

Name of Program: **Department of Chemistry, Wright State University**

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Indicate whether the program is

on campus

online

both

**NCA Criterion 1—Mission and Integrity**

**NCA Criterion 2—Preparing for the Future**

**NCA Criterion 3—Student Learning and Effective Teaching**

**NCA Criterion 4—Acquisition, Discovery, and Application of Knowledge**

**NCA Criterion 5—Engagement and Service**

**I. Department of Chemistry Program Mission (NCA Criterion 1 and Criterion 5)**

**A. Mission Statement**

The Department of Chemistry is one of six comprehensive departments in the College of Science and Mathematics at Wright State University and offers programs leading to the B.A., B.S. and M.S. degrees in chemistry. The B.S. program can be pursued with a pre-professional emphasis or with ACS certification. In addition, the B.S. in education with a concentration in chemistry is also available.

The mission statements for the Chemistry Department, the College of Science and Mathematics and Wright State University are collected in Table 1.

Table 1: Mission Statements

Chemistry Department	To provide the highest quality undergraduate and graduate education in chemistry, and to enrich human knowledge through innovative research
College of Science & Mathematics	To create passion for Science and Mathematics through evidence-based discovery, advancing knowledge of the natural world
Wright State University	Wright State University will be a catalyst for educational excellence in the Miami Valley, meeting the need for an educated citizenry dedicated to lifelong learning and service. To those ends, as a metropolitan university, Wright State will provide: access to scholarship and learning; economic and technological development; leadership in health, education, and human services; cultural enhancement, and international understanding while fostering collegial involvement and responsibility for continuous improvement of education and research.

## B. Consistency with Mission Statements and Program Objectives

The Department endeavors to maintain program quality and expand into new areas of study as research, teaching and training needs change. The Department has sought to achieve the latter through building its applied chemistry areas in both the program curriculum and in scientific research. The 13 full-time faculty of the Department, with backgrounds in the traditional areas of chemistry as well as applied chemistry, take primary responsibility for teaching courses from the freshman level, where students from other WSU programs comprise the majority of classes, to teaching at the advanced graduate level. The faculty members direct independent and collaborative research projects, which often serve both teaching and research needs. The course content for the majority of the introductory chemistry classes is driven by the desire to establish fundamental understanding as the bedrock from which future growth in independent thinking will stem. The more advanced courses (predominantly at the junior and senior level) draw upon this skill-set by fostering development of both analytical and practical laboratory skills through 'hands-on' exposure to state-of-the-art instrumentation (as best as this can be achieved; see Table 4), coupled with thoughtful experimental design and lectures. As regards instrumentation, for the majority of the 7-year review period, annual assessments by department alumni have ranked the lack of updated instrumentation as a key failing. The issue has been that, without a line item in the budget for either the acquisition or maintenance of instruments, it has fallen upon department faculty to achieve both aspects. Accordingly, much of the needed instrumentation has been acquired in the form of gifts from contacts at local companies and, typically, has had an extended working lifetime prior to its arrival at WSU. On many occasions, then, it has taken considerable investment of faculty time and department resources to bring these instruments up to working condition or to find that they cannot be made to do so. The problem has been exacerbated by the lack of a dedicated instrument technician and, indeed, one of the key recommendations from both external reviewers in our 2005 Self Study was that the hiring of such an individual was of crucial importance to the future success of the Department. Recently, with the advent of modest undergraduate student laboratory fees, and the even more recent approval for the resultant funds to be 'fed back' into the undergraduate labs, with the greatest need, we have been able to ameliorate our situation considerably. As can be seen in Table 4, by judicious use of departmental funds and state House Bill money (in 2005 and 2007), in the past 4 years, we have been able to purchase 9 major pieces of instrumentation to replace items with an average age of 13 years. Already, this has had a very positive effect on undergraduate student training and we are continuously evaluating departmental and student needs in this regard. Coupled with this improvement in laboratory instrumentation is the program enhancement that is being realized from completion of newly remodeled teaching laboratories in the basement of Brehm Laboratory. Seven, state-of-the-art laboratories have been designed for computational, environmental, inorganic, instrumental, organic, physical and quantitative chemistries. The 'flagship' laboratories are undoubtedly those for organic chemistry (with 19 fumehoods for up to 36 students) and instrumentation. The design of the latter has allowed, for the first time, a centralized support laboratory for the other teaching laboratories as well as a 'stand-alone' environment for the teaching of instrumental analysis. The renovation of research laboratories, administrative and office spaces in Oelman Hall is in the design phase and, when complete (~2010), will offer a considerably improved environment for research and teaching. In this regard, it should be noted that over 20 undergraduate students / year undertake research projects with Department faculty. Other opportunities for our students to gain experience with current technology include industrial coops and the SOCHE (Southern Ohio Consortium of Higher Education) program at Wright Patterson Air Force Base. Collaborations between several Chemistry Department faculty members and air force base personnel provide unique opportunities for undergraduate research.

The department faculty, staff and students participate in numerous events that foster community engagement, in its broadest sense. Regularly, Department members and students from the ChemClub have volunteered to act as judges at Science Fairs and as principal participants in area outreach events such as TechFest, National Chemistry Week and Exploring Science. TechFest, aimed at K-12 students, is an annual event that endeavors to stimulate interest in the STEM disciplines through hands-on exhibits, demonstrations and stimulating stage presentations, many of which feature department members. Similarly, the main avenue for department participation in National Chemistry Week (an American Chemical Society initiative) has been during the Dayton Boonshoft Museum ChemFest (a 2-day event). The use of chemical demonstrations during these events transmits the excitement of chemistry in a tangible, visual way. This philosophy has long been a hallmark of the department, exemplified especially in the form of the annual chemistry demonstration shows run by emeritus professors, John Fortman and Rubin Battino, with technical support from chemistry students and the freshman chemistry laboratory manager. These shows have been offered for over 25 years and, we believe, are the largest in the nation. Each year, in 14-18, 90-minute shows held on the WSU campus during the Winter and Spring breaks, 7,000-9,000 middle to high school students are treated to a rapid-paced, fun and educational experience. Surveys of students in freshman chemistry classes have demonstrated that a substantial percentage had previously attended a WSU chemistry demonstration show, a high percentage had thus gained an improved impression of chemistry and WSU and a significant number had been influenced to study chemistry as a result. Exploring Science is an annual College of Science and Mathematics initiative, which brings many hundreds of area high school students to campus over a 3-4 day period. The Chemistry Department has participated since the inception of the event and, most recently, elaborated on the use of chemistry in criminal forensics, in the form of a murder mystery. The reception for this novel approach has been overwhelmingly positive. Department members are involved also with more conventional undergraduate recruiting events such as Green and Gold and the Wright from the Start visit days.

In 2003, the Department inaugurated the Procter and Gamble (P & G) Lecture, in part to recognize the many contributions made by the Procter and Gamble company to Department operations. The aim of the P & G Lecture is to bring a 'name' speaker to campus to act as a role model for our students and to provide a topic of interest to the broader scientific community. Ideally, this cross-communication should provide for subsequent synergistic interactions. The three P & G lectures held to date (the fourth is scheduled for October 2008) have more than met these expectations and the speakers have been truly inspirational individuals. For more details of the previous P&G Lectures see <http://www.chm.wright.edu/archives.html>.

In addition to the aforementioned outreach endeavors, during the timeline for this review, two Department faculty members have offered summer workshops on a continuing basis. While these workshops have different audiences and content, they both arguably lead to better-equipped undergraduate students, whether directly or, given time, through improved teacher preparation. Thus, one workshop aims to train existing teachers in the inquiry-based teaching methodology and, the other, introduces university and college instructors to the timely area of combinatorial / green chemistry.

Interrelationships with other WSU programs include the general education program and other science and engineering programs, which have chemistry requirements for their majors. Thus, Biology, Earth and Environmental Sciences, Physics, Engineering, Environmental Sciences and PreMed. all require, to a greater or lesser extent, a chemistry component. The General Education Program lists CHM 101, 102, 105, 106, 107, 121, 122 and 123 as electives in Area IV. The Chemistry Department has a serious regard for its relationship with these other programs and, accordingly, the majority of these courses are taught by tenure-track faculty.

## II. Program Description (NCA Criterion 2)

Since the founding of Wright State University in 1964, the Chemistry Department has focused its curriculum development on: (1) a strong and comprehensive undergraduate program which is designed to meet the high certification standards of the American Chemical Society; and, (2) a thesis M.S. degree program, first offered in 1968, which provides students with the opportunity to study and perform original research in areas of traditional as well as applied chemistry. Areas of traditional endeavor available within the department include analytical chemistry with emphases in atomic force microscopy, mass spectrometry, chromatography and electrochemistry; inorganic chemistry with emphases in X-ray crystallography, and metal cluster chemistry; organic chemistry with emphases in synthesis of bioorganic natural products and polymer synthesis and characterization; and physical chemistry with emphases in gas phase laser kinetics, thermodynamic properties of gases in solutions and molecular modeling using quantum chemistry techniques. Areas of applied chemistry with active research and teaching components include environmental chemistry with emphases in analysis of volatile organic compounds in water and interfacial phenomena; and polymer chemistry with emphases in dendrimer and heterocyclic polymer synthesis and characterization. Since 1968, chemistry faculty have conducted research with undergraduate and graduate students and post-doctoral associates in the department as well as being involved in collaborative projects with scientists at WPAFB and a variety of other academic, government and industrial partners. This tradition of community cooperation continues today with over half of the chemistry faculty serving as consultants with local government and industrial laboratories. Almost forty percent of the departmental M.S. theses completed since 1968 have involved applied chemical research.

The department consists of the Chair, Associate Chair, thirteen full-time faculty, two classified staff and two unclassified staff members. The department utilizes adjunct faculty to teach courses and sections not covered by full-time faculty and, in this regard, using 2006-2007 as illustrative, 13 classes (along with 16 associated laboratory sections) were taught (or supervised) by adjunct faculty. Since Fall of 2004, the department Chair position has been held on an interim basis, a situation necessitated due to failed searches for external Chair candidates in 2005-6 and 2006-7. From conversations with the Chair candidates who declined our offers, it appeared that the ongoing renovation uncertainties (as they were manifested at the time) were the major issues for these individuals. Accordingly, it was decided to continue the interim position until summer 2009, at which time the major part of the renovation of research, administrative and office spaces will be complete. A new Chair search will be initiated in the future. It appears that renovation issues also had a deleterious effect upon the department's Environmental Chemistry faculty search in 2006-7. Two current searches have just been completed (in timely areas: Biorelated, Environmental and Materials) and, at the time of this writing, both candidates have taken up their duties in the department. It was obvious that the aforementioned renovation issues were less of an issue this time through, undoubtedly due to the completion of our attractive, new teaching spaces in Brehm Laboratory and the opportunities for extrapolation to the upcoming rehabilitation of Oelman Hall.

As mentioned previously, the Chemistry Bachelor of Science (BS) program is certified by the American Chemical Society (ACS) and this certification process occurs every 5 years. The department's most recent ACS certification review took place in 2003 and we are confident of re-accreditation in 2008. A five-year certification by the ACS indicates that a department has organized its curriculum in such a way as to provide its undergraduate chemistry majors with a well-rounded chemistry background with which they can successfully enter the job market or graduate school. The current, specific requirements include: 400 hours of classroom work, 500

hours of laboratory work, a core curriculum that covers the principles of analytical, inorganic, organic and physical chemistry, one year of advanced work in chemistry and one year of physics. Over the past 3 years, a considerable revamping of the current ACS program certification expectations has taken place. The final draft has become available recently and, gratifyingly, it is clear that the departmental guidelines now in place exceed the standards stated for certification under the new program as well. However, led by the undergraduate studies' committee, we have taken this as an opportunity to assess all aspects of our undergraduate program. In this regard, in an attempt to provide timely, practically focused educational opportunities for our students, for the first time in over a decade, the department is reoffering a physical polymer course. Many of our students take jobs in polymer-related areas and the absence of this course was a clear deficiency. Further, in response to the statewide shortage of trained science teachers (and Chemistry teachers in particular), we have partnered with the College of Science and Mathematics and the College of Education to develop a Chemistry track in the CORE program for teacher licensure. Several faculty members have developed and offered classes tailored to the needs of existing teachers. In the past 5 years, in response to the increased numbers of students pursuing degrees in teacher science education for early and middle childhood, we have increased the number of sections for these courses to 14-15. This is a considerable commitment of resources by the department since such courses are offered only in a lecture/lab format with smaller class enrollments and we have ensured that the majority of the classes are taught by doctoral faculty.

To fulfill the departmental mission, the faculty has operated under well-defined goals ever since the establishment of the degree programs. Faculty participated in goal setting sessions in 1975, 1978, 1992 and 2003. In addition, the goals of the department were reassessed and reaffirmed as part of the university-wide planning process in 1993-94 and, as part of the preparation for an external Chair search, a comprehensive self study was conducted in 2005, which resulted in a >100 page report, including the recommendations of two external reviewers.

#### **A. Students**

As can be seen in the following figures (Figures 1-4), over the past 12 years the number of Chemistry majors has hovered around the 150 to 200 mark (including students in University College who have declared an intention to pursue chemistry) with 20-45 of the students taking classes on a part-time basis. On average, the number of female Chemistry majors has been nearly equal to the number of male majors, with the past several years having more female majors than male. The number of Chemistry majors by race is consistent with the overall University percentages.

Figure 1. Chemistry Majors from 1995-2007.

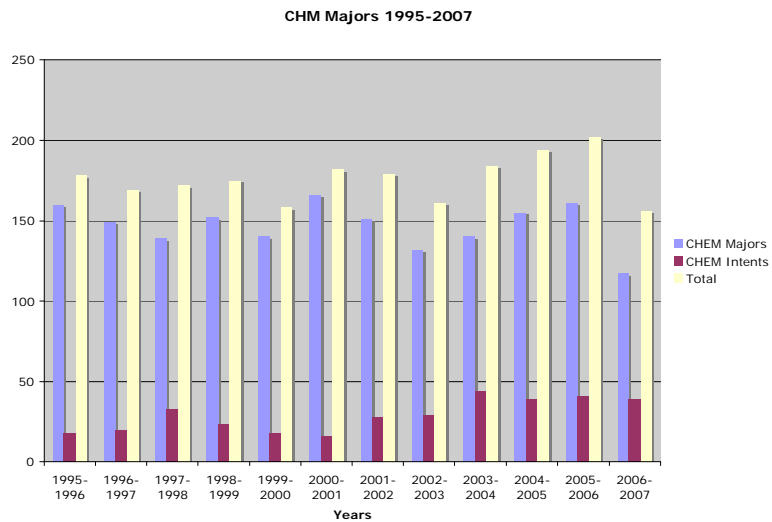


Figure 2. Chemistry majors (full time compared to part time) from 1995-2007.

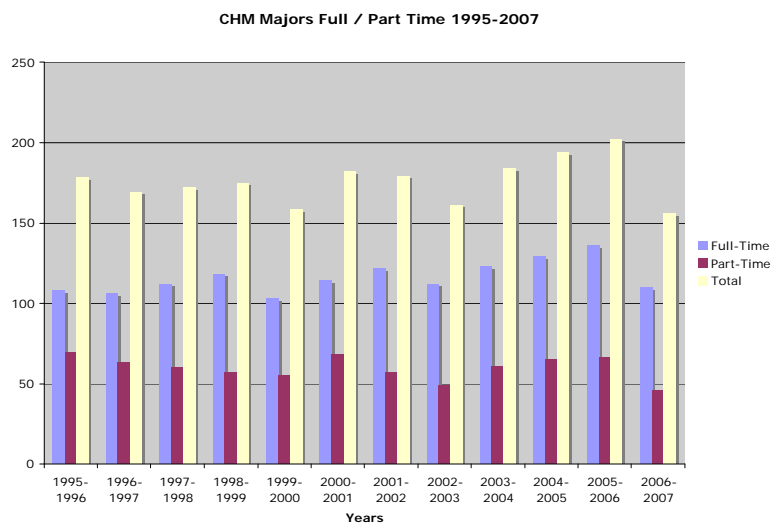


Figure 3. Chemistry majors by gender from 1995-2007.

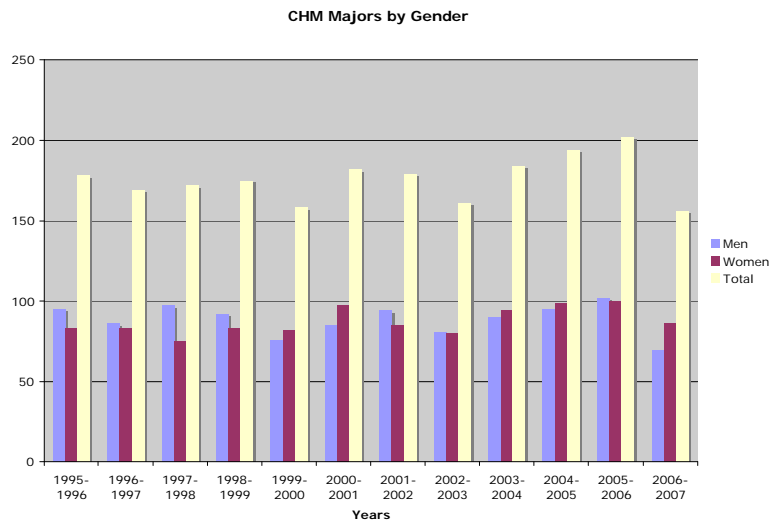
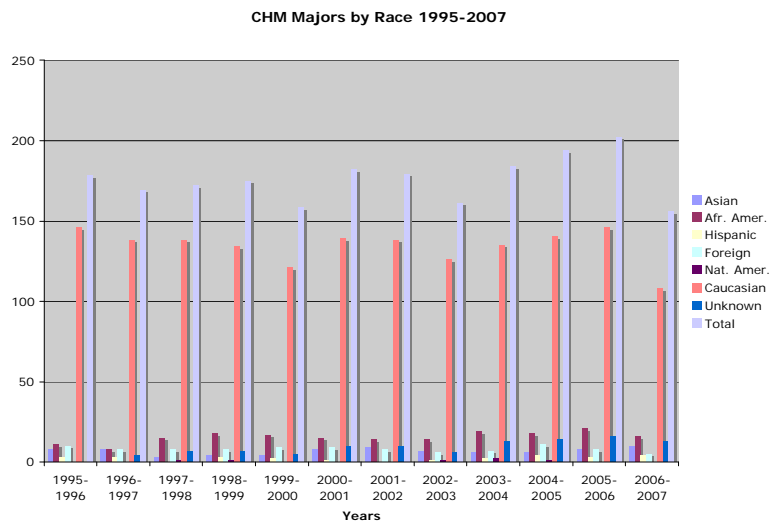


Figure 4. Chemistry majors by race from 1995-2007.



## B. Faculty and Staff

As shown in Figure 5, the number of faculty members has remained constant at thirteen over the review period (approximately 4 below the OBR guidelines). The total number of faculty has declined in the past twenty years from a high of sixteen in the 1986 / 1987 academic year. During this time period, there has been no decrease in the demand for instruction. This has led to increased workloads within the Department and one of the highest revenue to expense ratios in the College. Since no new hires have been made during the review period, the only significant change has been the promotion of individual faculty, one from instructor to assistant professor, two from assistant to associate professor and two from associate to full professor such that, at the present time, the Department is 'top heavy', having no assistant professors in the ranks. As mentioned earlier, an attempt was made in 2006-7 to hire a junior faculty member with research expertise in environmental chemistry, however, the search failed, undoubtedly due to the uncertainties inherent in the CoSM renovation project as they related to the Chemistry Department. While the search was unsuccessful, it was positive that five of the six individuals interviewed were women. More positive still is that, at the time of writing, the Department has completed two searches, primarily for junior faculty in areas of timely interest, and, as of Fall 2008, two female assistant professors have joined. Less positive is that two searches for a Department Chair (2005-6 and 2006-7) have proven fruitless, however, it is planned to revisit this possibility when the renovation situation for the Department is resolved (likely in Fall 2009, for a start date in Fall 2010). The make up of the Department faculty in gender (2 female and 11 male) and race (100% Caucasian) has stayed constant during the review period, however, as mentioned above, with the hire of two female faculty members, one of whom is non-white, this mix will change positively. It is reasonable to assume that this is a result of the Department's substantial efforts to attract minority applicants by appropriate advertising and by personal contacts.

As can be seen from Figure 6, the number of departmental support staff has remained constant during the review period, consisting of two classified and two unclassified staff members. The unclassified positions are the Freshman and Organic Chemistry laboratory managers, while the classified positions are the Department office support staff (both female, one Caucasian, one Asian). Not shown in the provided graph is the fact that there was a change in one of the unclassified positions in 2006, *viz.* the retirement of our long-time Freshman Chemistry laboratory manager (female, Caucasian) and the hiring of a new individual (male, Caucasian) to fill that role.

Figure 5. Number of chemistry faculty including rank from 2000-2007.

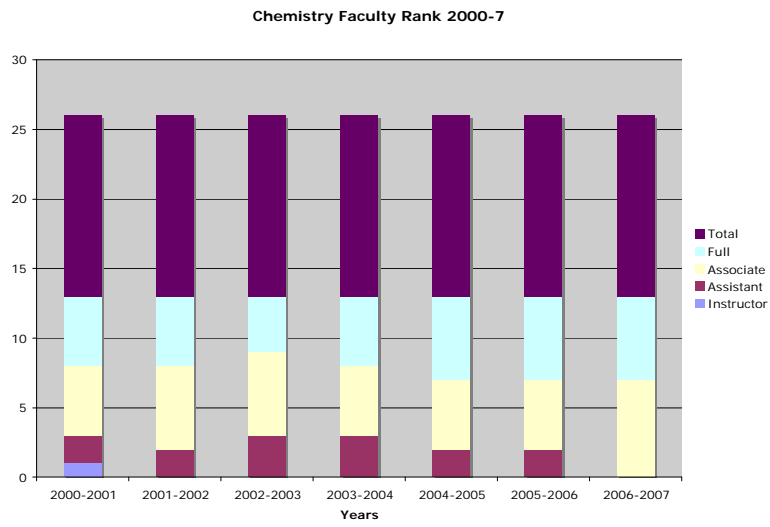
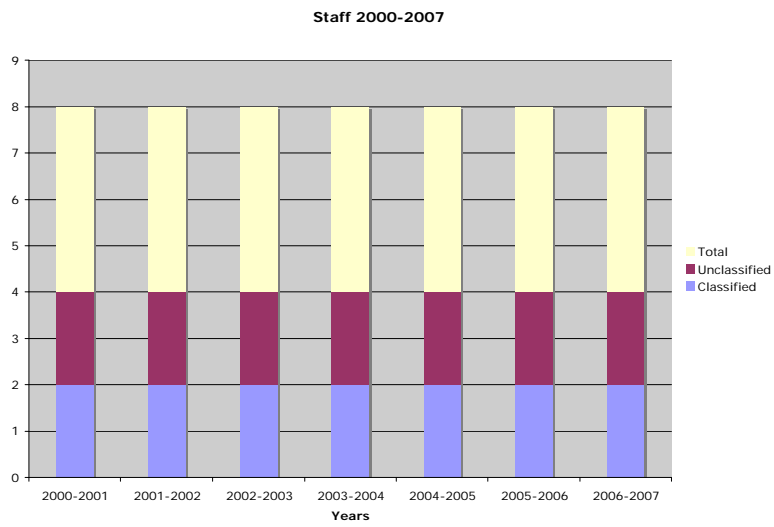


Figure 6. Number of staff from 2000-2007



### C. Budget

While, on average, the department budget has increased every year (currently ~\$2.4 million), this apparent improvement has been realized only as a result of wage and benefit raises for faculty, staff and students (which constitute more than 85% of the budget). In real terms, the operating budget has not enjoyed augmentation in over 15 years and, without the recent implementation of laboratory fees, this failure to provide for the routine necessities would have had a chilling effect on departmental operations. However, while the laboratory fees have helped to relieve some of the stress on the department budget, *e.g.* by covering the costs of chemicals and supplies for the teaching laboratories, this does not cover the entire needs for the department. The laboratory fee is \$15/credit hour for most of our laboratory-based courses however the fee has been lowered in those laboratory courses having more than 3 credit hours. These fees, along with other departmental funds, have helped upgrade current instrumentation and purchase new equipment previously unavailable in the department. The laboratory fee has not been increased since it was implemented, however, in light of future budget cuts, the tuition freeze and increased costs, the department has elected to increase laboratory fees for all Freshman and Sophomore laboratories by \$5 (in total), commencing in Winter 2009.

Table 2 lists expenses for the department in a five-year period from the 2001/2002 academic year to the 2005/2006 academic year. Expenses are given per student credit hour (SCH) and weighted student credit hour (WSCH). Included in this table is a comparison of these values with those for the college and the entire main campus. It is clear that the expenses are below those of many departments in the college and significantly below the expenses for the main campus. The most telling statistic is the revenue to expense ratio. The chemistry department has one of the highest ratios in the college and nearly twice the ratio for the main campus. These data suggest that the chemistry department is very cost effective. A primary reason for this may be the low number of faculty in the department. Over the past several years the rate of hiring new faculty has been lower than that for faculty retiring. During this same time period the number of courses and student enrollment has remained nearly constant. This obviously has increased the workload within the department (see workload section).

Table 2. Expense data from 2001 to 2006.

Academic Year	01-01	02-03	03-04	04-05	05-06
Expenses Per SCH					
Chemistry	106.89	116.10	116.01	118.82	122.23
College of Science & Math	128.15	136.72	141.53	150.18	156.77
Main Campus	179.02	166.45	170.23	170.27	178.87
Expenses Per WSCH					
Chemistry	32.48	35.76	36.19	37.26	38.78
College of Science & Math	56.25	60.24	61.63	64.79	68.09
Main Campus	70.34	65.37	66.99	66.56	69.81
Revenue to Expense Ratio					
Chemistry	2.932	2.813	2.951	2.966	2.876
College of Science & Math	1.879	1.842	1.838	1.842	1.807
Main Campus	1.554	1.736	1.705	1.812	1.785

#### D. Workload

Table 3 contains data giving the student FTE/weighted student FTE per faculty FTE for chemistry, the college and the main campus. In addition, the % of the OBR model is given. The student FTE/faculty FTE ratio differs little with the college and main campus. Over the past five years the Chemistry Department has had approximately 12 tenure-track faculty FTE's, 1 adjunct FTE and 7 graduate assistant FTE's. The large number of graduate assistant FTE's most likely accounts for the similarity of the department's numbers with the college and main campus. A good indication of the workload within the department is by considering the % of the OBR model values. The % of the OBR model is the ratio of the budgeted teaching FTE's to the average of the OBR modeled faculty as defined by OBR guidelines. This value is expressed as a % for 3 quarters of an academic year. As seen in Table 3 the College of Science & Math nearly meets the OBR model as well as the main campus. The Department of Chemistry is substantially below (approximately 70%) the OBR guidelines. These numbers, along with other data presented in this report, indicate that the chemistry faculty is cost effective (very high revenue to expense ratio) and has been teaching the same instructional load with 30% less faculty than suggested by the OBR model.

Table 3. Workload data from 2001 to 2006.

Academic Year	00-01	02-03	03-04	04-05	05-06
Student FTE Per Faculty FTE					
Chemistry	15.28	15.21	15.88	16.79	16.57
College of Science & Math	17.65	18.22	17.21	17.45	17.71
Main Campus	14.58	15.05	15.55	16.56	16.38
Weighted Student FTE Per Faculty FTE					
Chemistry	49.39	48.27	50.26	52.73	51.32
College of Science & Math	38.65	39.73	38.32	39.07	39.31
Main Campus	36.13	37.34	38.57	41.34	40.97
% of OBR Model					
Chemistry	72.85	74.54	71.58	68.23	70.10
College of Science & Math	93.11	90.57	93.91	92.08	91.52
Main Campus	100.37	96.46	93.38	87.14	87.92

#### E. Facilities and Equipment/Instrumentation

As was mentioned earlier (see page 2), for many years, the lack of modern, chemical instrumentation has been perceived by faculty, students and alumni alike as one of the most serious discrepancies in the department's mission to provide the best educational experience for our students. Recently, with the advent of Laboratory Fees (coupled with a judicious use of Alumni, RIF return and state House Bill funds), the Department has launched an aggressive

campaign to replace many of the oldest pieces of equipment. The first step in this process was to identify the most logical candidates for replacement, which was achieved by the establishment of an *ad hoc* Instrumentation Committee, a subsequent survey of departmental holdings and a tabulation of the results with recommendations. The second step, guided by these data, was to clear out much of the older instrumentation, the majority of which had been accumulated from generous gifts from alumni at area companies but much of which had not been brought up to fully working condition and was no longer supported by the manufacturer. With this sometimes painful process complete (though this is an ongoing situation), it has been possible to more clearly assess the real needs in both the areas of instrumentation and associated space. As can be seen in Table 4, by the means mentioned above, in the past 4 years, we have been able to purchase 7 major pieces of instrumentation to replace items with an average age of 13 years and, at the time of this writing, an X-Ray Powder Diffractometer and a thermogravimetric analyzer (TGA) have been purchased. While the acquisition of new instrumentation provides a more current experience for our students, in that they are then trained on instruments akin to those in use in industry, it also offsets one of the fundamental difficulties associated with our instrumentation situation, *viz.* the lack of a support technician. New instruments are likely to remain in good working condition for a longer period of time, thus reducing the need for time-consuming attention from faculty members. Of course, new equipment and cleaner laboratory space only goes so far. As delineated by both external reviewers for our Self Study process (2005) and our recent chair candidate (Atwood, 2007), the department is in desperate need of an instrument technician. At present, inordinate amounts of faculty time are spent in maintaining equipment and training students on higher end instrumentation (often as a protective measure!). For example, Bill Feld ran over 20 four hour training sessions on the NMR instrument over the past year and, as recently as Summer Quarter (2008), considerable faculty effort was spent in getting 3 instruments (all <2 years old) functional for our Instrumental Analysis class. Further, for the latter, Dan Bombick ran four half-week training sessions on four of our new instruments (Atomic Absorption, Inductively Coupled Plasma, Ion Chromatograph and Capillary Gas Chromatograph) to insure their continued utility. The point is that, even new equipment requires large amounts of time and attention, undoubtedly not the best use of precious faculty time.

Table 4. Chemistry Instrumentation

<b>Instrument</b>	<b>Used by:</b>	<b>Responsible party</b>	<b>Condition</b>	<b>Age, Years</b>	<b>Number of Users<sup>a</sup></b>
<b>HP GC/MS</b>	Chemistry, Environmental Chemistry & Science	Bombick	F	12	7
<b>Varian AA/AE 240FS</b>	Chemistry, Environmental Chemistry & Science	Bombick	I	3	3
<b>Varian ICP-AES 710-ES with Autosampler</b>	Chemistry, Environmental Chemistry & Science	Bombick	I	<1	4
<b>GPC</b>	Polymer Characterization	Fossum	Pump I, Detect I	9	2

<b>TA Instruments TGA</b>	Polymer Characterization	Fossum	I	<1	2
<b>PE Thermal Analysis TMA</b>	Polymer Characterization	Fossum	F	19	2
<b>TA Instruments DSC</b>	Polymer Characterization	Fossum	I	2	2
<b>Single Crystal X-Ray Diffractometer</b>	Chemistry	Grossie	C, F	26	4
<b>X-Ray Powder Diffractometer</b>	Chemistry	Grossie	I	<1	3
<b>Faraday Magnetic Balance</b>	Chemistry	Katovic	F	32	1
<b>2 Nicolet IR100 FTIR</b>	Organic	Organic Lab Manager	I	3	5
<b>HP8452 &amp; HP8453 Diode Array UV-VIS</b>	Physical Chemistry, Instrumental	Dolson	F	15	6
<b>Cary-UV-VIS</b>	Inorganic	Katovic	Original Upgraded I	8, 37	3
<b>Gow/Mac GCs</b>	Organic	Organic Lab Manager	N	20	2
<b>Varian Capillary GC</b>	Instrumental	Bombick	I	3	2
<b>Bruker AVANCE 300 NMR</b>	Chemistry	Feld	I	5	20
<b>Varian HPLC with Autosampler</b>	Instrumental	Bombick	I	2	2
<b>Rudolph Automatic Polarimeter</b>	Physical Chemistry	Grossie	I	2	2
<b>EG&amp;G Polarograph</b>	Instrumental	Bombick	F	12	2
<b>Dionex Ion Chromatograph</b>	Instrumental	Bombick	N	11	3
Condition: N - needs service, C - could use upgrade, F - functioning, I - in great shape. <sup>a</sup> Refers to number of faculty / staff users, not student users, which would be much larger					

## **F. Other Resources**

For many years, the Department has maintained a computer support laboratory adjacent to the Physical Chemistry laboratory. While the primary goal had been to enable the rapid processing of data accumulated during Physical Chemistry laboratory experiments, the role of the computer laboratory has expanded greatly over the years. Thus, 7-8 internet-enabled computer stations are available for all Chemistry undergraduate and graduate majors involved in research or upper level courses and each is equipped with a complete suite of software programs including Microsoft Office, ChemDraw and SigmaPlot. Further, as mentioned earlier, the Department has emphasized 'hands-on' use of chemical instrumentation as a fundamental avenue for furtherance of student independence and cognitive growth. Recently, with the acquisition of several new pieces of instrumentation it has become possible to bring this goal much closer to reality. With the renovation of the basement of Brehm Laboratory as the primary laboratory teaching space for the Department it has been possible to design a computer support laboratory of even more utility to our students, while retaining the positive features from the past. The Department has close ties with the Science Librarian, Mary Lou Jones, who provides library updates on a regular basis at Department meetings. In addition, Ms Jones is a co-presenter in the CHM 419 Chemical Literature and Composition undergraduate capstone course and a major participant in the CHM 700 Introduction to Teaching course. While the latter is ostensibly a graduate course, interested undergraduates, especially those who have been selected as teaching assistants, are expected to attend. From these courses, students gain an appreciation for the use of information technology, in all its forms, and are required to utilize said resources in the preparation of various presentations.

## **III. Program Effectiveness (NCA Criterion 3 and Criterion 4)**

### **A. Program Assessment**

For many years, there has been an annual program assessment conducted and, at present, the Department is in the 4<sup>th</sup> year of a 5-year assessment cycle. Therein, surveys are mailed to alumni at years 1, 3 and 5 post-graduation and responses are sought to the following questions: How did the Chemistry program prepare you for 1) mastery of basic and advanced chemical concepts; 2) mastery of fundamental laboratory techniques; 3) proficiency in using instrumentation; 4) ability to write in an appropriate scientific style and mastery of basic computer programs commonly used in scientific work? Response choices are 1) Very Well (numerical value 3); 2) Fairly Well (numerical value 2); 3) Not well (numerical value 1) and 4) Cannot Say (numerical value 0). Responders are encouraged to provide written comments also, and many do so. Since the adoption of the current format (just over 3 years ago), the Department has struggled with a fundamental issue, which is the poor response rate. For example, for the most recent assessment year (July 2006 - June 2007), of approximately 50 surveys sent out (both undergraduate and graduate), only 6 responses were received, and at least 2 of those were from M.S. graduates. Attempts to ameliorate the situation by including 'thank-you' gifts such as Department coasters, bookmarks or pens have not been successful (at least from the point of increased numbers of returned surveys). Accordingly, it is difficult to draw meaningful conclusions from the numerical data and the written comments, though it is fair to say that there has been near-universal criticism of the poor instrumentation situation within the Department. As mentioned earlier, a considerable effort has taken place in the past 3-4 years to improve this state of affairs and 9 new instruments have been purchased and set-up for student use.

Perhaps more meaningful assessment is conducted in four of the Department's upper-level classes, *viz.* CHM 419 (Chemical Literature, the Department capstone course), CHM 451, 452 and 453 (Physical Chemistry Lecture sequence). In the former, pre- and post-testing is conducted regarding knowledge and depth of understanding of the chemical literature. In addition, at the end of the term the students evaluate the course, session by session, so that it can be modified from year to year to meet the students' abilities and needs better. The students are encouraged also to add any general comments they wish at the end, and many do so. Each year, testing results indicate a considerable growth of knowledge at the course's completion as illustrated, for example, by the results from Spring 2007 [20 out of 22 improved considerably [7.7/12 pre-test; 10.7/12 post-test], 2 did not change [both had 10/12]]. In the CHM 451 to CHM 453 sequence, each quarter, students take the American Chemical Society standardized test as their final exam. These exams set out to test cognitive abilities as well as comprehensive coverage of material and are considered very challenging. Our stated goal with these tests is to have students perform above the national average. Using the results from Fall 2006 to Spring 2007 as illustrative, for CHM 451, the class average score on the ACS standardized test was 17.26 (out of 40; 58<sup>th</sup> percentile; median 16.0), in CHM 452, the class average score on the ACS standardized test was 20.48 (out of 40; 57<sup>th</sup> percentile; median 21.0) and, similarly, in CHM 453, the class average score on the ACS standardized test was 31 (median 32) [out of 50 questions], which corresponded to the 50<sup>th</sup> percentile. These current performances are very respectable (and a slight improvement from the previous years), especially since it is likely that those departments participating in the standardized testing process are above average to begin with.

#### **B. Integration of Technology into Curriculum and Instruction**

On a regular basis, the Department has evaluated the integration of technology into the curriculum, especially as it relates to undergraduate laboratory training. As mentioned several times herein, as a result of this introspection (and judicious use of funds), we have been able to provide major instrumentation upgrades and, accordingly, to enhance the resultant instructional milieu. In addition, much of the effort has been focused on the Freshman teaching laboratories. Therein, at considerable cost, for a number of years we have provided >30 dedicated laptop computers with interfaces for experimental data acquisition. This approach has meant that we have been able to offer our students a state-of-the-art experience and has worked well, in general. However, the heavy reliance on laptop computers, with associated maintenance and replacement issues, has yielded a higher cost to benefit ratio than we would like. Accordingly, recently, we have begun a process of replacing the older arrays with 'stand-alone' interfaces, which have greater capabilities and do not require a dedicated computer. It is our aim to replace all of our current interfaces by the end of 2008 (an approximately \$14,000 investment in the Freshman program).

#### **C. How the Program is Kept Current**

As mentioned earlier (see pp 11-13), the Department has been successful recently in updating a number of instruments, thus offering a more current experience for both our faculty members and students. Further, the Department offers a degree program certified by the American Chemical Society (ACS) [see pp 4-5]. The certification process takes place every 5 years and is designed to ensure that students graduating with an ACS certified chemistry degree have the skills, including a considerable amount of 'hands-on' training, to compete effectively in today's workforce. In addition, on a fairly regular basis, the Department has participated in goal-setting sessions and, most recently, undertook a comprehensive self-study (2005), which included evaluations by two external reviewers. Within the constraints of staffing and finances, efforts have been made to address concerns raised during these assessment exercises.

In an attempt to ensure that both faculty and students are exposed to 'state-of-the-art' topics, for decades the Department has maintained an external seminar program during the academic year. Thus, each quarter, under the guidance of an individual faculty member, speakers from academia, government and industry are invited to present at our weekly seminar sessions and are offered the opportunity to meet with students during a department-sponsored pizza lunch. We believe this to be a 'win-win' situation in that our students have the opportunity to learn about job and further education opportunities, while each speaker is presented with a golden recruitment opportunity. The seminar schedule is placed on the Department web-site, distributed to the WSU community and sent electronically to a list of interested parties, which we have developed over the years. Additionally, we have endeavored to use the seminar program to foster closer relationships between our department and neighboring institutions by inviting one or two speakers each quarter from local (~200 mile radius) colleges and industrial / government concerns. As a result, several departmental faculty members have developed ongoing, collaborative research projects and we have been able to attract some strong students to our Masters' program. In the same vein, the Department runs an outreach seminar program wherein a list of faculty seminar possibilities is sent out in the Fall to over 300 individuals and institutions. The Department picks up the cost of any resultant seminar invitations and, over the years, a considerable number of invitations have resulted.

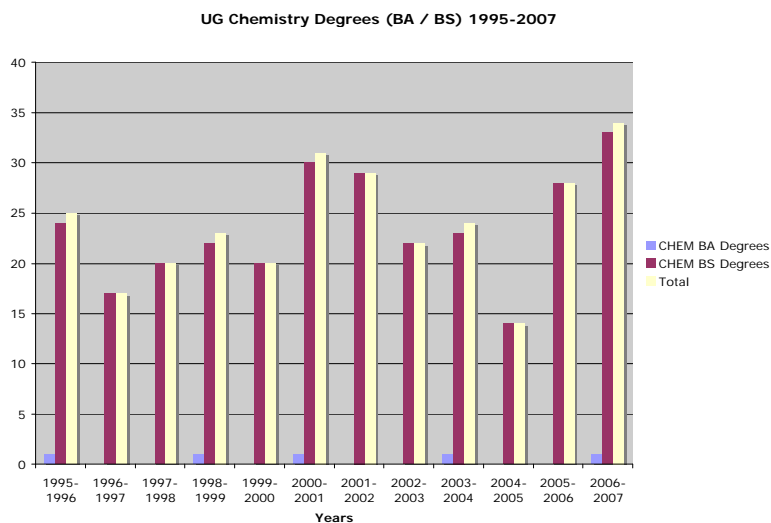
As mentioned earlier (see p 3), the Department initiated a sponsored, name-lecture series, the Procter and Gamble Lecture, in 2003, using seed funds provided by the Procter and Gamble company. The lecture has provided exciting opportunities for our students, faculty, the university community and beyond.

Each year, faculty members and research students can request a Chemistry Department subsidy for attendance at a professional society meeting, with the proviso that each individual must present his or her research results in the form of a poster or oral seminar. Wherever possible, we have sought to make such opportunities available also for outstanding undergraduate students even without the presentation requirement, where we have seen value to so doing. For example, in 2007, the Department subsidized attendance by Chemistry Club members at the American Chemical Society National meeting in the Spring since the club was one of only 30 in the nation (out of many hundreds) invited to participate in a Chemical Demonstration Exchange program. In addition, on a limited, but regular basis the Department has sponsored attendance by faculty or staff at training workshops dealing with instrumentation utilization, novel educational approaches or timely topics.

#### **D. Undergraduate Degrees Awarded**

In Figure 7 the number of BA and BS degrees are shown for the years of 1995-2007. The majority of awarded degrees are BS and while the number fluctuates from year-to-year approximately 20-25 degrees are awarded on average per year.

Figure 7. Undergraduate Chemistry Degrees during the period of 1995-2007



### E. Teaching Evaluations

Table 5 contains teaching evaluation data for the Spring quarter of 2000 and 2007. The questions used in the teaching evaluations are given at the bottom of the table. The year 2000 was chosen since this was the first year that the new teaching evaluation forms were implemented. Comparing the two years, the Chemistry Department's performance is the same or exceeds that of the CoSM and the main campus. The department has always had a strong commitment to teaching and a tradition of teaching excellence.

Table 5. Teaching Evaluations

Question*	Spring Quarter 2000			Spring Quarter 2007		
	Main Campus	Science & Math	Chemistry	Main Campus	Science & Math	Chemistry
1	4.36	4.22	4.35	4.56	4.50	4.32
2	4.54	4.36	4.44	4.57	4.53	4.45
3	4.40	4.20	4.30	4.43	4.41	4.25
4	4.32	3.96	3.92	4.40	4.30	4.15
5	4.29	4.13	4.17	4.33	4.31	4.18
6	4.41	4.49	4.47	4.45	4.43	4.50
7	4.12	3.86	3.90	4.25	4.08	4.00

\*The question numbers refer to the following questions used in the student evaluation of instruction form.

- Q1 Instructor Available for Consultation  
 Q2 Student Responsibilities Well-Defined  
 Q3 Class Time Was Well Spent  
 Q4 I Learned a Lot from the Instructor  
 Q5 Materials Contributed to my Learning  
 Q6 I was Challenged in this Course  
 Q7 Coming In, I was Motivated to Learn

#### F. Retention Rates

Table 6 contains retention and graduation rates for three cohort years. These data contain only chemistry majors (430) and do not include those intending chemistry (930). Retention data are difficult to interpret and can lead to misleading results. For example, these data include only new (from high school) degree-seeking full-time freshmen enrolled on the fourteenth day of the fall term. This, of course, may not include some students such as transfers or late registrants.

Table 6. Retention and Graduation Rates

Cohort Year	Number in Cohort	% Degrees Awarded in 4 Years	% Degrees Awarded in 5 Years
2000	10	40	70
2001	8	62.5	87.5
2002	4	50	75

#### IV. & V. Program Needs/Areas in Need of Improvement and Proposed Improvement Action Plan

The following proposals would propel the Chemistry Department in a forward direction that would strengthen and enhance the undergraduate program. Part of this plan would require a commitment from the administration to provide the necessary resources in order to accomplish some of these proposals. Another part of the plan requires little, if any, monetary resources but does need a collective effort by all chemistry faculty in order to bring some of these proposals to fruition.

1) Instrumentation Specialist

Referring to Table 4, the need for an instrumentation specialist is clear. D. Bombick, for example, is in charge of six instruments. The person in charge is responsible for the training of any instrument user, routine maintenance, supply requisitions and to ensure that the instrument is working efficiently. The person in charge is also responsible for repairing or arranging repair of a malfunctioning instrument. These responsibilities obviously require a substantial amount of time, which limits time investments in scholarly, academic and service activities.

Several outside sources have stated that the hiring of an instrument specialist is a top priority for the department. These sources included two external reviewers during a department Self Study in 2005 and several chair candidates in the chair searches conducted in 2005 and 2006. It is perplexing that the administration appears to ignore this suggestion since hiring an instrumentation specialist would decrease the burden on several faculty members and allow them to pursue more meaningful, academic endeavors.

There are other measures which could be implemented to give special consideration to those in charge of instrumentation, including a reduced teaching load and/or the provision of bonus pay. There is some precedent to this latter suggestion since some departments have overload pay for those teaching very large lecture sections. These measures may be helpful, however, the hiring of an instrument specialist to oversee the department's equipment needs would be the most ideal. Whatever action is taken regarding the caretakers of the department's instrumentation, it should be immediate.

[Note in proof: The Department is grateful to Dean Wheatly for recognizing this need and as of October 1, 2008 two part-time instrumentation specialists will be shared between the department and the Brehm Laboratory].

2) Increase in Supplies Budget and Creation of Repair/Maintenance Budget

The general supplies budget in the department has not been increased for over decade. This budget must be increased to ensure that the department can well continue to offer a quality undergraduate program. The following simple example illustrates the scope of this need. One item of glassware required in many undergraduate laboratories is the volumetric flask, a flask calibrated to contain a known volume and used extensively to prepare solutions of known concentrations. One ten milliliter volumetric flask today costs 23 dollars, which is a 350% increase compared to the cost for the same item ten years ago. Increases in equipment cost of this magnitude are typical and, in today's economic environment, it is inevitable that such costs will continue to rise disproportionately. While the implementation of laboratory fees has helped supplement the stagnant supplies budget, this approach can not keep up with the rising cost of supplies. Recently, the department has raised laboratory fees a modest amount, however, this course of action cannot be the routine response to rising costs. The state of Ohio wants to keep college tuition/fees affordable in order to increase enrollments. What is required is an increase in the department's supplies budget to reflect the higher supplies cost. This increase in budget should take place immediately.

Another aspect of a quality undergraduate program in chemistry is state of the art instrumentation. This instrumentation is a necessity to ensure that our undergraduates have the skills to allow them to succeed in the technical marketplace. In recent years, the

department has done a marvelous job in updating instrumentation. However, maintaining this instrumentation requires the routine replacement of parts and components, which is invariably very expensive. For example, the department recently purchased an inductively coupled plasma spectrometer largely through state House Bill funding. Even with only routine use this instrument requires approximately \$2K of parts per year to run efficiently. Extrapolation of this reality to the list of instrumentation shown in Table 4 leads to the obvious conclusion that the routine maintenance cost alone for the department is considerable. The department has a meager maintenance budget, which often requires dipping into the already 'stretched thin' supplies budget. In some cases, in order to save money, routine maintenance has been postponed until funds became available. At best, this produces a situation in which the instrument operates below optimum efficiency. At worst, this leads to a major instrument repair, which often leads to a mass scramble to provide the necessary funds.

Hopefully, it is clear that the department requires additional funding to enhance the maintenance/repair budget that truly reflects the needs. This should happen immediately so that the newer instrumentation in the department can operate efficiently and for a longer period.

3) Enhanced Recruiting Procedures

The chemistry faculty members intend to increase efforts in recruiting chemistry majors. Some suggestions to accomplish this include the following:

- Funds for advertisements in local publications as well as pamphlets that can be distributed to local schools
- Funds for a service to enhance the department's website
- Hiring professional help to recruit students. There are individuals that travel abroad recruiting students for a fee.
- Funds which will allow the department faculty to travel to recruit students. For example, having a faculty representative from the department at the state science fair may encourage students to explore an education at Wright State.

Funds to implement these suggestions do not have to be exorbitant. It is synergistic to couple the implementation of these suggestions with the recent publicity of the need for STEM students.

4) Reviewing The Current Undergraduate Program

The department needs to review the undergraduate program for the reasons illustrated below. First, as of Fall 2008 the department has two new faculty members who will bring new perspectives to the department. These new faculty will be expected to develop new courses to enhance the program. Secondly, scientific interests continue to shift in different directions. This poses the question of how to offer courses in an area, which is currently "hot". A good example of this would be the ever-expanding interest in nanotechnology and nanoparticles. In general, largely due to understaffing, the department has been 'reactive' rather than 'proactive', but the hiring of new faculty members will allow us to examine our offerings more critically with the aim to increase the 'timeliness' for our students. A third reason for review of the curriculum is the anticipated change to the semester system. Since the leadership of the state of Ohio has declared the need for a unified, state-wide, institutional calendar, it is clear the direction that this will take. Accordingly, the department should be proactive in formulating a plan to adapt the present courses to the semester format. In addition, changes to the program

of study may have to be made. Lastly, a review of teaching assignments should be undertaken since faculty members are often “locked-in” to teaching the same course for years, whether or not that is their desire. For example, the same faculty members have taught the general education courses year after year. Changing teaching assignments every 4 to 5 years would inject different perspectives into a course and provide a more equitable distribution of teaching duties in the department. Reviewing the teaching component of the undergraduate program would come at no cost but, potentially, could provide considerable enhancement. This review should take place during the next academic year.

5) Incentives for Promoting Faculty Interests in Teaching

There should be positive incentives from the administration to promote faculty enthusiasm for undergraduate education and a corresponding willingness to develop and/or improve courses. These incentives could include the provision of travel funds to attend seminars, workshops or other events, which may aid in course development and supplies such as new software, reference materials and equipment to benefit course development. The construction and implementation of a successful course should be viewed by the administration as scholarly work that is as important as a publication.

[Note in proof: The department gratefully acknowledges the administration’s creation of personal development funds (PDF’s) as a potential aid to help faculty in the teaching, improvement, development and creation of undergraduate courses].