spin-off efforts. To date, the MLSC initiative has awarded 63 grants for a total investment of $100 million. In 2002, the grant awards

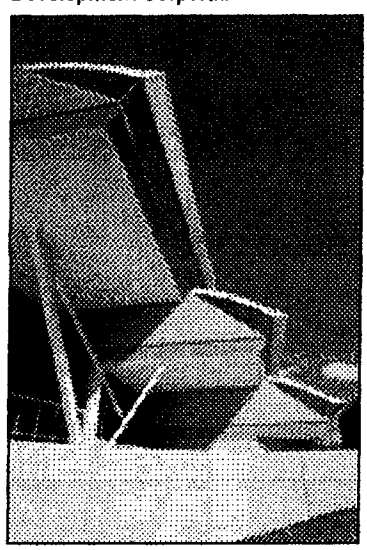
will be reduced to $45 million to help balance the state's budget, with the difference to be made up later. "We want to use the funding to increase the profile of Michigan's life science research and enterprise and enhance Michigan's R&D and commercialization environment," says **Raili Kerppola**, MLSC managing director.

The state government hopes to boost the creation of new companies and jobs and spur venture capital investment to complement the $1.2 billion private investment in research led by Pfizer Inc. and Pharmacia Corp., and the more than $500 million in university life science research. Michigan companies are also seeking foreign investment as evidenced by officials visiting firms in Sweden, Japan, and Korea to persuade executives to relocate some of their operations to the state.

Life Science Span State

The Michigan life sciences corridor stretches roughly 125 miles along Interstate 94, incorporating Wayne State University in Detroit; Pfizer Inc. and the University of Michigan in Ann Arbor; and Western Michigan University, Pharmacia Corp., and Stryker Corp. (a large medical equipment manufacturer), in Kalamazoo. Along the way, the corridor doglegs north to Michigan State University in East Lansing and the Van Andel Research Institute in Grand Rapids, a relatively new billion-dollar cancer research center.

Courtesy of Michigan Economic Development Corporation



Legacy for Medicine: The Van Andel Research Institute in Grand Rapids, Mich.

The MLSC initiative supports basic research at the University of Michigan, Michigan State University, Wayne State University, and at the Van Andel Research Institute through what's called the Core Technology Alliance. This five-year, $67 million initiative will create a linked network of five advanced laboratories—for genomics, proteomics, structural biology, animal models, and biological information—with each managed by an institution and the others serving as satellite facilities. The labs are to be outfitted with state-of-the-art equipment that also will be made available to private companies at minimal cost.

Though biotech may be new to Michigan, the life sciences and pharmaceuticals are not. The state has long housed Parke Pharmaceuticals, which later merged into Parke-Davis and finally into Pfizer Inc. The Upjohn Co., which opened in Kalamazoo in 1886, has been absorbed into drug giant Pharmacia Corp. "We already have significant research and manufacturing operations," Kerppola says.

The pharmaceutical companies produce a rich talent pool. But the state lacks entrepreneurial experience. Jan Gensheimer, executive director of the Michigan Biosciences Industry Association, predicts that once the needed experienced business

generators are in place the venture capital will flow. "The money people tell me [that] with the right people here, we won't have a money problem," she says.

To help attract these entrepreneurs, the life sciences initiative provided Sloan Ventures LLC $843,000 to establish a seed fund called the MLSC Catalyst Fund, to finance fledgling companies until they can get other capital. Streamline Proteomics LLC in Ann Arbor, and GeneGo Inc. in New Buffalo, have received some of these funds, according to **Richard S. Sloan**, managing director of the venture capital fund. The firm also manages $10 million in biotech venture capital funds.

Rubicon Genomics, Inc., a spin-off from the University of Michigan, won a $1.9 million grant from the state to develop sequencing reagents. **Thomas A. Collet**, Rubicon's president and CEO, says recruiting people from outside the state has been a challenge. "There is a view of the world that genomics is only on the East Coast or the West Coast," he says. "But once you bring people out to Michigan, they are quite favorably impressed. The quality of life in Ann Arbor is very, very good. For people who like the seasons and the outdoors, in a university setting with affordable housing and a lot of diversity, it's a great place."

Ann Arbor has been ranked in surveys as one the best places to live in the United States. It enjoys relatively low crime and high quality public education. But Ann Arbor's median sales price for existing homes, at $187,000, outpaces that of Detroit ($148,000), Kalamazoo ($114,000) Grand Rapids ($125,000), and Lansing ($114,000).[1]

Clearly the cities along the Michigan Life Sciences Corridor differ. Detroit, for instance, still suffers the crime, troubled public education, and other problems typical of older, industrial US cities. Initially, CEO **Randal Charlton**, of Asterand Inc., was apprehensive about locating in Detroit. "It seemed a bit like a Third-World city," he says. "But I think Detroit's coming back. I've lived all over the world and I enjoy it here." He has recruited more than 20 people, nearly all of them from out of state.

Michigan hospitality has also attracted other biotech brethren from outside the state. "The folks have been very helpful and welcomed us with open arms," says **Alan Walton**, senior partner of Oxford Biosciences Partners, a Boston-based venture capital firm that funds Asterand. Charlton's company rents space at Wayne State University's Karmanos Cancer Institute. "I'm sitting in absolutely state of the art facilities, with brand-new lab space in a large building with lots of backup facilities, and we're only paying $20 a square foot," boasts Charlton. "I couldn't have gotten this for five times the price on the East Coast."

For some, the potential value of Michigan's role in biotech stretches beyond the state boundary. "The real question is whether the Midwest can build a biotech corridor that is as attractive to companies and investors as are Boston and California," says **Barry Broome**, president of Southwest Michigan First, a trade association in Kalamazoo seeking to promote economic development. "I'd like to see Ann Arbor, Chicago, Indianapolis, Kalamazoo, [and] Grand Rapids in a seamless partnership," he says. "That would be an appropriate way to benefit all the communities."

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1. "Housing Opportunity Index: Second Quarter 2001," National Association of Home Builders, Washington, D.C.

Pharmaceutical Foundation

Michigan boasts its share of major life science companies:

- **Pfizer Inc.** Parke Pharmaceutical, then the largest drug company in the country, was headquartered in the state in the 1950s and later merged to form Parke-Davis. That company combined with Warner-Lambert into Pfizer Inc. Pfizer's research center in Ann Arbor employs 2,600 people.
- **Pharmacia Corp.** A biotech anchor in Kalamazoo, Pharmacia employs 6,000. It absorbed the former Upjohn Co., which opened in the state in 1886.
- **Stryker Corp.** A world leader in manufacturing medical products, including orthopedic implants and surgical instruments. Stryker employs 900 workers in Kalamazoo.
- **Perrigo Co.** This contract drug and pharmaceutical manufacturing company in Allegan (north of Kalamazoo) employs 2,800 workers.
- **Dow Chemical Co.** The chemical giant's agricultural science division in Midland focuses on plant genetics and biotech.
- **University of Michigan** This top-ranked academic powerhouse in Ann Arbor consistently ranks in the top five for life science research. The university's medical school attracts more than $200 million in research funding annually.
- **Michigan State University** The nation's first land-grant university spends more than $100 million a year on life sciences research, including genetic mapping, bioinformatics, and intercellular communication. The campus in East Lansing houses three medical schools: the College of Human Medicine, College of Osteopathic Medicine, and the College of Veterinary Medicine.
- **Wayne State University** With the fourth largest medical school in the nation, the Detroit-based institution attracts $80 million for research annually. Research developments include AZT and dCyd for treatment of AIDS, and t-PA, a clot buster.

Courtesy of Michigan Economic Development Corporation

- **The Van Andel Research Institute (VARI)** This 400,000-square-foot cancer research facility opened in May 2000 with a $1 billion endowment. Designed to rival centers such as the Howard Hughes Medical Institute in

Maryland and the Salk Institute in California, VARI will focus on the functions of genes and proteins in cancer and on developing diagnostics and treatments.

—Ted Agres

Inside VARI: The cancer genetics research lab at The Van Andel Research Institute

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The Scientist **16[1]:57, Jan. 7, 2002**

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BUSINESS IN MICHIGAN

MICHGIAN: A GREAT LOCATION FOR LIFE SCIENCES BUSINESS AND RESEARCH

Michigan is a great location for life sciences businesses and research. With 542 life sciences companies, resources like the Core Technology Alliance and the Technology Tri-Corridor, the industry continues to grow.

Michigan Life Sciences Industry at a Glance:

- 542 companies
- 31,777 employees
- $4.8 billion in sales
- Michigan's life sciences industry focuses on: pharmaceuticals, medical devices, instrumentation, diagnostics and biotechnology research and ancillary services
- Since 2000, 92 new companies have been created, making Michigan's life sciences industry the fastest growing in the nation
- 92 new companies created 450 jobs and generated $34 million in private investment
- Michigan's 10 SmartZones and 7 business accelerators aid life sciences start-up companies and provide office and lab space, as well as some equipment
- In 2004, $25 million will be invested to foster growth in life sciences, advanced automotive technologies, homeland security companies and research through the Technology Tri-Corridor
- The *Research Michigan Guide*, offers information on the types of life sciences research being conducted at Michigan's 15 public universities

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Response to the Academic Program Review – Biotechnology

Introduction

The faculty and administrators of the college of Arts and Sciences and the departments of Biological Sciences and Physical Sciences are deeply committed to continuing and improving the Biotechnology program. We have hired a new faculty member who is serving as program coordinator. Program enrollment has increased significantly in the last two years. Cooperative initiatives with the forensic biology and honors programs, as well as a new web page and other recruitment efforts, will address future enrollment.

Response

The following text outlines major points raised by the academic program review council and corresponding responses by the biotechnology faculty to these points.

1. **The biotechnology program has been characterized by low enrollment.**
   - Current enrollment in the program stands at 43 students. In 1999, enrollment stood at 24 students. There has been an overall trend for increasing enrollment over the past six years.
   - Upper level biotechnology classes are currently at or above capacity. For example, enrollment in BIOL 470 currently stands at 22 students and BIOL 474 at 20 students. The maximum approved enrollment for these classes is 15 students. Some upper level biotechnology classes are currently offered in alternate years to maximize enrollment. This policy may have to be reversed in those cases where the alternate year courses are laboratories, to prevent student numbers from exceeding those that can be properly and safely instructed.
   - To increase enrollment in the biotechnology program, the program coordinator and biotechnology faculty will work closely with Honors program staff to facilitate the recruitment of new students of a high caliber. The program coordinator, Dr. Brad Isler, has already initiated contact with Honors coordinator Maude Bigford to recruit honors students for undergraduate research opportunities.
   - The entry level "Introduction to Biotechnology" class has been reclassified as a 100 level course with no prerequisites. This class will serve to introduce entry-level students to biotechnology at Ferris State and beyond campus boundaries, and will serve as a recruitment tool for entry-level students.
   - The biotechnology program coordinator and faculty will develop relationships with area community colleges. A portion of biotechnology students enter the program as transfer students from community colleges. Continuing to develop relationships with community college faculty and administrators will help recruit additional students to the program.
   - Plans for a cooperative agreement with Angiang University in Vietnam have been initiated through Dr. Phil Watson. Long term goals of this relationship include the enrollment of outstanding Vietnamese students into the biotechnology program and the opportunity for American students to travel to Vietnam to participate in internships.

- Continued development of the program website will serve as an excellent public relations tool for students investigating the program. Coordination with the biotechnology student association (Delta Nu Alpha) and its website will also serve to introduce students to the program and its members.
- Dr. Jim Hoerter continues to run summer biotechnology workshops and camps for high school students. This may serve as a valuable recruitment tool for students preparing to enter college.
- The biotechnology program continues to innovate to meet the needs of students, which should help recruit and retain students in the program.
    i. A new upper-level class in bioinformatics will be offered during winter semester of 2006. Bioinformatics is a rapidly emerging area within the biotechnology field. Familiarity with this area should help to meet the needs of current students and recruit new students into the program.
    ii. A new program coordinator was hired in autumn 2005, which should facilitate the development of new ideas and continue innovation in the biotechnology program.

2. The biotechnology program has a low graduation rate, resulting from the large number of students that leave the biotechnology program during their second and third years. This may be a result of overly rigorous upper level biotechnology classes.

- There is a misconception that the biotechnology program is designed to train entry-level technicians. The biotechnology program was never designed to solely train entry-level technicians. The biotechnology program was developed to train research scientists. The wide variety of challenging classes required in the biotechnology program provides students a strong scholastic foundation in the modern molecular sciences. Upon graduation, biotechnology students have the scientific background to move into many career areas, including graduate school, professional school, and the pharmaceutical industry. In surveys, former students state that the rigorous, lab-intensive nature of the biotechnology program was an advantage when trying to secure a job or apply for admission to graduate or professional school. The rigorous nature of the program is recognized by both the biotechnology faculty and the biotechnology students as an advantage and not as a detriment to the program.
- To retain students in the biotechnology program, biotechnology faculty will work more closely with faculty of other programs. The strengthening of ties with other programs broadens the focus of our program and helps to serve students that have diverse career goals and increase the retention rate of the biotechnology program. In the future, we will seek to develop upper level classes that serve the needs of our program and others. For example, many biotechnology students already choose to double major in biotechnology and forensics. The newly developed bioinformatics course will be designed to cover areas attractive to both biotechnology and forensics students.
- The biotechnology coordinator and faculty recognize the need to closely advise biotechnology students as they approach the second semester of their second year. If students leave the biotechnology program, many do so at this time. Advisors should take special care to recognize the difficulties some students may encounter at this stage of their academic career and inform the students of all options, not only of the option to drop out of the biotechnology program.

- The biotechnology faculty recognizes the rigorous nature of the biotechnology curriculum. Ferris State is a diverse institution, granting degrees ranging from two-year associate degrees to professional degrees in pharmacy and optometry. The biotechnology program complements this diversity.

3. **The biotechnology program is too expensive.**
   - FTE costs for biotechnology specific courses are quite low. FTE costs for classes taught by tenure-track faculty are as follows: BIOL 470 = 0.09 FTE, BIOL 471 = 0.12 FTE, BIOL 472 = 0.13 FTE, BIOL 473 = 0.23 FTE, and BIOL 474 = 0.07 FTE. The program coordinator receives a 25% (0.25 FTE) load reduction for his duties.
   - The implementation of alternate year offerings for BIOL 470, BIOL 471 and BIOL 474 has also served to reduce the FTE cost for biotechnology classes.
   - Upper level biotechnology laboratory courses were originally designed to have small class sizes. The complicated and time-intensive nature of the molecular techniques performed in these laboratories is not served well by large class sizes. These upper-level, smaller enrollment classes make up only 12.5% of biotechnology requirements, while performing a crucial role in the instruction of future research scientists.

4. **There is little support within the biology department for the biotechnology program.**
   - The College and Dean, in support of the program, has recruited and hired a new biotechnology program coordinator, Dr. Brad Isler. The biology faculty is actively engaged in support of the new program coordinator.
   - Close ties are being formed between the biotechnology program and other programs within the biology department, such as forensics. Inclusion of the biotechnology program in cross-program initiatives such as the cooperative agreement with Angiang University illustrate the support for the biotechnology program by faculty members of other academic programs within the biology department.

Conclusion

Since most of the courses taken by biotechnology students are also required for other majors, the cost of the program is low. The program offers students a rewarding range of career paths after graduation, including graduate school, laboratory scientist, and professional school. The Biotechnology program strongly complements other programs at Ferris State University by offering an academically advanced science option that has a unique appeal to many of our students and their parents. We feel that the program enhances overall enrollment and should continue.

Questions For the Biotechnology Program

1. The program was designed with a maximum capacity of 16 students per year and is considered to be full at 12 students per year. What is the current upper-division enrollment in Biotechnology?

We currently have 43 students declared as biotechnology majors. Twenty-four of these students are in upper level courses. Upper level courses are at capacity or nearly so.

2. Besides going to graduate school, what are some of the reasons that students leave the program, especially those who leave the program before taking any of the indicator courses? If the students attrit, where do they go? What are the program's plans to track them?

Students do not leave the program to enter graduate school. Students actually stay in the program to prepare for graduate school. Biotechnology graduates are in excellent standing for admission to graduate and professional school. Students who do leave the biotechnology program do not leave Ferris State, but switch to other programs within in the natural and physical sciences, such as applied biology.

3. Please comment in more detail on plans to improve advising in the freshman and sophomore years.

A permanent program coordinator will serve as a consistent source of information for first and second year students. Consistency of advising instills confidence in both the biotechnology program and biotechnology students. Many times, students choose the path of least resistance in their academic careers. A consistent advisor and program coordinator will be there to advise students during their difficult times. This will strengthen the program and the academic careers of biotechnology students, even if they choose to leave the program.

4. Please comment on plans to target interested FSU students NOT enrolled in the Honors program.

In the winter semester, a representative from the biotechnology program will visit BIOL 122 and CHEM 122 lectures to promote the program. The revamp of "Introduction to Biotechnology" will also serve to recruit non-honors students.

5. Besides reverting to alternate year offering in some courses, what is planned to increase the number of students enrolled in upper-division courses?

Opening upper level biotechnology courses to non-biotechnology majors will result in a few extra students. However, the goal of the biotechnology program is to increase the number of students in the program enough to return to offering upper level courses every year.

6. Is the number of qualified faculty adequate to deliver the program at maximum capacity?

Yes

7. When is the next meeting of the advisory committee? Who are the members?

The external advisory committee most recently met in spring 2005. The most recent list of external committee members is attached to this document. The next meeting of the external advisory committee will be held during spring 2006.

8. Please comment on what is being done to address the perceptions by graduates that an increase in math requirements and more experience with databases would be helpful?

Databases will be covered in great detail during the new Bioinformatics class being offered in winter 2006. No plans have been made for changing MATH requirements, but comments by current and former students suggest that we study these requirements more fully.

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