

# I - Analysis and Evaluation of the Program

## I.a - Purpose of the Program

The Chemistry Department at Western Wyoming Community College offers traditional chemistry classes, similar to the ones available in the freshman and sophomore years at other colleges and universities around the country.

Specific objectives of the WWCC Chemistry Program are as follows:

For Chemistry and Science majors:

- Provide transferable chemistry coursework for degree-seeking students.
- Properly advise Chemistry and Pre-Pharmacy majors.

For Non-Science majors:

- Offer the "Introductory Chemistry" (CHEM 1000) course to provide a level of chemistry that is adequate for non-science majors (or students who need a quick review of fundamental Chemistry topics).

The objectives stated above can not be properly fulfilled until the current program limitations are removed. The two major limiting factors that the Chemistry Program currently has are:

- Lack of modern scientific instrumentation
- Lack of sufficient number of instructors

These limitations severely hinder the quality and variety of teaching that our students can receive, as well as the hands-on learning activities we can offer. Due to these limitations, students who successfully complete the recommended two-year program at WWCC will find themselves at a disadvantage (compared to other students) when they transfer to a four-year institution to continue their studies. **Solving the lack of modern scientific instrumentation should be our first priority, so we can serve our students better.** After all, "students are our focus".

## I.b - Primary Learning Goals and Assessment

Primary Learning Goal	Assessment
Communicate using the appropriate chemical terms and symbols	<ul style="list-style-type: none"><li>- Write formal laboratory reports using appropriate scientific vocabulary</li><li>- Questions in exams and homework that require short-essay type answers or definitions of chemical terms</li><li>- Provide written solutions to assigned problems</li><li>- Solve problems where definitions or explanation of chemical terms is specifically required</li><li>- Written essays</li></ul>
Understand chemical energy	<ul style="list-style-type: none"><li>- Solve problems that require understanding the correlation between chemical reactions and chemical energy</li><li>- Specific questions (in exams, homeworks, etc.) that require short-essay type answers</li><li>- Chemical experiments performed by the students in the laboratories in which energy is released or absorbed during a chemical reaction</li></ul>
Understand the periodic nature of chemical elements	<ul style="list-style-type: none"><li>- Solve problems that require the understanding and application of general trends of properties in the periodic table</li><li>- Specific questions (in exams, homeworks, etc.) that require short-essay type answers</li><li>- Chemical experiments performed by the students in the laboratories, in which similar chemical reactions are compared between different elements</li></ul>
Understand electronic structure, chemical bonding and chemical reactions	<ul style="list-style-type: none"><li>- Specific questions (in exams, homeworks, etc.) that require the writing of electronic configuration and its relationship with bonding and reactivity</li></ul>
Predict the product(s) of a reaction based on the reactants	<ul style="list-style-type: none"><li>- Specific questions (in exams, homeworks, etc.) that require the students to predict the products from reactions</li></ul>

### Assessment measures in individual courses:

The chemistry courses currently being taught at WWCC are:

- CHEM 1000 (Introductory Chemistry, a 1-semester course taught every semester)
- CHEM 1020 & 1030 (General Chemistry I and II, a 2-semester sequence taught in the Fall and Spring)
- CHEM 2320 & 2340 (Organic Chemistry I and II, a 2-semester sequence taught in the Fall and Spring).

Due to a shortage of instructors that started in the Fall of 2005, the Chemistry Department is unable to offer any more courses at this time.

All the chemistry courses being offered at WWCC require the following (except as noted below):

- Formal laboratory reports: Instructor grades according to accuracy in gathering and recording data, analysis of data, quality of conclusions, organization, clarity and completeness of the report, and proper use of written English and scientific terms (except CHEM 1000).
- Informal laboratory reports: Instructor grades according to accuracy in gathering and recording data, analysis of data, quality of conclusions, organization, clarity and completeness of the report.
- Assigned problems and homework: Instructor grades according to clarity of presentation, and quality of results.
- Tests: Instructor grades according to clarity of presentation, quality of results and proper use of written English and scientific terms.
- Written essays: Students are assigned to write at least one written essay per semester that relates chemistry (or a closely related science) with other fields or society (some of the topics given to the students for essays include: superconductors and their application, organic agriculture vs. traditional agriculture, biodegradable

and non-biodegradable plastics, renewable vs. non-renewable energy sources, nuclear energy and nuclear waste, "evolution vs. creationism and 'intelligent design'" and biodiesel). Essays are to be written individually by each student (not in groups), do not need to be long (less than 7 pages long, without counting references or title page) and they must contain at least 7 references (4 of which can not be from a website). Essays are graded according to accuracy and understanding of the topic, analysis of the references, quality of conclusions, organization, clarity and completeness of the essay, as well as the proper use of written English and scientific terms (TurnItIn and SmartThinking will be used in the future to help in the evaluation of essays).

## I.c - Enrollment and Audience

### Analyze the Audience:

Which students are part of our audience? Which students need to take chemistry classes? It all depends on the student's chosen major. The following table shows a breakdown of which chemistry courses are suggested to students, depending on their major field of study.

<b>Suggested Chemistry Classes per Academic Major (courses usually taken by freshman students)</b>			
<b>CHEM 1000</b>	<b>CHEM 1020</b>	<b>CHEM 1030</b>	<b>CHEM 1090</b>
Criminal Justice	Biology	Biology	
Exercise Science	Chemistry	Chemistry	
Geography	Environmental Science	Environmental Science	
Outdoor Leadership	Engineering	Engineering	
Pre-Dental Hygiene	Engineering Technology	Geology	
Pre-Forestry	Geology	Pre-Dentistry Medicine	
Pre-Occupational Therapy	Pre-Dentistry Medicine	Pre-Medicine	
Pre-Rangeland Ecology	Pre-Medicine	Pre-Pharmacy	
Psychology	Pre-Pharmacy	Pre-Physical Therapy	
Radiography at WSU	Pre-Physical Therapy	Pre-Veterinary Medicine	
Nursing *	Pre-Veterinary Medicine	Pre-Wildlife Biology	
	Pre-Wildlife Biology		

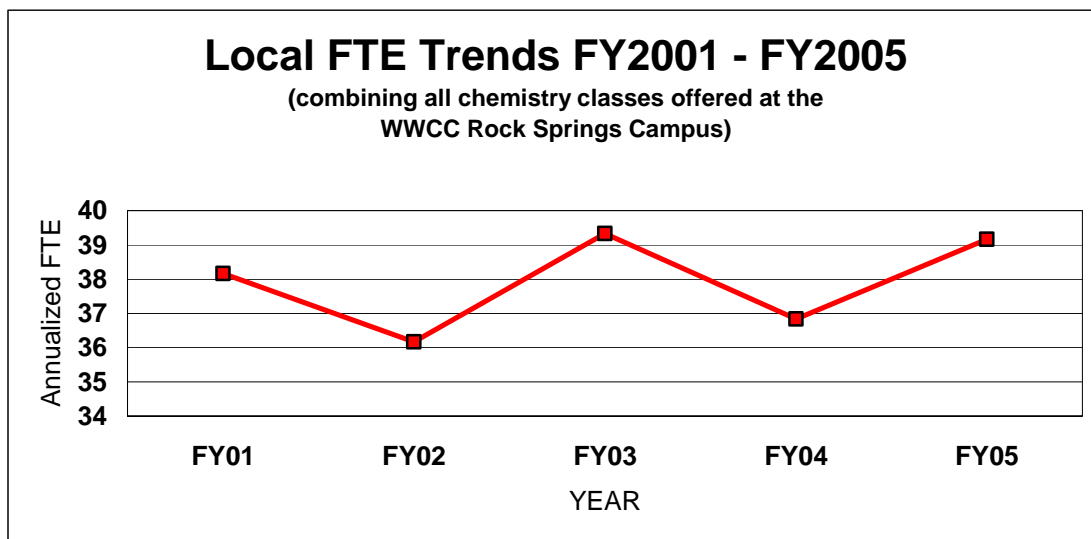
\* Although the WWCC nursing program has dropped the chemistry requirement, students who transfer to another institution to complete their nursing degree will be required to take at least 1 semester of chemistry. Many of the students currently taking CHEM 1000 have reservations about the College decision to drop the chemistry requirement for nursing.

<b>Suggested Chemistry Classes per Academic Major (courses usually taken by sophomore students)</b>			
<b>CHEM 2230</b>	<b>CHEM 2290</b>	<b>CHEM 2320</b>	<b>CHEM 2340</b>
Chemistry	Pre-Rangeland Ecology	Biology	Biology
Pre-Medicine		Chemistry	Chemistry
Pre-Veterinary Medicine		Environmental Science	Environmental Science
		Pre-Dentistry Medicine	Pre-Dentistry Medicine
		Pre-Medicine	Pre-Medicine
		Pre-Pharmacy	Pre-Pharmacy
		Pre-Physical Therapy	Pre-Physical Therapy
		Pre-Veterinary Medicine	Pre-Veterinary Medicine

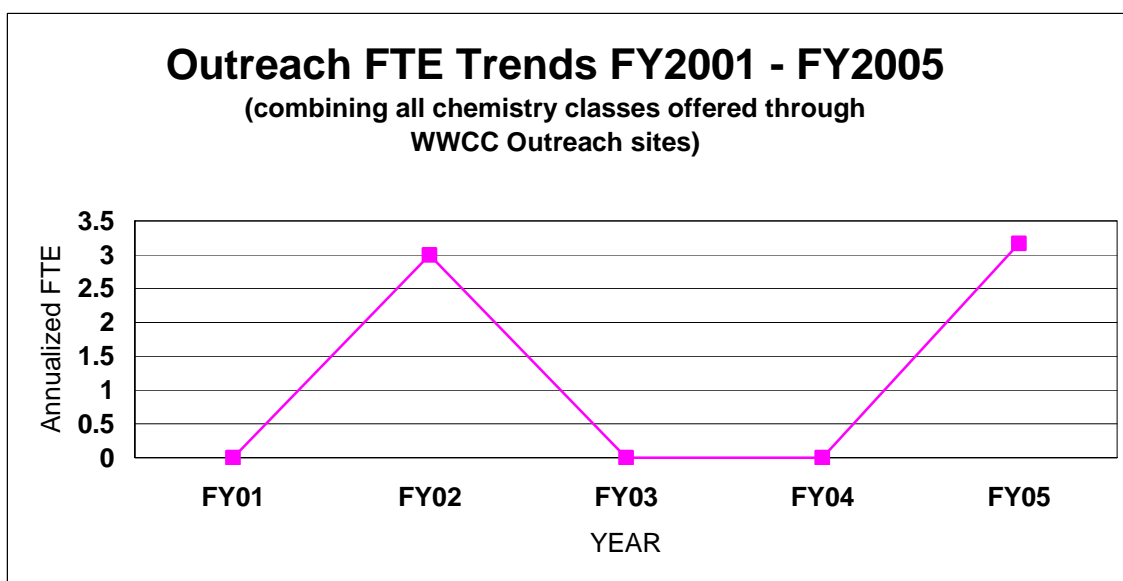
The past five years worth of FTE data shows some interesting trends in the enrollment. The local enrollment is cyclic in nature with the odd fiscal years being the peaks (highs) and even fiscal years being the valley (lows). The difference between peaks and valleys is about 3 FTEs. Outreach numbers show that two classes have been taught, each one of which contributed about 3 FTEs. One class coincided during a valley and the other a peak. This makes the overall enrollment drop in FY 04 and increase greatly the next year. This is purely the timing of the two outreach CHEM 1000 classes being taught.

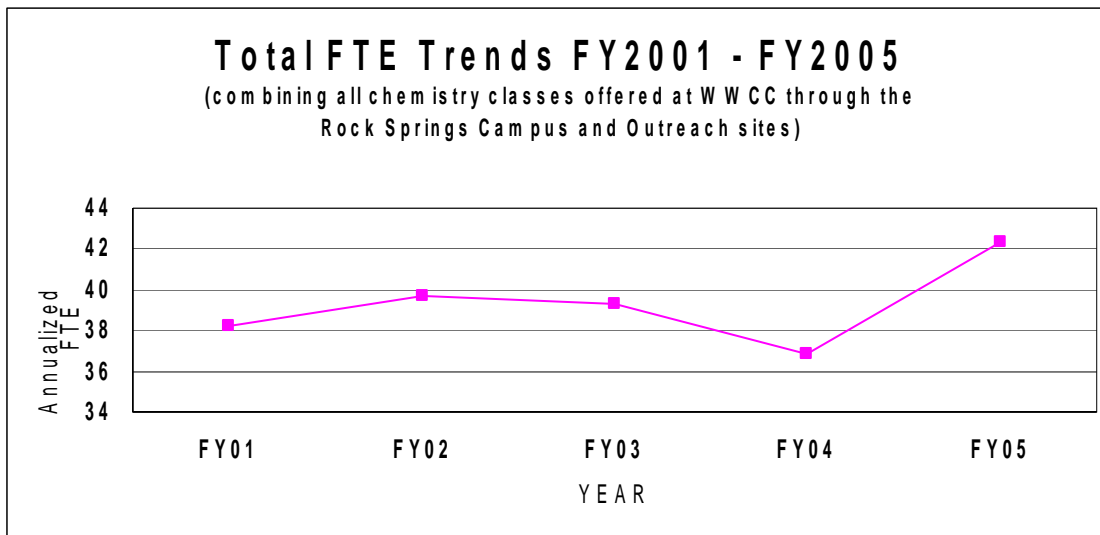
Annualized FTEs/FY	FY 01	FY 02	FY 03	FY 04	FY 05
Local	38.17	36.17	39.34	36.84	39.17
Outreach	0	3	0	0	3.17
Total	38.17	39.71	39.34	36.84	42.33

Why do we have a cyclic pattern in local FTEs? It appears to be basically caused by some of the smaller classes. The "Fundamentals of the Universe" class (CHEM 1090) is offered alternating spring semesters, and "Introductory to Comparative Biochemistry" was offered during some of these years. In addition, there was a significant drop in the CHEM 1000 classes being offered at night in Fall '01 (9 in Fall '00, 4 in Fall '01 and 12 in Fall '02). The net effect of all of this is a cyclic increase/decrease of approximately 3 FTEs.



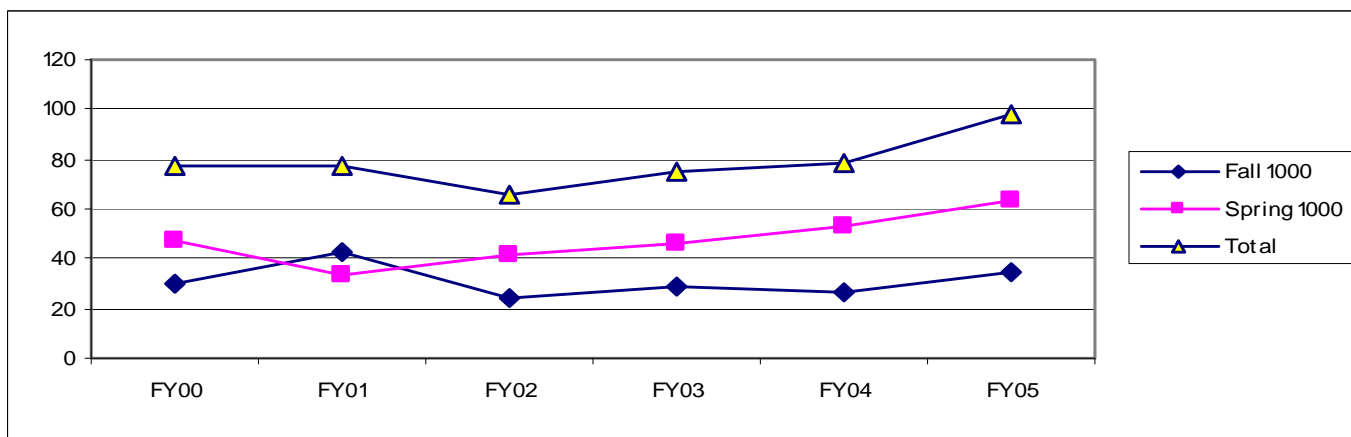
Enrollment in CHEM 1000 has remained fairly steady until a big jump in FY '05. The General Chemistry sequence (CHEM 1020 and 1030) has jumped around some but is mostly around 90 students for the year. The "Fundamentals of the Universe" class (CHEM 1090) has grown in enrollment each of the years offered, with 11 students in the class in Spring '05. The Organic Chemistry sequence has gradually declined to half of the enrollment numbers compared to FY '00. CHEM 2290 has never had an enrollment of more than 3 students when it was offered through 2000-2003 and maybe it should be dropped from the WWCC course catalog.



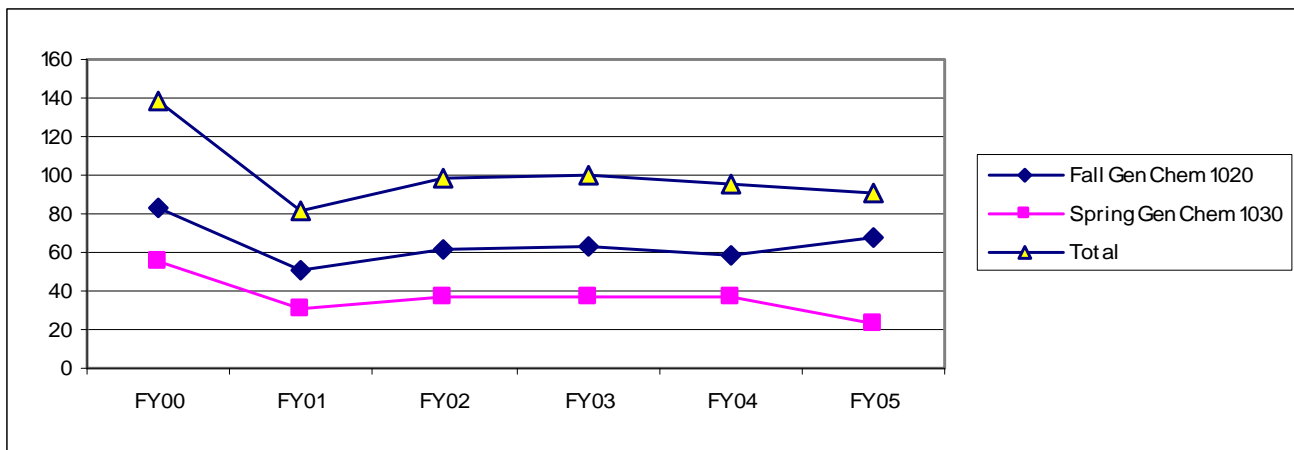


Are there audiences currently being underserved? At the present, CHEM 1000 NT is being developed to help meet the needs of outreach students plus the local students who can't attend the regularly offered night time CHEM 1000 class. One major concern is the infrequent offering of Quantitative Analysis CHEM 2230. The low enrollment numbers in this class has made it difficult to offer it on a regular basis, but not offering it makes it difficult to attract and keep certain majors. Working on recruiting more students who major in chemistry, pre-medicine and pre-veterinary would increase the course enrollments in upper level chemistry classes and better use these resources.

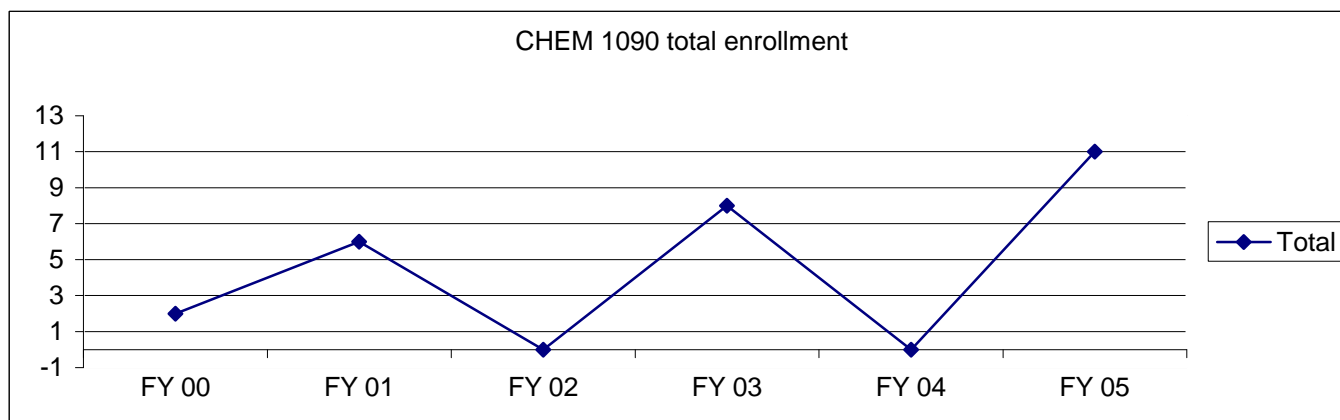
CHEM 1000 Enrollment Numbers ("headcount")	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05
Fall	30	43	24	29	26	35
Spring	47	34	42	46	53	63
<b>Total</b>	<b>77</b>	<b>77</b>	<b>66</b>	<b>75</b>	<b>79</b>	<b>98</b>



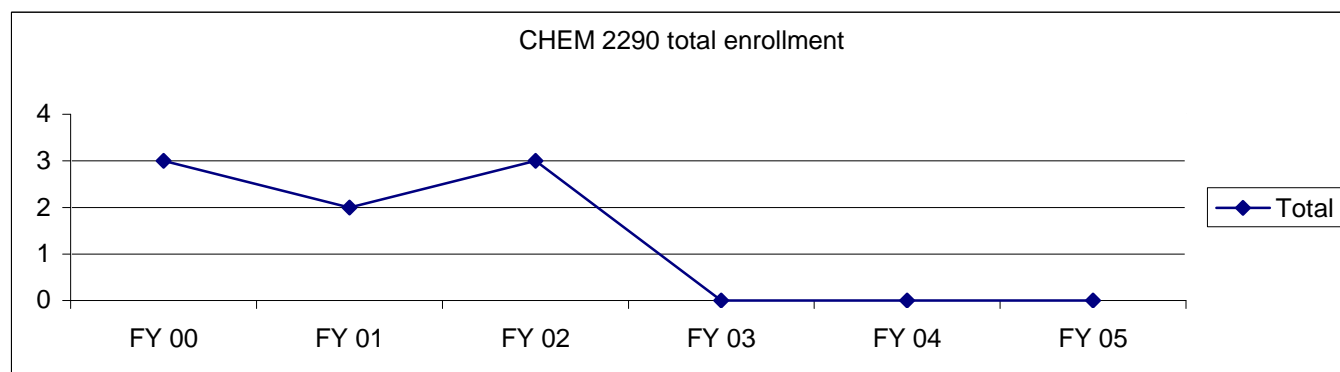
CHEM 1020-1030 Enrollment Numbers ("headcount")	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05
Fall (CHEM 1020)	83	51	61	63	58	68
Spring (CHEM 1030)	56	31	37	37	37	23
<b>Total</b>	<b>139</b>	<b>82</b>	<b>98</b>	<b>100</b>	<b>95</b>	<b>91</b>



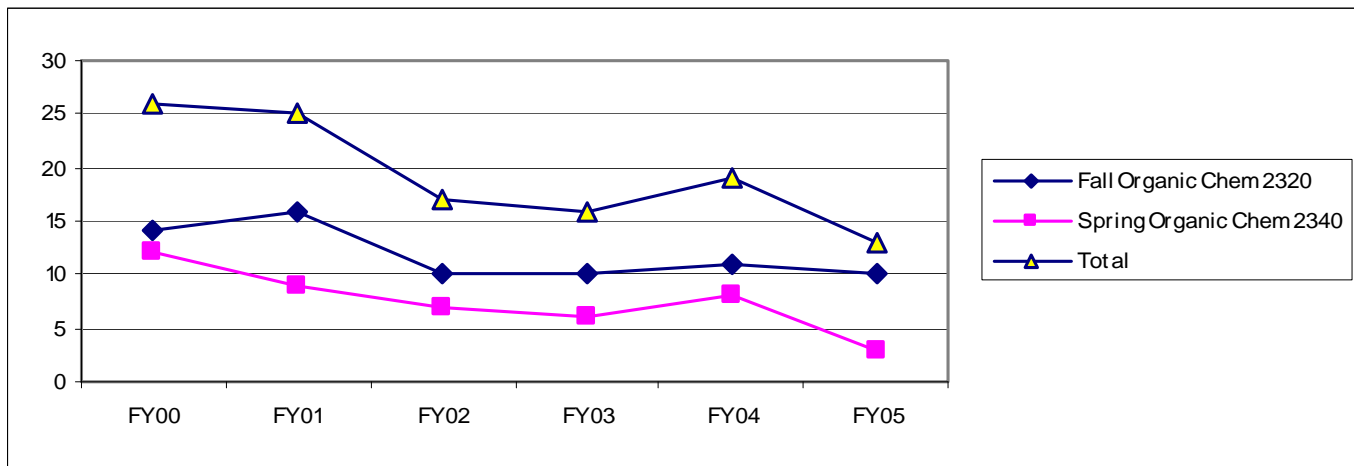
<b>CHEM 1090 Enrollment Numbers ("headcount")</b>	<b>FY 00</b>	<b>FY 01</b>	<b>FY 02</b>	<b>FY 03</b>	<b>FY 04</b>	<b>FY 05</b>
Fall	0	2	0	0	0	0
Spring	2	4	0	8	0	11
<b>Total</b>	<b>2</b>	<b>6</b>	<b>0</b>	<b>8</b>	<b>0</b>	<b>11</b>



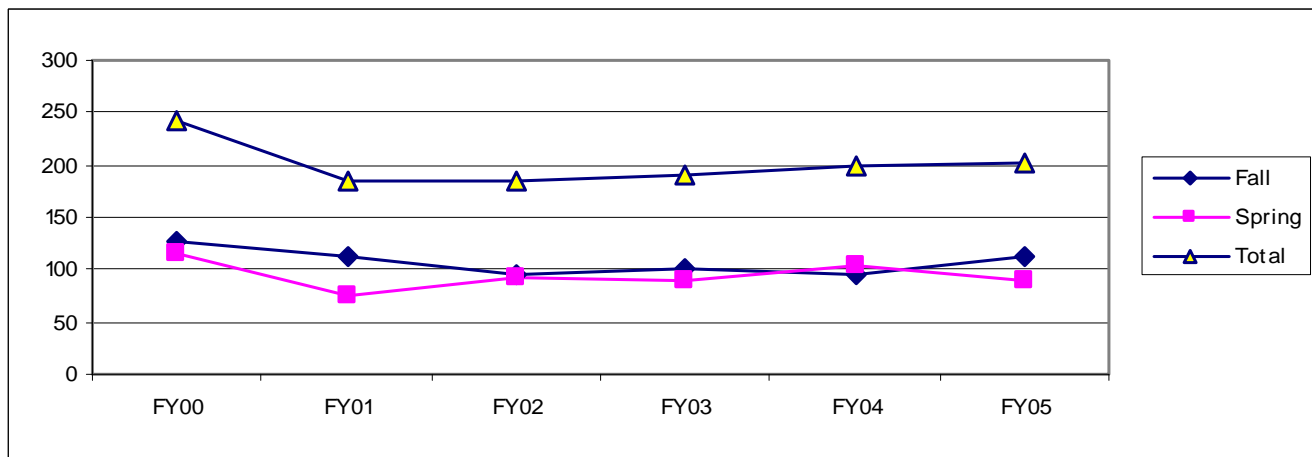
<b>CHEM 2290 Enrollment Numbers ("headcount")</b>	<b>FY 00</b>	<b>FY 01</b>	<b>FY 02</b>	<b>FY 03</b>	<b>FY 04</b>	<b>FY 05</b>
Fall	0	0	0	0	0	0
Spring	3	2	3	0	0	0
<b>Total</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>



<b>CHEM 2320-2340 Enrollment Numbers ("headcount")</b>	<b>FY 00</b>	<b>FY 01</b>	<b>FY 02</b>	<b>FY 03</b>	<b>FY 04</b>	<b>FY 05</b>
Fall (CHEM 2320)	14	16	10	10	11	10
Spring (CHEM 2340)	12	9	7	6	8	3
<b>Total</b>	<b>26</b>	<b>25</b>	<b>17</b>	<b>16</b>	<b>19</b>	<b>13</b>



<b>Total CHEM Enrollment Numbers ("headcount")</b>	<b>FY 00</b>	<b>FY 01</b>	<b>FY 02</b>	<b>FY 03</b>	<b>FY 04</b>	<b>FY 05</b>
Fall	127	112	95	102	95	113
Spring	115	74	91	89	104	89
<b>Total</b>	<b>242</b>	<b>186</b>	<b>186</b>	<b>191</b>	<b>199</b>	<b>202</b>



## I.d - Recommendations From Previous Program Review and Actions Taken

<p style="text-align: center;"><b>Recommendations from the previous program review (year 2000)</b></p>	<p style="text-align: center;"><b>Actions taken</b></p>
<p>Have 2 full-time and one part-time (adjunct) Chemistry instructors</p>	<p>The chemistry department currently has only one full-time faculty member - A request to hire another full-time faculty for the following academic year of 2006/2007 has been declined</p>
<p>To offer an Honors General Chemistry course every semester</p>	<p>Due to the shortage in chemistry instructors mentioned above, this can not be done at this time without severely overloading the full-time chemistry instructor (or hiring more instructors)</p>
<p>Modernize the antiquated general state of the General Chemistry lab (rm. 1439). Several sinks are broken or leak. Some pipes are so old that the water that comes from them is unusable. The lab only has 3 fume hoods. Frequent gas leaks in the lab due to old connections. The heating system in the chemical storage area is inadequate and damage has occurred to equipment and chemicals have been destroyed due to the cold.</p>	<p>Most critical repairs have been done. All sinks are in working condition, as well as all the fume hoods. Four fume hoods have been added to a room situated in the back of the lab. Gas leaks have not been detected (at least, not in the last 2 years). The lab still has a problem of uneven heating and cooling, which sometimes makes teaching uncomfortable. The heating is more uneven in the hall just behind the lab, which also serves as storage for chemicals.</p>
<p>Scientific equipment needs to be kept up to date with current advances in the chemical sciences</p>	<p>There is <u>only one relatively modern</u> scientific apparatus in working condition: an FTIR (Fourier-Transformed Infrared) spectrometer (bought in 1997). This instrument is only suitable for teaching Organic Chemistry (it is not appropriate for General Chemistry or Introductory Chemistry). Improvement in this area is desperately needed. Students cannot be effectively taught under these conditions. Most outdated or non-working instruments have been discarded (decommissioned) in the last 2 years.</p>
<p>The department website will also be expanded and used as a supplemental teaching tool for all chemistry courses</p>	<p>The department website has only 4 webpages. It is not currently being used for teaching. The website went through a very minor update in the last 2 years to include new faculty information and some small changes, but a major review is still due.</p>
<p>Extend the use of computers in both the classroom and the laboratory to expand the abilities for the instructors to teach effectively</p>	<p>None of the labs being used has a working computer. The only lab that <u>used to have</u> a computer was the analytical chemistry lab (rm 1441), but the computer was extremely old (bought in 1997). It would be extremely beneficial for students to see how computers have been integrated in Chemistry and science, especially in the field of data acquisition, data processing and statistical analysis of experimental data.</p>

## I.e - Evaluation of Facilities and Equipment

We have divided the evaluation of facilities and equipment in the lecture room and labs that are currently being used for teaching chemistry.

**1. Room 1204 (Organic Chemistry Lab, which is also currently being used for General Chemistry labs and Introductory Chemistry):** This is the newest chemistry laboratory. Some of the current facilities and equipment are appropriate, but some others need considerable improvement.

<b>Current situation as of Fall/2005</b>	<b>What has been done in the last 2 years</b>	<b>Changes needed (listed in order of priority <u>after</u> all the tables)</b>
All fume hoods are in good operating and working condition	Annual calibration and weekly checks	Fume hoods' fans are extremely noisy and they should be repaired or replaced
The lab has 2 safety showers and 5 eyewash stations	All of them are periodically tested and kept in full working condition	none
Some small and relatively inexpensive new equipment has been purchased using funds allocated to the Department in the last 2 years (approx. \$17,000)	Purchased: melting point apparatus, hot plates with stirring, rotary evaporators and analytical balances	A special oil-less, solvent-resistant vacuum pump (\$1,200) is required for acceptable performance of the rotary evaporators
The Reverse Osmosis (RO) equipment that provides "distilled water" to lab 1204 is in good condition	During the Spring/2003, Prof. Alex Cuello serviced the unit and replaced the RO membrane, bringing the equipment to full functionality. Since then, the water quality and the equipment is being tested and serviced once a month	none

<p>This lab has an extremely outdated (40+ years old) and non-working Gas-Liquid Chromatograph (GC)</p>	<p>Attempts to repair and make this instrument usable have not been successful. It's too old and unreliable to be of any practical use</p>	<p>This type of instrument is extremely important for the formation of students in Organic and Analytical Chemistry. Purchasing this instrument would mean an investment in the order of approximately \$50,000-100,000. Having a GC (or a Gas Chromatograph with Mass Spectrometry detection, GC-MS) instrument is <u>a necessity</u> in our Chemistry Department if WWCC wishes to provide the appropriate hands-on learning experience to our students. The GC-MS is actually a 2-in-1 instrument, and will provide our students considerably better hands-on training and education (The GC-MS can provide positive identification of chemical compounds by comparing the experimental results with the ones in a database of compounds, which is a great advantage over a plain GC instrument). A GC-MS will also be an invaluable tool for faculty research in Chemistry, Biology, Environmental Science and Biochemistry. A GC-MS will also allow the development of science courses that follow the style of the TV series "CSI", which appeal very much to a large number of our students. This could potentially increase the enrollment in our science courses significantly. Most of these instruments could be used by other departments at WWCC (such as Criminal Justice, Biology, etc.) to provide a more interdisciplinary experience for our students.</p>
<p>The College does not have a Nuclear Magnetic Resonance Spectrometer (NMR)</p>	<p>The "old" NMR, which was housed in rm 1441 (Analytical Chemistry lab), was built in the 60's and has been broken for at least 5 years. Repairing it was out of the question due to its extreme old age</p>	<p>Like the GC mentioned above, this is one of the <u>most necessary instruments</u> in Organic and Analytical Chemistry. One disadvantage of the NMR is that this instrument is generally more expensive to purchase and to maintain than a GC (could cost \$200,000 or more and up to \$2,000/month to maintain, but we don't have specific numbers at this time). Modern NMR instruments have a very powerful superconductor magnet that must be kept at very low temperatures and require a constant supply of liquid nitrogen to do this.</p>
<p>We currently have only one (very old and in unknown working condition) UV-Vis (Ultraviolet-visible) spectrophotometer and only one pH-meter (in working condition)</p>	<p>One good quality pH-meter was bought last year. The pH-meter is a very small instrument (not much bigger than a calculator), which can not be used by more than 2-3 students at a time. Having only one pH-meter is obviously not enough to be useful and practical for laboratory sessions that normally have up to 24 students.</p>	<p>At least six Ultraviolet-visible (UV-Vis) spectrophotometers (\$5,000 each) and at least six good quality pH-meters (\$1,200 each) are needed <u>in this lab alone</u> (room 1204) for the adequate formation of General Chemistry, Introductory Chemistry and Organic Chemistry students (moving UV-Vis spectrophotometers between labs is unwise and impractical: the instrument has many parts that are very sensitive to vibration and may break; also, the instrument will lose its calibration and will need to be re-calibrated, which is considerably time-consuming). pH-meters and UV-Vis are the <u>most common</u> of all chemistry laboratory instruments. The current situation, in which students who graduate from WWCC have never seen or used one of these apparatus, puts our students in a serious disadvantage.</p>
<p>The lab does not have hand soap or paper towel dispensers</p>	<p>nothing</p>	<p>Having hand soap available in the labs will allow students to remove any chemicals they may have on their hands before leaving the labs. Install "liquid hand soap" dispensers in all chemistry labs ("soap foam" or "antibacterial foam" are quite ineffective in removing chemicals from skin and should be avoided). Paper towel dispensers should also be installed. Neither of the labs have hand soap. Paper towels are just lying around the lab and they end up in the floor when the fume hoods fans are turned on</p>

**2. Room 1439 (currently being used to teach Introductory Chemistry Lab, was used before for General Chemistry labs)**

Current situation	What has been done in the last 2 years	Changes needed (listed in order of priority <u>after</u> all the tables)
All fume hoods are in good operating and working condition	Annual calibration and weekly checks	none
The lab has 1 safety shower and 1 eyewash station.	All of them are periodically tested and are in fully working condition.	none
There are no instruments in this lab (except analytical balances)	No new equipment has been purchased for this lab. In the last 2 years, 2 very old and non-working UV-Vis were decommissioned and discarded through WWCC surplus sale	We need to purchase at least four good quality pH meters and at least four UV-Vis spectrophotometers <u>for this lab alone</u>
The lab does not have hand soap or paper towel dispensers. Having hand soap available in the labs will allow students to remove any chemicals they may have in their hands before leaving the labs.	nothing	Install "liquid hand soap" dispensers in all chemistry labs ("soap foam" or antibacterial foam" are quite ineffective in removing chemicals from skin and should be avoided). Paper towel dispensers should also be installed. Neither of the labs have hand soap. Paper towels are just lying around the lab and they end up in the floor when the fume hoods fans are turned on.

**3. Room 1444 (Lecture room for all Chemistry classes):** This lecture room is in barely acceptable condition for teaching lectures, but improvements are needed to offer a better teaching and learning experience. This room is used for teaching lectures of General Chemistry I and II, Introductory Chemistry and Organic Chemistry I and II. It is not uncommon to have 35-45 students seated in this room, so we normally have students occupying the very last row of chairs.

- A cabinet with glass doors (and a lock) should be installed for storing molecular models and other teaching aid items.
- The TV screen in the room is too small for students seated in the middle and back of the room to see anything. A data projector and computer, similar to the system installed in room 1408 (without the "Smartboard") would improve this situation. Due to this limitation, tapes and DVDs are not currently presented to students in the classroom.
- The shades in the room are inadequate to darken the room enough for using the projection screen. New and more effective shades should be installed.
- The temperature control in the room is extremely poor, uneven and unreliable. Quite often, one of the heating/air conditioning units will be blowing cold air, while the other will be blowing very hot air. The thermostat in the room also needs to be re-calibrated or replaced (it is not uncommon that you need to set the thermostat to 60 °F to have the room around 70 °F). Several repair requests have been filed through Physical Plant and Maintenance, but the issue remains unresolved despite their efforts.

**4. Room 1441 (Analytical Chemistry Lab, previously used for the "Water Quality Lab"):** This lab is currently not being used for teaching, so its functionality is unknown at this time. However, it is worth mentioning that after a heating system was installed in the back of this lab sometime during the Spring/2004, the whole lab has been left in disarray and it needs to be reorganized. There is an Atomic Absorption (AA) spectrometer that was left by the old "Water Quality Lab" when it was closed 7-10 years ago. The AA has not been used in many years and will need a thorough recalibration, cleaning, and set-up before it can be used again.

This room will be used in the future to accommodate the UV-Vis and pH-meter instruments requested to purchase. Students taking chemistry classes will come to Room 1441 to run the experiments that require the use of a UV-Vis and/or a pH-meter. These instruments occupy too much room to be moved to another lab.

### **Facilities and Equipment Improvements Needed (in order of priority, highest priority first)**

1) At least 10 Ultraviolet-visible (UV-Vis) spectrophotometers (\$5,000 each) and at least 10 pH-meters (\$1,200 each) are needed for the adequate hands-on instruction of our Chemistry students. Total investment: approximately \$62,000 (will benefit students taking General Chemistry, Introductory Chemistry and Organic Chemistry, about 110-150 students each semester). A previous request on Fall/05 to obtain funds for the purchase of one or more UV-Vis spectrophotometers was not granted.

2) A new Gas Chromatograph (GC) or a Gas Chromatograph-Mass Spectrometer (GC-MS) to be installed in room 1204, for the adequate instruction of Organic and Analytical Chemistry students. The GC-MS is a much more versatile and useful instrument for our students than a plain GC. A GC-MS will provide exceptional hands-on learning experience for our students, while also providing a valuable tool for research in Chemistry, Biology, Biochemistry and other scientific fields. Total investment: approximately \$50,000-100,000. The acquisition of a GC will benefit students taking Organic and Analytical Chemistry (about 20 students each semester). A GC-MS will additionally benefit students taking General Chemistry and Introductory Chemistry (about 110-150 students every semester).

3) An NMR spectrometer, to be installed in a room exclusively dedicated for this instrument (due to problems and hazards associated with the high magnetic field of the instrument). At this point, it is worth exploring if an inexpensive NMR instrument can be purchased or obtained through a donation. The NMR could be used by students taking Organic Chemistry, Analytical Chemistry, and faculty research.

4) A solvent-resistant, oil-free vacuum pump for the 2 rotary evaporators that we already have in room 1204. Without this, the rotary evaporators are of little use. Total investment: approximately \$1,200 (will benefit students taking Organic Chemistry, about 8-13 students each semester). Last request to fund this instrument purchase on Fall/05 was not granted.

5) Repair or replace the noisy fume hood fans in room 1204. Cost of project and feasibility is unknown. The reason why the fume hood fan is so noisy is unknown at this time. This project will benefit students taking General Chemistry, Introductory Chemistry, and Organic Chemistry (about 80-100 students each semester).

6) Install a cabinet in room 1444 with (lockable) glass doors for molecular models and other teaching aid items. Cost of project: about \$1,200. This will benefit students taking General Chemistry, Introductory Chemistry, and Organic Chemistry (about 110-150 students each semester).

7) Install "liquid hand soap" and paper towel dispensers in all chemistry labs. Neither of the labs have hand soap. Having hand soap available in the labs will allow students to remove any chemicals they may have in their hands before leaving the labs.

## I.f - Review of all Printed Materials and Website

### 1. WWCC Catalog

- Suggested Program for A.S. Degree with emphasis in Chemistry:  
The suggested program recommends English I (ENGL 1010) in the first semester and English II (ENGL 1020) in the fourth semester. English II or Technical Writing should be recommended in the second semester instead. This can be accomplished by swapping English II and “Foreign Language or Elective” in the suggested program. In the fourth semester, the recommended “Computer Class” should be replaced with “Science/Math/Computer Elective.” A computer course is already recommended in the first semester. The purpose of the program, and program goals, are not included in the catalog.

### 2. Course Descriptions

- We have found that course descriptions in the catalog are appropriate in most cases.
- CHEM 1000 and CHEM 1020 should consider having a pre-requisite of MATH 0920 (pre-college beginning algebra) or appropriate math placement score. CHEM 1030 should have a pre-requisite of MATH 0930 or appropriate math placement score. At the present time, many students taking these chemistry classes struggle in the course because they do not have or do not remember the most basic algebra skills they should have acquired before entering college.
- We suggest a change in the length of the CHEM 2321/2341 (Organic Chemistry I and II labs). These labs are currently 2 hours long at WWCC, but they are 2:50-3:00 hours long in the rest of the Higher Education institutions in WY (see table below). The experiments run in Organic Chemistry labs are very time-consuming. Having a 2-hr. lab severely limits the amount of experiments that can be run during the semester, since experiments need to be divided in smaller parts to make them "fit" in a 2-hr lab session. If this change is approved, we may need to change the description of the laboratory in the WWCC Catalog too.

Higher education institution	Length of Organic Chemistry Labs (in hrs. per lab session per week)
University of Wyoming	2:50
Laramie County Comm. College	2:50
Central Wyoming College	2:50
Eastern Wyoming College	3:00
Northwest Community College	3:00
Casper College	3:00
<b>WWCC</b>	<b>2:00</b>

### 3. Chemistry Webpages

- On the Course page, the course descriptions need to be updated to match the current catalog descriptions.
- On the Careers page, links to appropriate chemistry sites would be a plus.

### 4. Chemistry Brochure

We believe the chemistry brochure needs considerable work. For example, most of the pictures in the brochure show extremely outdated equipment. Inside the brochure, the first picture on the left shows a Nuclear Magnetic Resonance (NMR) spectrometer model, which is at least 40 years old (and even much older equipment in the background). Most of the "modern instrumentation and equipment" mentioned in the brochure might have been relatively new 30 years ago, but now they are very outdated and most of them don't even work (with the exception of the FTIR, which was bought in 1997).

Two of the pictures in the brochure show students working in the lab with no eye protection (could be interpreted as lack of safety in our labs).

It is worth noting that in the last several years, considerable advances have been made in the use of computers to solve chemistry-related problems. Although WWCC does not have any of these specialized software, Prof. Alex Cuello has volunteered to use his personal copy of this software to generate some color pictures for the brochure. Other pictures could show teaching demonstrations or students working in our labs. The writing also needs to be changed.

The use of color pictures, graphics and photographs in the chemistry brochure would give it a more professional appearance and will make it more appealing to prospective students.

### **5. Course Outlines (syllabi)**

With the changes in chemistry faculty this year, it is appropriate to review only the course outlines for current instructors. The following syllabi were reviewed:

- CHEM 1000, Spring 2005 and Fall 2005
- CHEM 1020, Fall 2005
- CHEM 2320, Fall 2005
- CHEM 2340, Spring 2005

These course outlines conform to the standards set by WWCC.

## **I.g - Strengths, Limitations, and Opportunities**

### **Strengths: Improvements in the last 3 years**

- For the last 2 years, CHEM 1000 has been offered once a year as a night/evening class (one of these was also a compressed-video class for students taking this course at the Outreach sites).
- The times at which the chemistry courses are offered have been rearranged to accommodate students who may be taking other courses that conflicted with the chemistry classes.
- General guidelines have been suggested for instructors teaching CHEM 1000 at the Outreach sites. The purpose of the guidelines is to be consistent in the way the course is taught across the different sites.
- Prof. Craig Thompson has agreed to help with the shortage of chemistry instructors. He has taught CHEM 1000 in the Fall/2005 and Spring/2006. This situation should be taken as a temporary solution by the College administration. Prof. Thompson has other responsibilities, which require a considerable part of his time at WWCC. The Science and Math Division, and specially the Chemistry Department, appreciate his willingness and disposition to help in this matter.

### **Limitations: Factors that limit the program's achievement of its goals**

- One of the biggest limitations that the Chemistry program faces is the lack of modern basic instrumentation. This restricts the hands-on education we can provide to our students and severely limits the type of experiments that can be developed for our chemistry courses (the instruments needed, such as pH meters, UV-Vis spectrophotometers, a GC or GC-MS, and NMR, were discussed in more detail under the subtitle "Facilities and Equipment Improvements Needed ", in page 14). Last year one pH meter was bought by the Chemistry Department. Although this is a step in the right direction, it would be quite impractical to teach a laboratory experiment where 24 students share the only pH meter we currently have in Chemistry (pH meters are not big instruments, - not much larger than a calculator - with a digital display that usually measures 1" x 3"... so it can't be seen by students who are more than one or two feet away).
- The lack of sufficient full-time instructors to deliver the courses is also a big problem. At the end of last academic term (2004-2005), Dr. Jocelyn Goodwin left WWCC after teaching Chemistry for us only a year. At that time, the search committee in charge of finding a replacement for her was unable to find a suitable candidate to fill the position. This situation left the Chemistry Department with only one full-time instructor. A request to hire another full-time chemistry instructor for the next academic year of 2006-2007 has been declined.

### **Opportunities: Possible areas in which the program can improve within its limits**

- Major improvements are very limited until more full-time chemistry instructors are hired.
- Prof. Alex Cuello is developing an internet version of CHEM 1000 (Introductory Chemistry). It is scheduled to be delivered for the first time in the Fall/2006. Depending on the success and enrollment of this class, other chemistry courses could be offered via the internet. CHEM 1090 (Fundamentals of the Physical Universe) and/or CHEM 1020 (general Chemistry I) are other possibilities worth exploring.
- The purchase of a GC-MS will allow the development of science courses that follow the style of the TV series "CSI", in which science and the scientific method are used to solve crimes. "CSI" has a relatively large audience of followers, including many of our current students (there is also an increasing number of college science textbooks that are taking advantage of this). These "CSI-like" courses could be designed with a significant amount of time spent in hands-on problem-solving strategies, providing our students a unique experience and a valuable teaching tool. This option could potentially increase enrollment in our Science classes significantly.
- Many colleges in the country are offering a series of short courses to obtain a "pharmacy technician certificate". Implementing these courses could attract more students. Also, the possibility of offering this certificate completely online should be explored (many colleges are already doing this).
- A relatively large number of companies in the Rock Springs area deal with chemicals. Because of this, special consideration should be given to offering courses that will take advantage of the needs of these companies. The creation of short-courses that grant certificates such as "laboratory technician", "quality control technician", "hazardous materials handling and safety technician", etc. should be considered. Collaboration with the companies from the surrounding area could result in a steady flow of applicants, especially if they require annual re-certification or "refresher" courses.

- A specific course for students interested in pre-pharmacy could be developed. When students apply to a Pharmacy school, they must pass a standardized test called PCAT (Pharmacy College Admission Test). The student's score in the PCAT will determine whether he/she can apply to the university of his/her choice or not. Overall, for every 10 students who apply to a Pharmacy school, only one will be accepted. Prof. Alex Cuello taught for The Princeton Review during 1998-2000 to prepare students taking a very similar standardized test, the MCAT (Medical College Admission Test). Alex's previous experience in this field will facilitate the development of a course like this.

## II - Action Plan

<b>Action plan for 2006-2007</b>			
<b>Task or Action</b>	<b>Purpose</b>	<b>Measure of Success</b>	<b>Who is Responsible?</b>
Increase the length of time allocated to Organic Chemistry I and II labs (CHEM 2321 and 2341) from 2 hrs. to 3 hrs.	Give enough time to students to finish the experiments in one lab session	Length of labs increased is indicated in WWCC class schedule	Chuck Newberg and Alex Cuello
Drop CHEM 2290 from the College catalog (this course has had no more than 3 students registered when it was offered in 2000-2003)	Drop a chemistry course with a very low enrollment. The course is not required by any program	Course is dropped from the College catalog	Chuck Newberg and Alex Cuello
Study the possibility of having MATH 0920 (pre-college beginning algebra) or appropriate math placement score as a pre-requisite for CHEM 1000 and CHEM 1020	Students taking these courses will be better prepared before they enroll in the class. It will help lower the number of students who drop and fail these classes	Pre-requisite adopted, as indicated in WWCC class schedule	Dave Metz, Chuck Newberg, Craig Thompson and Alex Cuello
Have MATH 0930 (intermediate algebra) or appropriate math placement score as pre-requisite for CHEM 1030 (general chemistry II)	Students taking these courses will be better prepared before they enroll in the class. It will help lower the number of students who drop and fail these classes	Pre-requisite adopted, as indicated in WWCC class schedule	Dave Metz, Chuck Newberg, Craig Thompson and Alex Cuello
Install liquid soap and paper towel dispensers in all chemistry labs	Allow students to remove chemicals from their hands before leaving the labs	Soap and towel dispensers installed in all chemistry labs	Craig Thompson
Explore and evaluate the possibility (and cost) of purchasing and maintaining an NMR, GC and/or GC-MS	Incorporate modern scientific equipment in teaching to provide adequate hands-on instruction to our students (as mentioned in the previous chemistry program review 5 years ago). Would allow to develop new courses, which appeal to a larger audience of students	Report of feasibility and cost of purchasing and maintaining the instruments mentioned	Alex Cuello

**Action plan for 2007-2008**

<b>Task or Action</b>	<b>Purpose</b>	<b>Measure of Success</b>	<b>Who is Responsible?</b>
Re-write the Chemistry brochure	Modernize the chemistry brochure and get rid of outdated information and pictures. Compare the design of the new chemistry brochure to chemistry brochures from other colleges and universities	Availability of the new Chemistry Brochure	Alex Cuello and Dave Metz
Update the Chemistry website to include course descriptions matching the current catalog descriptions and add links to appropriate chemistry sites in the Careers page	Provide more accurate and useful information to online visitors	Website is updated and available	Alex Cuello
Study and implement possible solutions to present problems in lecture and lab rooms (uneven heating, noisy fume hood fans, frequent sewer-like smells)	Provide a better environment for learning to our students	Problems mentioned are solved	Craig Thompson and Dave Metz
Evaluate the status of the 2 UV-Vis spectrophotometers we currently have (working condition unknown)	Develop experiments that use the new instruments for Introductory Chemistry, General Chemistry and Organic Chemistry	Instruments are used by students during experiments	Alex Cuello

**Tasks or actions that depend on other factors (available funding, College approval, etc.) for 2006-2010  
(arranged in order of priority, highest priority first)**

<b>Task or Action</b>	<b>Purpose</b>	<b>Measure of Success</b>	<b>Who is Responsible?</b>
<b>Depending on available funding:</b> Purchase new instruments that are necessary (priority 1) for Chemistry (UV-Vis, pH-meters). <b>This must be the top priority if funds are made available</b>	Appropriate hands-on problem-solving instruction of chemistry students	New experiments developed to take advantage of the instruments. Funding availability must first be granted	Alex Cuello
<b>Depending on available funding:</b> Hire at least one more full-time instructor for Chemistry. <b>This should be the second priority if funds are made available</b>	Better serve our students, provide a larger variety of chemistry courses	New instructor hired. College must first approve funding for the full-time teaching position	Division chair
Assess the feasibility of offering CHEM 1090 and/or CHEM 1020 online (course development will depend on hiring another full-time chemistry instructor, since the full time chemistry instructor we currently have is already teaching overload of credits. If another full-time instructor is not hired, this task will be delayed at least until 2008)	Increase student enrollment. Allow students to take these courses every semester (CHEM 1020 is currently offered once a year and CHEM 1090 is offered once every other year)	Courses are offered. Due to current and projected future overload of teaching hours for the chemistry instructor, course development will not be possible for at least 2 more years	Division chair and Chemistry Department instructor(s)
<b>Depending on available funding:</b> Integrate computers into the laboratory experiments	Provide hands-on instruction to our students in the fields of data acquisition, data processing and statistics applied to science	New experiments developed to take advantage of the instruments. Funding availability must first be granted	Chemistry Department instructor(s)
Explore the feasibility of a PCAT-preparation course for pre-pharmacy students (course offering will depend on hiring another full-time chemistry instructor, since the full time chemistry instructor we currently have is already teaching an overload of credits. If another full-time instructor is not hired, this task will be delayed at least until 2008)	Better prepare our students, provide a larger variety of chemistry courses	Course is offered. Due to the current shortage of chemistry instructors, offering this course will be extremely difficult unless another full-time instructor is hired	Chemistry Department instructor(s)

<p>Expand the Department website to be used as an aid for teaching. Doing this will require considerable work and planning. (because the full time chemistry instructor we currently have is already teaching an overload of credits, this task will need to be delayed at least until 2008)</p>	<p>Provide more help and class-related material to our students</p>	<p>Improved chemistry website. Better use of College resources for teaching. Due to current shortage of chemistry instructors, this project needs to be delayed for at least 2 years</p>	<p>Chemistry Department instructor(s)</p>
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