FAIRMONT STATE UNIVERSITY

Office of the Associate Provost

1201 Locust Avenue
Fairmont, West Virginia 26554-2470
Phone (304) 367-4101
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MEMORANDUM

TO: Curriculum Committee

FROM: Christina Lavorata CL

DATE: March 21, 2011

SUBJECT: Curriculum Proposal #10-11-14

I recommend approval of attached Curriculum Proposal #10-11-14 from the College of Science and Technology, Department of Biology, Chemistry, and Geoscience. The proposal changes the requirements for the BS in Chemistry, the BA in Education with Teaching Specialization in Chemistry, and the Chemistry Minor.

cc: Dr. Maria Rose
Dr. Anthony Gilberti
Dr. Erica Harvey
Ms. Evie Brantmayer

FAIRMONT STATE UNIVERSITY

College of Science and Technology

1201 Locust Ave.
Fairmont, WV 26554
Phone: (304) 367-4642
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MEMORANDUM

To: Dr. Christina Lavorata, Associate Provost

From: Dr. Anthony F. Gilberti, Dean, College of Science and Technology

Subject: Chemistry Curriculum Proposal

Date: March 20, 2010

CC: Chemistry Accreditation files

The faculty in the Chemistry program area proposed a curriculum revision to the Department of Biology, Chemistry, and Geoscience on February 25, 2011. This was reviewed by the faculty and approved on March 7, 2011. The proposal changes the requirements for the B.S. in Chemistry, the B.A. in Education with a Teaching Specialization in Chemistry, and the Chemistry minor. The proposal also contains two new courses and the removal of several other courses from the above programs. I support the faculty in the development of this proposal and the submitted proposal being reviewed by the Curriculum Committee.

PREPARING CURRICULUM PROPOSALS

INSTRUCTIONS

Draft your proposal in accordance with the guidelines below and the format shown on the following pages. Should any item under the several headings not pertain to your proposal, write N/A. **Number the second and subsequent pages of your proposal.**

Supply the preliminary information about the proposal as indicated below:

PROPOSAL NUMBER: Leave this space blank. A number will be assigned to the proposal by the Associate Provost.

SCHOOL: Enter the name of the College or School (e.g., *Liberal Arts*), Department (e.g., Language and Literature), and Program (e.g., English).

PREPARER/CONTACT PERSON: Enter the name of the person who prepared the proposal and his/her telephone extension number.

COPIES OF MEMOS SENT TO AFFECTED DEPARTMENTS: Attach these to the back of your proposal.

LETTERS OF SUPPORT FROM DEANS OF AFFECTED DEPARTMENTS: If the Curriculum Committee requests these letters, attach them to the back of your proposal.

DATE SUBMITTED: The Curriculum Committee meets on the fourth Tuesday of each month. **Proposals are due in the Office of the Associate Provost on or before the second Tuesday of the month.**

REVISION SUBMISSION DATE: If changes are required to the original proposal, enter the date the proposal was resubmitted.

IMPLEMENTATION DATE REQUESTED: Enter the first day of the semester (or summer term) and year in which the proposed curriculum change(s) would take effect.

CURRICULUM PROPOSAL (Submit one hard copy and an electronic copy to the Associate Provost by the second Tuesday of the month.)

Proposal Number: #10-11-14

School/Department/Program: Science and Technology/BCG/Chemistry

Preparer/Contact Person: Erica Harvey

Telephone Extension: x4498

Date Originally Submitted: 2/8/2011

Revision (Indicate date and label it Revision #1, #2, etc.): Revision #1, 4/20/11, requested after first reading

Implementation Date Requested: Fall 2011

I. **PROPOSAL**. Write a brief abstract, not exceeding 100 words, which describes the overall content of the proposal.

Based on changes in the guidelines for program approval by the American Chemical Society Committee on Professional Training, this proposal changes the requirements for the B.S. in Chemistry, the B.A. in Education with Teaching Specialization in Chemistry, and the Chemistry Minor. Course content is revised, credit hours, titles and prerequisites are changed, two new courses are created, a course is identified as a writing intensive course, and several courses are removed from the curriculum. Students have more flexibility in course sequencing and hours required for the various degrees are reduced.

II. **DESCRIPTION OF THE PROPOSAL**. Provide a response for each letter, A-H, and for each Roman Numeral II–V. If any section does not apply to your proposal, reply N/A.

A. Deletion of course(s) or credit(s) from program(s)

1. B.S. Chemistry deletions:
CHEM 1106 Chemical Principles II (4 credits)
CHEM 1113 Practical Scientific Statistics with a Spreadsheet (1 credit)
CHEM 4405 Advanced Integrated Laboratory (1-2 credits per course; 7 credits required for major)
CHEM 4455 Advances in Modern Chemistry (3 credits)

Total hours deleted. 15

Note: the courses above are also being deleted from the catalog.

2. B.A. Education with Specialization in Chemistry deletions:
CHEM 1106 Chemical Principles II (4 credits)
CHEM 1113 Practical Scientific Statistics with a Spreadsheet (1 credit)
CHEM 2205 Analytical Chemistry (4 credits)
CHEM 4405 Advanced Integrated Laboratory (1-2 credits per course; 1 credit required for major)

Total hours deleted. 10

3. Minor in Chemistry deletions:
CHEM 1106 Chemical Principles II (4 credits)
CHEM 1113 Practical Scientific Statistics with a Spreadsheet (1 credit)

CHEM 2201 Organic Chemistry I (4 credits)
CHEM 2202 Organic Chemistry II (4 credits)
CHEM 2205 Analytical Chemistry (4 credits)
OR
CHEM 2215 Intermediate Instrumental Analysis (4 credits)

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B. Addition of course(s) or credit(s) from program(s)

1. B.S. Chemistry additions:

CHEM 2200 Foundational Biochemistry (4 credits)
CHEM 4404 Synthetic Methods and Materials (4 credits)
CHEM 3304 Inorganic Chemistry (+1 credit to existing course*)

Total hours added. 9

Note: CHEM 3304 Inorganic Chemistry is a 4 credit course, but the previous version of this course is already required for the B.S. Chemistry degree. That previous version, CHEM 4450, only had 3 credits and is being revised into CHEM 3304 (4 credits) with this proposal. Thus, only 1 net credit is being added to the program.

2. B.A. Education with Specialization in Chemistry additions:

CHEM 2200 Foundational Biochemistry (4 credits)
CHEM 3304 Inorganic Chemistry (4 credits)
PHSC 4430 Science Integration Seminar (1 credit)

Total hours added. 9

3. Minor in Chemistry additions:

CHEM 2200 Foundational Biochemistry (4 credits)
Any 3 courses with a CHEM prefix except CHEM 2225 (12 credits)

Total hours added. 16

C. Provision for interchangeable use of course(s) with program(s)

Not applicable.

D. Revision of course content. Include, as an appendix, a revised course description, written in complete sentences, suitable for use in the university catalog.

Revised catalog course descriptions for all the courses shown in the table in Section E are included in Appendix B. In addition, a revised catalog course description is also included for CHEM 2202 Organic Chemistry II, though no other changes are being made to the course that would necessitate its inclusion in Section E.

E. Other changes to existing courses such as changes to title, course number, and elective or required status.

Course number		Course title		Prerequisites		Credits	
Old	New	Old	New	Old	New	Old	New

CHEM 1105	No change	Chemical Principles I	Chemical Principles	MATH ACT 20, MATH SAT 480, Compass 42, or CHEM 1101 with a grade of C or better	No change	5	No change
CHEM 2201	No change	Organic Chemistry I	No change	CHEM 1106	CHEM 2200	4	No change
CHEM 2205	No change	Analytical Chemistry	No change	CHEM 1106, 1113	CHEM 1105	4	No change
CHEM 2215	CHEM 3315	Intermediate Instrumental Analysis	Instrumental Analysis	CHEM 1106, 1113	CHEM 2200, 2205, PHYS 1102 or 1106	4	No change
CHEM 3301	No change	Physical Chemistry I	No change	CHEM 2201, 2205, MATH 1185 or 1190, PHYS 1102 or 1106	CHEM 2200, ENGL 1108, MATH 1185 or 1190, PHYS 1101 or 1105	4	No change
CHEM 3302	CHEM 4415	Physical Chemistry II	No change	CHEM 2201, 2215, 3301, MATH 1186 or 3315	CHEM 3301, PHYS 1102 or 1106, MATH 1186 or 3315	4	No change
CHEM 4450	CHEM 3304	Advanced Inorganic Chemistry	Inorganic Chemistry	CHEM 3302	CHEM 2200	3	4*
BIOL 3360	No change	Biochemistry	No change	CHEM 2202, MATH 1185 or 1190	CHEM 2201, MATH 1185 or 1190	4	No change

*Because an hour is being added to this course for a laboratory component, we have included a two-level outline and student learning outcomes for the new CHEM 3304 in Appendix C.

Rationale for renumbering of courses (added at request of curriculum committee upon passage for first reading):

Three courses are renumbered in this proposal. In all three cases, the numbering change helps to highlight a designation for American Chemical Society (ACS) approval purposes as a Foundation versus Advanced course. Advanced courses are designed to follow Foundation courses, and we wanted the course numbers to reflect the level of each course in the new curriculum.

CHEM 2215 Intermediate Instrumental Analysis is renumbered and renamed to CHEM 3315 Instrumental Analysis. This course also gained several prerequisites, including the ACS Foundational courses CHEM 2200 Foundational Biochemistry and CHEM 2205 Analytical Chemistry, as well as the 2-semester Physics sequence. The addition of these prerequisites will allow us to build on student knowledge about chemical analysis, intermolecular forces (a basis for chromatographic separation methods) and electromagnetic radiation (a basis for spectroscopic instrumentation.) In the past, without these prerequisite courses, we had to introduce these foundational topics in the course. Now we will have time to go deeper into the design and analytical capabilities of each instrument.

CHEM 3302 Physical Chemistry II is renumbered to CHEM 4415. This course will be offered only every other year and will have an explicit focus on connections of quantum mechanics to spectroscopy. A lab was also added to this course. It is one of the Advanced courses for ACS purposes and we wanted the course number to reflect that standing. While not much in the new course description has changed from the old course description, this course has always been one of the most mathematically and conceptually challenging courses in the curriculum and probably needed to be renumbered long ago.

CHEM 4450 Advanced Inorganic Chemistry is renumbered and renamed to CHEM 3304 Inorganic Chemistry. The course description is also substantially revised to reflect the new survey nature of the course. This course has a substantially shorter prerequisite string than it did previously, and will be commonly taken after the first two courses in the major. This course is a Foundation course for ACS purposes and its lowered number reflects that standing.

III. **RATIONALE FOR THE PROPOSAL.**

A. **Quantitative Assessment**: Indicate the types of assessment data, i.e., surveys, interviews, capstone courses, projects, licensure exams, nationally-normed tests, locally developed measurements, accreditation reports, etc., that were collected and analyzed to determine that curricular changes were warranted. Quantitative data is preferred.

The chemistry program at Fairmont State University received formal approval from the American Chemical Society in the fall of 2008, under the Society's old guidelines from the Committee on Professional Training (ACS CPT). The ACS CPT has now changed its guidelines for approval of programs to allow a more flexible structure. The current proposal allows us to meet the new guidelines, while also decreasing the number of hours in the program and providing students with more options for proceeding through the curriculum.

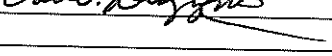
Analysis of trends in declared student majors over time indicates that most students who graduate with chemistry degrees from FSU enter our institution with declared pre-professional, biology, or forensic science majors rather than chemistry majors. Many students in our state are unaware of careers available to chemists. Thus, we recruit chemistry majors from a population of students who are interested in applications of chemistry to medicine, pharmacy, physical therapy, dentistry, life sciences, etc. For this reason, we are inserting a biochemical focus to the second semester course in the first year, and building almost all subsequent courses from that focus.

B. **Qualitative Assessment**: Based upon the assessment data above, indicate why a curricular change is justified. Indicate the expected results of the change. Be sure to include an estimate of the increased cost, or reduction in cost of implementation. FOR EXAMPLE: Will new faculty, facilities, equipment, or library materials be required?

Our proposal will allow us to stay in compliance with the new guidelines from ACS CPT. Over time, we expect the changes to result in an increased number of chemistry majors and therefore a higher efficiency in use of faculty time. No new faculty, facilities or library materials are expected to be required. Some new laboratory equipment will be helpful to support the Inorganic Chemistry laboratory and Synthetic Methods and Materials laboratory, but we are writing grants and working with our Dean on an equipment list of items to purchase from existing course fee and program budgets.

IV. Should this proposal affect any course or program in another school, a memo must be sent to the Dean of each school impacted and a copy of the memo(s) must be included with this proposal. In addition, the Deans of the affected schools must sign below to indicate their notification of this proposal.

By signing here, you are indicating your college's/school's notification of this proposal.

College/School	Dean	Signature
School of Education	Van Dempsey	

Appendix D contains the memo sent to the Dean of the School of Education.

V. Should this proposal affect any course to be added or deleted from the general studies requirements, a memo from the chair of the General Studies Committee indicating approval of the change must be included with this proposal.

We anticipate future submission of CHEM 3301 for the Teamwork Attribute in General Studies, but currently no chemistry courses are approved for Teamwork. The remainder of the curriculum proposal does not affect General Studies courses.

We also ask that CHEM 3301 be approved as a Writing Intensive course. CHEM 4405 Advanced Integrated Laboratory, our previous writing intensive course, is being removed from the program curriculum with this proposal. See Appendix E for our explanation of how CHEM 3301 meets the Writing Intensive requirements.

VI. ADDITIONAL COMMENTS.

III. **RATIONALE FOR THE PROPOSAL.**

A. **Quantitative Assessment**: Indicate the types of assessment data, i.e., surveys, interviews, capstone courses, projects, licensure exams, nationally-normed tests, locally developed measurements, accreditation reports, etc., that were collected and analyzed to determine that curricular changes were warranted. Quantitative data is preferred.

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Analysis of trends in declared student majors over time indicates that most students who graduate with chemistry degrees from FSU enter our institution with declared pre-professional, biology, or forensic science majors rather than chemistry majors. Many students in our state are unaware of careers available to chemists. Thus, we recruit chemistry majors from a population of students who are interested in applications of chemistry to medicine, pharmacy, physical therapy, dentistry, life sciences, etc. For this reason, we are inserting a biochemical focus to the second semester course in the first year, and building almost all subsequent courses from that focus.

B. **Qualitative Assessment**: Based upon the assessment data above, indicate why a curricular change is justified. Indicate the expected results of the change. Be sure to include an estimate of the increased cost, or reduction in cost of implementation. FOR EXAMPLE: Will new faculty, facilities, equipment, or library materials be required?

Our proposal will allow us to stay in compliance with the new guidelines from ACS CPT. Over time, we expect the changes to result in an increased number of chemistry majors and therefore a higher efficiency in use of faculty time. No new faculty, facilities or library materials are expected to be required. Some new laboratory equipment will be helpful to support the Inorganic Chemistry laboratory and Synthetic Methods and Materials laboratory, but we are writing grants and working with our Dean on an equipment list of items to purchase from existing course fee and program budgets.

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By signing here, you are indicating your college's/school's notification of this proposal.

College/School	Dean	Signature
School of Education	Van Dempsey	

Appendix D contains the memo sent to the Dean of the School of Education.

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We also ask that CHEM 3301 be approved as a Writing Intensive course. CHEM 4405 Advanced Integrated Laboratory, our previous writing intensive course, is being removed from the program curriculum with this proposal. See Appendix E for our explanation of how CHEM 3301 meets the Writing Intensive requirements.

VI. ADDITIONAL COMMENTS.

None.

APPENDIX A

B.S. Degree in Chemistry
Current Program

Required Major Courses			HRS	
CHEM 1105	Chemical Principles I		5	
CHEM 1106	Chemical Principles II		4	
CHEM 1113	Practical Scientific Stat. with a Spreadsheet		1	
CHEM 2201	Organic Chemistry I		4	
CHEM 2202	Organic Chemistry II		4	
CHEM 2205	Analytical Chemistry		4	
CHEM 2215	Intermediate Instrumental Analysis		4	
CHEM 3301	Physical Chemistry I		4	
CHEM 3302	Physical Chemistry II		4	
CHEM 4405	Advanced Integrated Laboratory		7	
CHEM 4450	Advanced Inorganic Chemistry		3	
CHEM 4455	Advances in Modern Chemistry		3	
BIOL 3360	Biochemistry		4	
PHYS 1102 or 1106	Introduction to Physics II/Principles of Physics II		4-5	
MATH 1185 or 1190	Applied Calculus I or Calculus I		4	
MATH 1186 or 3315	Applied Calculus II or Calculus II		4	
TOTAL Required Major Courses				63-64
Major Electives				
Minor Electives				
TOTAL HOURS FOR MAJOR				**63-64**
Required General Studies Courses				
First Year Experience				15-16
ENGL	1104	Written English I	3	
ENGL	1108	Written English II	3	
INFO	1100	Computer Concepts and Applications	3	
MATH			3-4	
COMM	2200, 2201, OR 2202	Communication	3	
Scientific Discovery				8
PHYS	1101 or 1105	Introduction to Physics I /Principles of Physics I		
Cultural / Civilization Exploration				9
Society / Human Interactions				6
Artistic / Creative Expression				6
TOTAL GENERAL STUDIES HOURS				**45-46**
TOTAL FREE ELECTIVES				**19-20**
TOTAL HOURS				**128**

Appendix A, continued

B.A. Degree in Education: Specialization in Chemistry 9- Adult

Current Program

Chemistry/Science Curriculum		HRS	
CHEM 1105	Chemical Principles I	5	
CHEM 1106	Chemical Principles II	4	
CHEM 1113	Practical Scientific Stat. with a Spreadsheet	1	
CHEM 2201	Organic Chemistry I	4	
CHEM 2205	Analytical Chemistry	4	
CHEM 3301	Physical Chemistry I	4	
CHEM 4405	Advanced Integrated Laboratory	1-2	
MATH 1185 or 1190	Applied Calculus I or Calculus I	4	
PHYS 1101 or 1105	Introduction to Physics I/Principles of Physics I	4-5	
PHYS 1102 or 1106	Introduction to Physics II/Principles of Physics II	4-5	
PHSC 4431	Methods and Materials in Teaching Science	3	
TOTAL Required Courses – Chemistry Curriculum			38-40
NOTE: Professional Education courses are unchanged from existing core.			**36**
Major Electives			
Minor Electives			
TOTAL HOURS FOR MAJOR			**74**

Required General Studies Courses				
First Year Experience				12
ENGL	1104	Written English I	3	
ENGL	1108	Written English II	3	
INFO	1100	Computer Concepts and Applications	3	
MATH	Included above			
COMM	2200, 2201, OR 2202	Communication	3	
Scientific Discovery				
PHYS	1101 or 1105 and 1102 or 1106 included above			
Cultural / Civilization Exploration				9
Society / Human Interactions				6
Artistic / Creative Expression				6
TOTAL GENERAL STUDIES HOURS				**33**
TOTAL FREE ELECTIVES				**24**
TOTAL HOURS				**131**

Appendix A, continued
Minor in Chemistry
Current Program

Chemistry Curriculum		HRS	
CHEM 1105	Chemical Principles I	5	
CHEM 1106	Chemical Principles II	4	
CHEM 1113	Practical Scientific Stat. with a Spreadsheet	1	
CHEM 2201	Organic Chemistry I	4	
CHEM 2202	Organic Chemistry II	4	
CHEM 2205	Analytical Chemistry	4	
OR			
CHEM 2215	Intermediate Instrumental Analysis	4	
TOTAL Minor Required Courses			22
Minor Electives			
TOTAL HOURS FOR MINOR			**22**

Appendix A, continued

B.S. Degree in Chemistry
Proposed Program
--and--
Analysis of Compliance with Degree Definition Policy

Required Major Courses			HRS		Degree Definition Policy
CHEM 1105	Chemical Principles		5		
CHEM 2200	Foundational Biochemistry		4		
CHEM 2201	Organic Chemistry I		4		
CHEM 2202	Organic Chemistry II		4		
CHEM 2205	Analytical Chemistry		4		
CHEM 3315	Instrumental Analysis		4		
CHEM 3301	Physical Chemistry I		4		
CHEM 3304	Inorganic Chemistry		4		
CHEM 4404	Synthetic Methods and Materials		4		
CHEM 4415	Physical Chemistry II		4		
BIOL 3360	Biochemistry		4		
MATH 1185 or 1190	Applied Calculus I or Calculus I		*4		
MATH 1186 or 3315	Applied Calculus II or Calculus II		4		
PHYS 1101 or 1105	Introduction to Physics I		*4-5		
PHYS 1102 or 1106	Introduction to Physics II		*4-5		
TOTAL Required Major Courses				61-63	
Major Electives					
Minor Electives					
* Satisfies general studies requirements; see below					
TOTAL HOURS FOR MAJOR				**61-63**	Max 65
Required General Studies Courses					
First Year Experience				12	
ENGL	1104	Written English I	3		
ENGL	1108	Written English II	3		
INFO	1100	Computer Concepts and Applications	3		
MATH	*Satisfied in major; see * course above*				
COMM	2200, 2201, OR 2202	Communication	3		
Scientific Discovery – *satisfied in the major; see * course above*					
Cultural / Civilization Exploration				9	
Society / Human Interactions				6	
Artistic / Creative Expression				6	
TOTAL GENERAL STUDIES HOURS				**33**	32-42
TOTAL FREE ELECTIVES				**32-34**	Min 21
TOTAL HOURS				**128**	128

Appendix A, continued

B.A. Degree in Education: Specialization in Chemistry 9- Adult

Proposed Program

Chemistry Curriculum			HRS	Degree Definition Policy
CHEM 1105	Chemical Principles		5	
CHEM 2200	Foundational Biochemistry		4	
CHEM 2201	Organic Chemistry I		4	
CHEM 3304	Inorganic Chemistry		4	
CHEM 3301	Physical Chemistry I		4	
MATH 1185 or 1190	Applied Calculus I or Calculus I		*4	
PHSC 4430	Integrated Science Seminar	1		
PHSC 4431	Methods and Materials in Teaching Science	3		
TOTAL Required Courses – Chemistry Curriculum			**29**	
NOTE: Professional Education course hours are unchanged from existing core.			**36**	
Major Electives				
Minor Electives				
* Satisfies general studies requirements; see below				
TOTAL HOURS FOR MAJOR			**65**	Max 65
Required General Studies Courses				
First Year Experience			12	
ENGL	1104	Written English I	3	
ENGL	1108	Written English II	3	
INFO	1100	Computer Concepts and Applications	3	
MATH	*Satisfied in major; see * course above*			
COMM	2200, 2201, OR 2202	Communication	3	
Scientific Discovery			8-10	
PHYS 1101 or 1105	Introduction to Physics I/Principles of Physics I		*4-5	
PHYS 1102 or 1106	Introduction to Physics II/Principles of Physics II		*4-5	
Cultural / Civilization Exploration			9	
Society / Human Interactions			6	
Artistic / Creative Expression			6	
TOTAL GENERAL STUDIES HOURS			**41-43**	32-42
TOTAL FREE ELECTIVES			**20-22**	Min 21
TOTAL HOURS			**128**	128

Appendix A, continued
Minor in Chemistry
Proposed Program

Chemistry Curriculum		HRS
CHEM 1105	Chemical Principles	5
CHEM 2200	Foundational Biochemistry	4
TOTAL Minor Required Courses		9
Minor Electives		12
Any three additional course with CHEM prefix except CHEM 2225.*		
TOTAL HOURS FOR MINOR		21

*Note: CHEM 2225 Forensic Microscopy is actually a forensic science course.

Appendix B. Course Descriptions for Existing and Revised/New Courses

Old Catalog Course Description	New Catalog Course Description
CHEM 1105 Chemical Principles 5 This course and the following one, CHEM 1106, constitute an introduction to modern chemistry and its applications to society, including structure, nomenclature, properties and simple reactivity of inorganic and organic chemicals, descriptive chemistry, periodic properties, spectroscopy, stoichiometry involving solids, gases and solutions, basic thermodynamics, chemical equilibrium (acid/base and solubility), introductory kinetics, biochemistry, electrochemistry and nuclear chemistry. 4 hours of lecture and one 3-hour laboratory per week. PR: ACT math score of 20; SAT Math 480, Compass score of 42 or CHEM 1101 with a grade of C or better. Fall semester only.	CHEM 1105 Chemical Principles 5 This course constitutes an introduction to modern chemistry and its applications to society, including structure, nomenclature, properties and simple reactivity of inorganic chemicals, spectroscopy, stoichiometry involving solids, gases and solutions, chemical equilibrium, introductory kinetics and thermodynamics, electrochemistry and nuclear chemistry. 4 hours of lecture and one 3-hour laboratory per week. PR: ACT math score of 20; SAT Math 480, Compass score of 42 or CHEM 1101 with a grade of C or better. Fall semester only.
	CHEM 2200 Foundational Biochemistry 4 hrs An introduction to biochemistry with emphasis on the role of basic general chemistry principles, including molecular structure and intermolecular forces, periodic properties, acid-base chemistry, diffusion and osmosis, kinetics and energetics, structural models and visualization. Introduces biochemical reaction mechanisms, cell components and their functions, and a chemical view of proteins, lipids, and cell membranes. 3 hours of lecture and one 3-hour laboratory per week. PR: Chem 1105. Spring only.
CHEM 2201 Organic Chemistry I 4 This course is a systematic study of organic chemistry with emphasis on kinetic behavior, reaction mechanisms and structural relationships. It includes the study of all major classes of organic compounds and functional groups. The course consists of 3 hours of lecture and one 3-hour laboratory per week. PR: CHEM 1105. Fall semester only.	CHEM 2201 Organic Chemistry I 4 hrs This course presents an overview of the properties and reactivity of all major classes of organic compounds and functional groups. Selected reactions and mechanisms, particularly those with a biochemical connection, are also discussed. 3 hours of lecture and one 3-hour laboratory per week. PR: Chem 2200. Fall semester only.
CHEM 2202 Organic Chemistry II 4 This course is a continuation of CHEM 2201 and consists of 3 hours of lecture and one 3-hour laboratory per week. PR: CHEM 2201. Spring semester only.	CHEM 2202 Organic Chemistry II 4 hrs This course builds on the foundation from CHEM 2201 to provide a systematic study of the structure and reactivity of all major classes of organic compounds and functional groups with an emphasis on synthesis, mechanisms and structural relationships. 3 hours of lecture and one 3-hour laboratory per week. PR: Chem 2201. Spring Semester only.
CHEM 2205 Analytical Chemistry 4 Classical methods of chemical analysis, with emphasis on quantitative techniques. Also includes theory of acid-base, precipitation and oxidation methods, molecular structure, and an introduction to electrochemistry and spectroscopy. 3 hours of lecture and one 3-hour laboratory per week. PR: CHEM 1106, 1113. Fall semester only.	CHEM 2205 Analytical Chemistry 4 Classical methods of chemical analysis, with an emphasis on quantitative techniques and statistical analysis. Topics include error propagation, median, mean and standard deviation, t-test, q-test, hypothesis testing, linear regression analysis, creation of appropriate graphs and use of calibration curves, equilibrium, precipitation, acid-base theory, acid-base and redox titrations, activities, electrochemistry and potentiometry. 3 hours of lecture and one 3-hour laboratory per week. PR: CHEM 1105. Fall

	semester only
CHEM 2215 Intermediate Instrumental Analysis 4 This course includes the study of the basic concepts of instrument design and construction, operation of chemical instrumentation, use of standard procedures of analysis (including forensic and environmental methods), and method development for specific analyses. Spectroscopic, chromatographic and electrochemical methods of analysis are included. The course consists of two hours of lecture and one four-hour laboratory per week. PR: CHEM 1106, 1113. Spring semester only.	CHEM 3315 Instrumental Analysis 4 Basic concepts of instrument design and construction, operation of chemical instrumentation, use of standard procedures of analysis (including forensic and environmental methods), and method development for specific analyses. Spectroscopic and chromatographic methods of analysis are emphasized. The course consists of two hours of lecture and one four-hour laboratory per week. PR: CHEM 2200, 2205, PHYS 1102 or 1106. Spring semester only.
CHEM 3301 Physical Chemistry I 4 This course consists of a rigorous treatment of chemical kinetics and thermodynamics, based on calculus and physics. The application of partial differentiation and mathematical software to chemical problems is specifically addressed during this course. The course consists of four lecture hours per week. PR: CHEM 2201, 2205, PHYS 1102 or 1106, MATH 1185 or 1190. Fall semester only.	CHEM 3301 Physical Chemistry I 4 A systematic treatment of chemical kinetics and thermodynamics, based on calculus and physics. The application of partial differentiation and mathematical software to chemical problems is specifically addressed. This course serves as an introduction to writing in the discipline, particularly in the laboratory component. 3 hours of lecture and one 3-hour laboratory per week. PR: CHEM 2200, ENGL 1108, MATH 1185 or 1190, PHYS 1101 or 1105. Fall semester only.
CHEM 3302 Physical Chemistry II 4 This online course deals with the development of quantum chemistry. Elements of linear algebra, differential equations and mathematical software will be applied to chemical problems. Some synchronous electronic meetings are required. PR: CHEM 2201, 2215, 3301 MATH 1186 or 3315. Spring semester only.	CHEM 4415 Physical Chemistry II 4 This heavily web-supported course deals with the development of quantum chemistry and its applications to spectroscopy. Elements of linear algebra, differential equations and mathematical software will be applied to chemical problems. 3 hours of lecture and one 3-hour laboratory per week. PR: CHEM 3301, MATH 1186 or 3315, PHYS 1102 or 1106. Spring semester, even years only.
CHEM 4450 Advanced Inorganic Chemistry 3 This course consists of an advanced study of inorganic reactions, coordination compounds and theories based on quantum mechanical principles. The course consists of three lecture hours per week. PR: CHEM 3302. Fall semester only.	CHEM 3304 Inorganic Chemistry 4 hrs This course covers the synthesis, reactions, and properties of elements and inorganic compounds. Topics include atomic and molecular structure; ionic bonding, crystals, and intermolecular forces; redox chemistry; acids, bases, and nonaqueous solvents; the main group elements; the transition metals; structure, bonding, synthesis and reactions of coordination compounds. 3 hours of lecture and one 3-hour laboratory per week. PR: Chem 2200. Fall semester only.
	CHEM 4404 Synthetic Methods and Materials 4 hrs This laboratory-intensive course is a study of synthetic methods and materials used in organic and inorganic chemistry, including green approaches to synthesis. Topics include organometallic compounds, metal catalysis, inert gas techniques, characterization techniques including electrochemistry, and the synthetic chemical literature. 2 hours of lecture and one 4-hour laboratory per week. PR: Chem 2202, Chem 3304. Fall semester only, even years.

BIOL 3360 Biochemistry 4 hrs This course is a study of general principles of biochemistry, including the synthesis and metabolism of carbohydrates, proteins, lipids and nucleic acids. The course integrates theory, concepts and applications. It encompasses the molecules of life, the dynamic function of biomolecules, the storage and transfer of biological information and bioenergetics of cells and organ systems. 4 hours of lecture per week. PR: CHEM 2202 and either MATH 1185 or MATH 1190. Offered on rotation. See Biology program website for rotation schedule.	BIOL 3360 Biochemistry 4 hrs A study of general principles of biochemistry. Topics include structure and function of proteins, DNA, and RNA, enzyme kinetics, regulation, carbohydrates, lipids, membranes and metabolism. 3 hours lecture and one 3-hour laboratory per week. PR: Chem 2201, Math 1185 or 1190. Spring semester only.

Appendix C. Course Descriptions, Outlines and Outcomes for New Courses

1. Chem 2200 Foundational Biochemistry 4 hrs

An introduction to biochemistry with emphasis on the role of basic general chemistry principles, including molecular structure and intermolecular forces, periodic properties, acid-base chemistry, diffusion and osmosis, kinetics and energetics, structural models and visualization. Introduces biochemical reaction mechanisms, cell components and their functions, and a chemical view of proteins, lipids, and cell membranes. 3 hours of lecture and one 3-hour laboratory per week. PR: Chem 1105. Spring only.

Course Outline

1. The cell
    a. cell organelles
    b. function of organelles
    c. biomolecules
2. Aqueous solutions
    a. ions
    b. neutral ionic and molecular compounds
    c. strongly acidic and basic compounds
    d. weakly acidic and basic compounds
    e. buffers
3. Cell membranes
    a. lipids
    b. Lewis structures - 90 % rule
    c. specific ions and molecules not following the 90 % rule
    d. functional groups
    e. shapes/structure and function in biological molecules
    f. VSEPR
    g. intermolecular forces of small molecules
    h. polarity of molecules
    i. interaction of molecules (like dissolves like)
4. Proteins
    a. amino acids
    b. acid-base chemistry of amino acids
    c. protein folding and intermolecular forces
    d. primary, secondary, tertiary and quarternary structure
    e. protein structure databases and visualization
    f. enzymes
5. Biochemical reactions
    a. classification
    b. gradients and electrochemical potential
    c. diffusion and osmosis
    d. energetics
    e. kinetics

Course Outcomes

After successful completion of this course, students will be able to:

1. Identify and describe the structure and function of the major organelles of a eukaryotic cell.
2. Identify the major classes of biological macromolecules based on their structure, and identify the major biological functions of these classes of macromolecules.
3. Use periodic table to rank biologically relevant atoms and ions by radii/size
4. Identify and find the relative abundances of all species present in a given aqueous solution
5. Predict the effect of the addition of a strong acid or base to an aqueous solution – recognize buffers.
6. Draw Lewis structures for molecular and ionic species pertaining to biochemistry
7. Identify 7 functional groups and classes of organic compounds

8. Categorize lipids.
9. Predict shapes, including bond angles and resonance, using VSEPR.
10. Predict possible intermolecular forces for small molecules or portions of a larger molecule.
11. Assess the polarity of a molecule or portions thereof using polarity scales.
12. Predict the interaction of molecules based on their intermolecular forces.
13. Reproduce from memory the structure, name and 3 letter codes for the 20 amino acids. Rank by polarity.
14. Predict the predominant form of an amino acid at a given pH based on pKa
15. Interconvert between amino acid sequence and primary protein structure; using N-terminus and C-terminus conventions correctly.
16. Analyze a protein from the Protein Data Bank in terms of polarity and secondary structure.
17. Predict the folding of a protein chain based on biochemical principles.
18. Showcase the function and mechanics of an enzyme
19. Analyze biochemical reactions by recognizing the transfer of groups (e.g. OH) and/or electrons.
20. Explain the nature and applications of gradients in osmosis and diffusion, including concentration and electrochemical potential gradients.
21. Write fully balanced chemical equations for selected biochemical reactions, including biochemically important half reactions.
22. Use Gibb's free energies to predict the outcome of biochemical processes and reactions (single and coupled).
23. Compare and contrast a chemical reaction to its counterpart involving a (bio) catalyst using concepts from kinetics.
24. Define and explain (bio) chemical terms.
25. Extract, answers questions about, and present information from written sources.
26. Use spectroscopic techniques to identify molecules of biochemical interest
27. Demonstrate laboratory competencies: report, practicum
28 Participate effectively in groups/prepare for class (first half of term.)
29 Participate effectively in groups/prepare for class (second half of term.)

Outcome Assessments

Outcomes 1-23 will be assessed by mastery-based exam questions.
Outcomes 24-25 will be assessed by presentation rubrics and by electronic quizzes on textbook readings.
Outcomes 26-27 will be assessed through laboratory activities and assignments.
Outcomes 28-29 will be assessed through daily record-keeping by students.

2. Chem 3304 Inorganic Chemistry 4 hrs (included here because an hour is added to the course, to accommodate a laboratory component.)

This course covers the synthesis, reactions, and properties of elements and inorganic compounds. Topics include atomic and molecular structure; ionic bonding, crystals, and intermolecular forces; redox chemistry; acids, bases, and nonaqueous solvents; the main group elements; the transition metals; structure, bonding, synthesis and reactions of coordination compounds. 3 hours of lecture and one 3-hour laboratory per week. PR: Chem 2200. Fall semester only.

Course Outline

1. Structure
    a. Atomic Structure
    b. Molecular Structure
    c. Lewis Structure and VSEPR
2. Bonding
    a. Ionic Bonds
    b. Intermolecular Bonds
3. Reactions
    a. Thermodynamics
    b. Reaction Types
4. Acids and Bases

   a. Theories
   b. Nonaqueous Solvents
5. The Main Group Elements
   a. The Elements
   b. Important Compounds
   c. Structure and Reactivity
6. The Transition Metals
   a. The Metals
   b. Important Compounds
7. Coordination Compounds
   a. Naming
   b. Structure
   c. Stability
   d. Bonding Theories
   e. Synthesis
8. Laboratory Experience
   a. Safety, Chemical Handling and Storage
   b. Synthesis and Characterization of Main Group Element Compounds
   c. Synthesis and Characterization of Transition Metal Compounds
   d. Synthesis and Characterization of Bioinorganic Compounds
   e. Qualitative Analysis
   f. Separation Techniques (e.g. ion exchange chromatography)
   g. Structure Visualization (e.g. Spartan, Odyssey)

Course Outcomes

After successful completion of this course the student will be able to:

1. Name inorganic compounds.
2. Draw Lewis structures of inorganic molecular compounds.
3. Predict the geometry of inorganic molecular compounds using VSEPR.
4. Answer questions related to the descriptive chemistry of the major main group and transition metal elements and some of their compounds.
5. Explain the bonding of inorganic compounds and elements using established bonding models (covalent, ionic, metal, MO, complex, crystal field).
6. Explain inorganic reactions based on acid-base reaction, metal complex reaction and reduction-oxidation reaction models.
7. Synthesize and characterize examples of main group and transition metal compounds.
8. Determine the composition of an unknown sample using test reactions.
9. Present from memory the descriptive chemistry of the major main group and transition metal elements and some of their compounds.
10. Write a good-quality technical report.

3. Chem 4404 Synthetic Methods and Materials 4 hrs

This laboratory-intensive course is a study of synthetic methods and materials used in organic and inorganic chemistry, including green approaches to synthesis. Topics include organometallic compounds, metal catalysis, inert gas techniques, characterization techniques including electrochemistry, and the synthetic chemical literature. 2 hours of lecture and one 4-hour laboratory per week. PR: Chem 2202, Chem 3304. Fall semester only, even years.

Course Outline

1. Organometallic Compounds
   a. Bonding
   b. Preparation
   c. Reactions and mechanisms

2. Metal Catalysis
    a. Heterogeneous and homogeneous catalysis
    b. Hydrogenation
    c. Olefin metathesis
    d. Palladium in catalysis
3. Pericyclic Reactions
    a. The Woodward-Hoffmann Rules
    b. Electrocyclic Reactions
    c. Cycloadditions and reversions
4. The Synthetic Chemical Literature
    a. Primary and secondary literature
    b. Databases (CAS, Beilstein)
    c. Procedures in the primary literature

Course Outcomes and Methods of Assessment

After successful completion of this course, students will be able to:

Use inert-gas techniques.	Successful synthesis of an air-sensitive compound in a yield of at least 30 % of the published value.
Reproduce synthetic procedures from the primary literature.	Successful synthesis based on yield and purity; assessed by a grading rubric
Find the procedure for the synthesis of an inorganic and organic compound.	Successful completion of assignment
Explain in detail and elaborate on the experimental set-up of a synthetic procedure from the primary or secondary literature.	assessed by a grading rubric
Apply the methods of a synthetic procedure (including green approaches) to a new problem.	Successful synthesis based on yield, purity, and student engagement; assessed by a grading rubric
Answer questions related to the bonding, preparation and reactions of organometallic compounds.	Written examination
Answer questions related to the mechanism of selected catalytic cycles.	Written examination
Answer questions related to the mechanisms and product formation of pericyclic reactions.	Written examination
Present her/his work on a professional poster suitable for an ACS undergraduate student poster session	assessed by a grading rubric
Write a good-quality technical report.	assessed by a grading rubric

Appendix D. Memo to Van Dempsey, Dean, School of Education

Memo

To: Van Dempsey, Dean, School of Education
From: Erica Harvey, Chemistry Program
Date: 2/8/10
Re: Proposed changes to content courses in the Specialization in Chemistry 9-Adult

The chemistry program has developed a curriculum proposal that will affect the content courses currently offered in the Specialization in Chemistry 9-Adult. Dr. Deb Hemler, Science Education coordinator, has worked closely with the program to ensure that the proposed new curriculum meets the needs of students pursuing the Specialization in Chemistry 9-Adult. The total hours in the specialization are reduced by 1, and courses are added with an explicit focus on Biochemistry and Integrated Science.

A copy of the proposal is attached. Please let us know of any concerns or comments, and respond with your approval so that we can include it with the proposal.

Thank you.

Appendix E. CHEM 3301 as a Writing Intensive Course

Information found at the following link: http://www.fairmontstate.edu/academics/wic/default.asp

WRITING INTENSIVE COURSES (WIC)

The Fairmont State Liberal Studies Curriculum indicates that "students will be required to complete at least one designated writing intensive course as part of their liberal studies program or their major field of study. This course will not be in addition to their other courses, but rather a course from those approved as liberal studies or majors courses."

Rationale for WIC

Writing intensive courses benefit students by:

1) improving writing skills as a means of self-expression
2) increasing knowledge and understanding of course content
3) enhancing critical thinking skills
   - •Evaluation
   - •Analysis
   - •Interpretation
   - •Inference
   - •Explanation
   - •Self-regulation

Criteria for WIC and How CHEM 3301 Meets the Criteria:

1. A minimum of twenty pages of written work will be assigned in a variety of formal and informal writing assignments and formats throughout the semester. This might include, but is not limited to: research reports, critical essays, laboratory reports, logs, journals, or short in-class responses.

   Lab reports, notebooks, preparation logs before each class session, and annotation of mathematical problem-solving documents are the major formal and informal writing assignments used in this course. This amounts to at least 20 pages of writing during the semester (actually much more.)

2. The instructor will provide opportunities for substantial revision in which the student responds to instructor feedback as well as discipline-specific writing instruction.

   Lab reports have detailed guidelines shown below and students submit revised reports (up to 1 per resubmission possible per report) in response to detailed instructor feedback. An example of the rubric is also included below.

3. At least 30% of the course grade must be based on writing assignments.

   Lab reports, notebooks, preparation logs, and annotated Mathcad documents constitute at least 30% of the course grade.

4. Prerequisites- English 1104 and English 1108

   Students will typically be juniors, and ENGL 1108 is a listed prerequisite (added in this proposal.).

5. An enrollment cap of twenty students

   Enrollment will be capped at 20 students.

Course Description

CHEM 3301 Physical Chemistry I 4

A systematic treatment of chemical kinetics and thermodynamics, based on calculus and physics. The application of partial differentiation and mathematical software to chemical problems is specifically addressed. This course serves as an introduction to writing in the discipline, particularly in the laboratory component. 3 hours of lecture and one 3-hour laboratory per week. PR: CHEM 2200, ENGL 1108, MATH 1185 or 1190, PHYS 1101 or 1105. Fall semester only.

Appendix E, continued. CHEM 3301 as a Writing Intensive Course

Learning Outcomes

Meta-Skills Outcomes

- Identify problem types and the appropriate "skills toolbox" to use to solve each one.
- Make and identify appropriate assumptions and their probable validity.
- Identify unrealistic answers and discuss the dependence of an answer on the assumptions made.
- Solve new problems that require synthesis of elements from mastery outcomes and other previous knowledge.
- Annotate mathematically-complex solutions to open-ended problems.
- Explain the process used to solve an open-ended problem.
- Collaborate with other students to solve open-ended problems.
- Find reliable sources of information (print, electronic and interview) and cite appropriately.
- Read, summarize and apply physical chemistry information from the literature and other non-teacher sources (e.g., books, web).
- Present/teach information and thought processes to peers.
- Apply the scientific method to any problem.
- Use mathematical models to generate predictions, and model physical systems mathematically.

Core Content Outcomes

Thermodynamics:

- Solve practical problems relating to ideal gas laws and pressure.
- Relate the verbal and mathematical statements of the laws of thermodynamics; apply the laws to solve problems.
- Go from a word problem to a picture of a system moving from state 1 to state 2 during a process, with system and surroundings identified
- Label variables as extensive and intensive; systems as open, closed or isolated; and processes as adiabatic, diathermic or isothermal.
- Apply the relationship between work, heat and energy.
- Calculate reversible and irreversible work, heat and energy changes for adiabatic and isothermal expansions of ideal gases.
- Calculate enthalpy and entropy changes for gas expansions.
- Calculate efficiencies of engines and coefficient of performance of heat pumps.
- Solve multistep heat transfer problems involving heating, cooling and phase transitions (e.g. using dry ice to cool a cup of coffee.)
- Calculate enthalpies and entropies of reaction (T-independent and T-dependent, including T-dep. Cp's).
- Solve practical problems that require the application of partial derivative relationships.
- Use a variety of approaches to calculate standard Gibbs' free energy changes; evaluate the relative utility of different approaches: Formations from tables; $\Delta G=\Delta H-T\Delta S$; Equilibrium constants; Standard cell potentials.
- Calculate Gibbs' free energy changes under non-standard conditions, including impure solids and liquids and various solution or gas activities. ($\Delta G= \Delta Go+RTlnQ$)
- Use precise scientific arguments about entropy (universe versus system) and its ramifications in daily life; connect Gibbs free energy to the entropy of the universe.
- Make predictions about enthalpies and entropies of reaction from chemical considerations.
- Create a concept map to show linkages (connections) between thermodynamic equations and concepts.

- Demonstrate, explain and solve problems involving freezing point depression, boiling point elevation, osmotic pressure, isothermal distillation, volumes and heats of mixing, Raoult's Law and Henry's Law (ideal and non-ideal).
- Interpret a phase diagram (identify stable phase, find boiling point, vapor pressure, freezing point, critical point, triple point, construct a cooling curve qualitatively).
- Apply the dependence of chemical potential on temperature and pressure expressed in G=VdP-SdT, connect to phase diagrams.
- Solve equilibrium problems (Ksp, Ka, Kb) using activities, detailed unit analysis, and impure solids or liquids
- Identify the theoretical/mathematical basis for general chemistry assumptions (e.g. le Chatelier, solids and liquids are 1, etc.)

Kinetics:

- Integrate zero, first and second order reactions, linearize the equations.
- Use initial conditions and rate law information (analytical solutions, rate constants and/or half-life values) to predict concentrations at a specified time.
- Apply pseudo-first order assumptions to analyze rate data.
- Analyze data using the method of initial rates.
- Use integrated rate expressions to analyze kinetic data (order in each species and rate constant(s); not just first and second order; required integration of mastery skills.)
- Apply the Arrhenius equation to rate-versus-temperature or rate constant-versus-temperature data to get activation energies and A's.
- Use transition state theory to interpret activation energies and A-factors in terms of activation enthalpies and entropies.
- Use kinetic results to evaluate and propose mechanisms for chemical reactions, including structures of activated complexes.
- Use a proposed mechanism to generate a rate law.
- Apply the steady state approximation to simplify the expression for a rate law based on a proposed mechanism.
- Numerically solve a complex rate law.

Math outcomes:

- Use partial and total derivatives and integration.
- Apply Euler's criterion for exactness.
- Solve problems involving complicated algebraic manipulations.
- Use log rules quickly and accurately.
- Perform units analysis and convert readily between scientific units.
- Solve straightforward math/calculus problems by hand (simple or commonly-used integrals, integrals requiring integral tables, and selected series expansions).
- Use a symbolic solver for complicated math problems (Mathcad) Measure thermodynamics quantities for example equilibrium constants, enthalpy and entropy values for various reactions.

Laboratory outcomes:

- Use molecular-modeling software to determine thermodynamic properties for ideal and non-ideal gases.
- Measure reaction kinetics to determine the order of a reaction to determine the activation energy of a reaction.
- Error analysis Straight forward analysis Sophisticated error analysis.
- Follow detailed instructions.
- Construct a resume and go through an interview process.
- Write lab reports in the style of journal articles, using detailed and precise language.
- Keep a current and correct lab journal.
- Lab safety and professionalism.

List of laboratory experiments

- Determination of Cp and Cv for idea gases by molecular modeling.
- Determination of the enthalpy of dissolution for soluble salts via coffee cup calorimetry.

- The enthalpy of vaporization by gas chromatography.
- Determination of Ksp of slightly soluble salts via electrochemical measurements.
- Determination of K (complexation) for silver complexes via electrochemical measurements.
- pKa of an Acid–Base Indicator by Spectrophotometry.
- Determination of ΔG, ΔH, and ΔS for the acid equilibrium of an indicator by measuring the temperature dependence of Ka.
- Measure the effect of ionic strength on equilibrium of $FeSCN^{+2}$ Complexes.
- Deterrmination of the rate constant for the spontaneous hydrolysis of methylchloroformate using UV-Vis spectroscopy.
- Determination of the rate law for the halogenations of acetone.
- Use the method of initial rates to determine the rate law of methylene blue reduction by ascorbic acid.
- Activation energy experiment.

COMPONENTS OF LABORATORY REPORTS

Laboratory Report Cover Sheet. This sheet is used to maintain our database.

Title Page. Includes report title, author(s), date, course and report number.

Abstract. Briefly (3-4 sentences maximum) explain the goal of the experiment, state the basic experimental technique and give the conclusions of the experiment. (For example, you might state the values of measured rate constants, the chemical reaction to which the values apply, an assessment of the amount of error in the values, and a brief description of the method used to measure the values.) The abstract of a scientific report is a stand-alone summary; information in the abstract will be repeated and expanded in the report body.

Background/Introduction. The purpose of the work and any background information pertinent to the present study should be presented here. This section should be sketched out before you actually begin the lab, as part of your plan of procedure.

The background should include a review of prior experimental results (at FSU or in the literature) and a discussion of relevant theoretical principles behind your experiment (including appropriate equations). Even when prior results disagree with the results to be presented, they should be discussed. Equations should not be derived in this section, but a source for a derivation of the equation should be clearly referenced. Chemical reaction equation(s) should be shown here.

The background should include a statement of your planned experiment and the theory behind your experiment. For example, the following sorts of discussions may be appropriate:

> According to Aileen Rottweiler the reaction being considered follows a first order rate law under the chosen conditions. 1 The integrated form of a first order rate equation2 is given in Equation (1),
>
> 1) $\ln [A] = -kt + \ln [Ao]$
>
> where *[A]* denotes the concentration of blubarium, *k* is the rate constant and *t* is time. Equation (1) is a linear equation that presents *ln [A]* as a function of time; a plot of *ln [A]* versus *t* should yield *-k* as the slope...

Experimental details. Concisely explain the procedure actually used during the experiment. A subsequent worker should be able to reproduce the experiment from your report. This section differs from the notebook entries because repetitive measurements and dead-ends are summarized rather than written in detail. Pertinent details are also organized for logical flow rather than sequentially, as they would be in the notebook. Include the names and brands of all instruments, equipment, software, computers (for calculational experiments) and chemicals. Include, and justify, **all** deviations from, and additions to, the procedure given out by the instructor or used by previous workers.

Calculations and Error analysis. Include a written-out sample of each calculation, even when the calculation was actually performed in a spreadsheet. Write the equation being used first, and then plug the numbers in. The purpose of this is to show the reader what the spreadsheet was doing and to allow for the propagation of error through the calculations. Error propagation is addressed in the Instrumental Analysis textbook and will also be addressed in Chemistry 3301.

Before you can propagate uncertainties or errors, you must critically evaluate how much error or uncertainty is present in your raw data. Discuss in the report all expected sources of error for each measured quantity and realistically estimate the amount of uncertainty each source provides. Explain how you arrived at your estimated values.

How much uncertainty do your *results* have? Propagate your uncertainties through your calculations. You should also report uncertainties in values obtained from parameters in curve fit equations (e.g., slope and intercept for a linear plot.) Make sure that all numbers (both data and results) are accompanied by error bars (±uncertainty).

Data, Results and Discussion. Present compiled primary data and the results calculated from them, preferably in tables. Pages of raw numbers from a spreadsheet are not necessary, but the descriptive headings and first entries from a large amount of spreadsheet data should be included as a table. A separate table of results (with corresponding uncertainties and an appropriate number of significant figures) should be provided.

Each table and graph should be descriptively labeled, numbered in the order of discussion in the text, and referred to (by page number and title or graph number) in the discussion. If you don't discuss a table or graph, it's not clear why it is being included! For example, for each graph, include the equation that describes the plot, and explain what information has been obtained from the plot.

Notes about particular data points should be discussed in the text and given as footnotes to tables or graphs. For example, a symbol such as "*" might appear beside certain data points in a graph or table. Below the table, the following type of statement would be included:

* These points were obtained with a water blank, instead of a methanol blank.

Finally, identify the information that was sought in the experiment and finish with definite and concise **conclusions**!!! Where possible, compare your results to previous workers' values, and discuss differences. Be sure to give a appropriate citations to previous work, including student lab reports.

Procedure analysis. Was your procedure adequate? If not, what would you change if you were to do this experiment again? Are there any improvements you could suggest for future chemists working on this experiment?

Bibliography. Include a list of references in standard format at the end of the narrative section.

For example

1. Aileen Rottweiler, "Kinetics of Decomposition of Blubarium," Physical Chemistry Lab Report 4, 1996.
2. Florence T. Hornswaggle, *Principles of Physical Chemistry,* 4th edition. Fort Worth: Harcourt Brace College Publishers, 1947.

General Tips:

Graph and table titles should describe what the graph or table is about.
The first graph or table mentioned in the report is Graph 1 or Table 1.
Don't start sentences with a numeral or a chemical symbol.
Use a spell-checker AND get someone to proofread for you.
Don't capitalize the names of chemicals.
Data should be shown as individual points or symbols on the graph; curve-fit lines should be solid lines.

Form: "Lab Report Form S10 - updated"

Created by: Fairmont Chemistry Manager
Created on: 04/26/2010 9:38 pm (EST)
Last edited: 04/26/2010 9:43 pm (EST)

Response is required

Lab Report Incomes

Notes regarding course incomes: The Plagiarism, Formatting, English, Abstract and Experimental Details sections represent criteria with which you are supposed to be proficient from previous classes. These criteria/skills are required incomes. The incomes have been developed in previous Chemistry courses. A deficiency in 2 or more income sections results in a penalty of 25 points and requires revision within 72 hours after your initially graded lab report grade is returned here; please check frequently. If the revisions are not completed within the deadline, the lab report incomes will not be regraded.

Plagiarism
Report is unacceptable and is returned without further review if evidence of plagiarism is found. One revision is allowed.

○ Report shows evidence of plagiarism ○ Report does not show evidence of plagiarism

Formatting
Deficiency in 2 or more categories, without revision, results in the loss of 10 points

Response Legend:
1 = deficient

	1	N/A
page numbers, spell-checking by computer		
chemical names not capitalized, sentences start with letters only		
consistent units and variable names		
superscripts, subscripts, Greek symbols		
descriptive graph titles and table titles		
graphs and tables sequentially numbered		
graph axes labeled.		
descriptive column titles on tables		
	1	**N/A**
Mathematical and chemical equations clearly and consecutively numbered.		
Mathematical and chemical equations indented, set off from text by carriage returns.		
Uncertainties included in tabulated data.		
Mathcad regions clearly annotated		
Bibliography: list of references in standard format		
Printouts from instrumentation must be clearly labeled. (Can scan the printout). Caption or titles must be typed, not handwritten. Need appropriate labeling of variables. Need to decide what is in the caption or description.		
Caption of print-out includes: experiment that gave data, important parameters (temperature, solvents, compounds etc.), and other descriptive information that helps the reader to understand immediately what the print-out is representing.		

English
Deficiency in 2 or more categories, without revision, results in the loss of 20 points

Response Legend:
1 = deficient

	1	N/A
correct spelling		
proofread for typos by a human being		
third-person passive; no pronouns. "The solutions were placed in the UV-Visible spectrophotometer." NOT "Next we will put the sample in the UV-Vis."		
constant and logical verb tenses; (past tense except in rare situations.)		
appropriate punctuation		
subject/verb agreement; parallel construction		
complete sentences; no run-on sentences		
no dangling prepositions; no split infinitives		

	1	N/A
no awkward sentence construction		
Stylistic: varied sentence structure		
Stylistic: writing expresses author's meaning		
Stylistic: paragraphs used appropriately		
Stylistic: writing flows logically and smoothly		
Stylistic: no unnecessary words (then, next, after this was done: can't use any of these words more than once per page!!!)		

Abstract
Deficiency in 2 or more categories, without revision, results in the loss of 10 points

Response Legend:
1 = deficient

	1	N/A
abstract is a succinct summary		
goal of the experiment is clearly stated		
experimental technique(s) are clearly described		
results are stated		
conclusions are concise and clear		

Experimental Details
Deficiency in 1 or more categories, without revision, results in the loss of 20 points

Response Legend:
1 = deficient

	1	N/A
concise, complete explanation of actual experimental procedure		
summary of dead-end experiments if applicable		
names and brands of instruments, equipment, software, computers (for calculational experiments) and chemicals		
deviations from and additions to previous work		

Feedback on Incomes
Feedback on Formatting, English, Abstract, and Experimental Details sections.
Formatting, English **Abstract, Experimental Details**

No answer specified
(Max chars: 10,000)

No answer specified
(Max chars: 10,000)

Lab Report Outcomes

The sections associated with Lab Report Outcomes address areas in which you should expect to see significant growth during the AIL sequence.

Content: Outline
Deficiency = - 5 points

Response Legend:
1 = deficient

	1	N/A
report includes an outline with the list of ideas in a logical order; thoughts in the report are expressed in a linear fashion; one idea (outline entry) per paragraph		

Background/Introductions
Deficiencies in 1 - 3 categories = - 5 points* # of deficiencies

Deficiencies in >3 categories = - 20 points

Response Legend:
1 = deficient

	1	N/A
statement and purpose of planned experiment		
review of prior experimental results (at FSU or in the literature, cited properly)		
information clearly in writer's own words, not paraphrased from references.		
equations provided are correct		
discussion of relevant theoretical principles (with equations)		
referenced source for derivation of equations		
chemical reaction equation(s) shown		
chemical reaction equation(s) are redrawn in ChemDraw (not just copied)		

Safety
Deficiency in 2 or more categories, without revision, results in the loss of 10 points

Response Legend:
1 = deficient

	1	N/A
chemical structures and corresponding names for all reactants and products shown in table format		
safety precautions summarized and explained for hazardous compounds		
Safety data is complete, accurate and includes references.		
physical properties for all chemicals listed (color, phase at room temperature, bp. for liquids, mp. for solids)		

Calculations, including Error Propagation
Deficiencies in 1 - 3 categories = - 5 points* # of deficiencies;

Deficiencies in >3 categories = - 20 points

Response Legend:
1 = deficient

	1	N/A
written-out sample of each calculation, including units (even spreadsheet)		
calculations are correct		
critical, justified assignment of uncertainty present in all raw data		
propagation of uncertainty through the calculations		
all numbers (both data and results) are accompanied by uncertainties (number ± uncertainty).		

Data, Results, Discussion, Error Analysis
Deficiencies in 1 - 3 categories = - 5 points* # of deficiencies

Deficiencies in >3 categories = - 20 points

Response Legend:
1 = deficient

	1	N/A
compiled primary data and calculated results appropriately		
table of results (with corresponding uncertainties and an appropriate number of significant figures) provided		
tables and graphs discussed sequentially		
equation describing each plot		
explanation of how data has been extracted from each plot		
thoughtful analysis of data is provided		
analysis of data is correct (e.g., spectral interpretation)		
definite and concise conclusions		
comparison to previous workers' results		
appropriate citations to previous work		

Procedure Analysis
Deficiencies in categories = - 5 points* # of deficiencies

Response Legend:
1 = deficient

	1	N/A
Summary of encountered problems was provided		
explanation of encountered problems was provided		
explanation of encountered problems is thoughtful, reasonable and scientific in nature. This should include mathematical proof if possible		
suggestions for improvement by future workers are provided		

Feedback on Outcomes
Feedback on Formatting, English, Abstract, and Experimental Details sections.

Outline, Background, Safety
No answer specified
(Max chars: 10,000)

Calculations, Data Analysis, Error Analysis, Procedure Analysis
No answer specified
(Max chars: 10,000)

Deductions and Scoring Summary

Income Deductions Summary
Point deductions for each area.

Response Legend:
1 = 0 deductions! **2** = 5 points **3** = 10 points **4** = 15 points **5** = 20 points **6** = sent back without further review

	1	2	3	4	5	6
Plagiarism						
Formatting						
English						
Abstact						
Experimental Details						

Outcome Deductions Summary
Point deductions for each area.

Response Legend:
1 = 0 deductions! **2** = 5 points **3** = 10 points **4** = 15 points **5** = 20 points

	1	2	3	4	5
Outline					
Background/Introduction					
Safety					
Calculations including Error Propagation					
Data, Results, Discussion, Error Analysis					
Procedure Analysis					

Total Deductions
No answer specified

Final Score
The maximum score possible is 100. Scores may in some cases be negative. Please avoid this by paying attention to the required elements as you prepare your report!
No answer specified