



## **Self-Study**

### **Physical Science Program Review**

**College of Arts and Sciences  
Dakota State University**

**April 21, 2015**

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## **Part 1 - Institutional History**

Dakota State University has enjoyed a long and proud history of leadership and service since its founding in 1881 as the first teacher education institution in the Dakota Territory.

For most of its history, DSU has been identified with teacher preparation, first as a normal school and later as a four-year public college. The University has had several different names, among them Madison Normal, Eastern Normal, and General Beadle State College. The name, Dakota State College, was adopted in 1969. On July 1, 1989, Dakota State College became Dakota State University. The University title was conferred on the institution by the South Dakota Legislature in order to better reflect its purpose in the total scheme of the state's higher education system. Prospective elementary and secondary teachers continue to be educated here. To this traditional emphasis, DSU added business and traditional arts and science programs in the 1960s and two health services programs, Health Information Management and Respiratory Care, in the late 1970s.

In 1984, the South Dakota Legislature and the South Dakota Board of Regents turned to Dakota State University to educate leaders for the information age. In response, Dakota State University developed leading-edge computer/information systems degree programs. The graduates of these programs enjoy enviable status in the national marketplace. As a leader in computer and information systems programs, DSU has pioneered the application of computer technology to traditional fields of academic endeavor. This thrust has led to the development of unique degree programs in biology, English, mathematics, and physical science.

In recognition of its pioneering academic programs and outreach efforts, DSU was selected as one of the ten finalists for the 1987 G. Theodore Mitau Award. The Mitau Award is peer recognition by the nation's largest association of higher education institutions, the American Association of State Colleges and Universities, of the nation's top state colleges and universities for innovation and change.

Dakota State University has been named to Yahoo Magazine's list of the 100 most wired universities in the U.S. - ranking 12th on the list in 1998, 10th on the list in 1999, 9th on the Baccalaureate II list in 2000, and 2nd on the list of top public comprehensive colleges in the Midwest according to the annual America's Best Colleges survey results released by the US News and World Report in 2005.

Dakota State University continues to serve the needs of a changing society in its second century. In order to provide its academic programs to a broader audience, DSU has taken a step forward in distance education and offers courses and academic programs via Internet, the Governor's Electronic Classroom, the Dakota Digital Network and the newly renovated Technology Classroom Building. As society's educational needs change, Dakota State University will continue to evolve to meet these needs with education, scholarship and service.

## History of the University

- 1881 - Dakota Normal School established by the Territorial Legislature.
- 1947 - Name changed to General Beadle State Teachers College.
- 1969 - Name changed to Dakota State College.
- 1984 - SD Legislature mandated mission change at Dakota State. The new mission integrated technology across all areas of the curriculum.
- 1989 - Name changed to Dakota State University.
- 2004 - DSU goes wireless with tablet computer initiative. DSU is named Center of Information Assurance by the National Security Agency and the Department of Homeland Security.

## Mission

The mission of Dakota State University as it appears in the Board of Regents Policy Manual (1:10:5, adopted 08/07) states:

The Legislature established Dakota State University as an institution specializing in programs in computer management, computer information systems, and other related undergraduate and graduate programs as outlined in SDCL § 13-59-2.2. A special emphasis is the preparation of the elementary and secondary teachers with expertise in the use of computer technology and information processing in the teaching and learning process.

The Board implemented SDCL § 13-59-2.2 by authorizing undergraduate and graduate programs that are technology-infused and promote excellence in teaching and learning. These programs support research, scholarly and creative activities and provide service to the State of South Dakota and the region. Dakota State University is a member of the South Dakota System of Higher Education.

DSU implemented a wireless mobile computing initiative in the fall of 2004, mandating student leases of tablet PCs with a nominal user fee. The widespread and thorough integration of the wireless computing throughout courses and programs is an example of DSU's continuous efforts to incorporate the latest in technology into the curriculum.

## College Mission

The College of Arts and Sciences offers a variety of programs and courses leading to many successful career paths. Computer technology is integrated throughout all majors. The College offers the vast majority of the general education courses, serving as a background for all degrees. Faculty in Speech and Theater, English, and Digital Arts and Design are principally located in Beadle Hall. Math, science and social science faculty are housed in the C. Ruth Habeger Science Center. The clinical faculty in the Respiratory Care Program are located at Avera McKennan and Sanford Hospitals in Sioux Falls.

The College of Arts and Sciences offers degree programs in Biology, Computer Game Design, Digital Arts and Design, English Education, English for New Media, Mathematics, Physical Science, Professional and Technical Communication and Respiratory Care. In addition to these degree programs, the College of Arts and Sciences offers majors, minors, and courses which qualify students to apply for admission to professional schools and programs.

## **History of the Physical Science Program**

At the time of the institutional mission change in 1984-1985 separate degrees in Chemistry for Information Systems and Physics for Information Systems were established. These degrees fit well within the defined focus of DSU on computer integration into the curriculum. The physics and chemistry majors both had low numbers of declared majors over the next decade. In 1999, the chemistry and physics programs were combined to develop a Physical Science major curriculum with common core courses and the choice of either a chemistry or physics specialization within the major. The changes provided students the opportunity to develop expertise in an area of physical science related to their career interests, research, and internship experience, and to develop unique interdisciplinary expertise not offered by traditional physics and chemistry majors.

In response to the Board of Regents state-wide review of small enrollment programs in 2011, Black Hills State University and Dakota State University created a collaborative physical science program shared by the two Universities, improving opportunities for students on both campuses. The joint major was established with the intent of saving time and money by combining BHSU and DSU resources, reducing duplication of courses, and increasing enrollment in upper level classes.

## **Date of Last Physical Science Program Review**

The last institutional program review for the Physical Science degree was in March 2007.

## **Outcomes of the Last Physical Science Program Review**

The strengths and limitations identified in the last review are still pertinent to the Physical Sciences program at DSU today. The greatest challenge continues to be that of recruiting a critical mass of students into the program so that the breadth and depth of courses can be offered in a timely fashion.

## **Part 2 - Trends in the Discipline**

Since our 2007 program review, knowledge in the physical sciences has continued to grow and diversify at a staggering rate. What it means to be a “physical scientist” has also changed dramatically. Where this term once referred simply to hybrid studies of the traditional sub-disciplines of chemistry and physics, the term now encompasses myriad emerging and fast evolving sub-disciplines all firmly grounded within the two broader parent disciplines. For example, not very long ago all chemists were either organic, inorganic, polymer or analytical

chemists, while all physicists were either theoretical or experimental physicists. But, the unique scientific, technological and societal challenges of the 21<sup>st</sup> century have rendered these arbitrary disciplinary classifications largely obsolete. Physical scientists are now routinely called upon to identify, prioritize and solve complex problems across a wide spectrum of continually expanding chemistry and physics sub-disciplines. Such demands have spawned a variety of formal academic programs devoted to training more broadly trained physical scientists capable of transdisciplinary problem solving. These more highly interdisciplinary programs are often more appealing to millennial students who require more diverse training in order to adapt and thrive within multitudinous technology-intensive professional scientific environments throughout multiple careers. In this way, the physical science frontiers are now anywhere and everywhere, often seemingly at the same time. And computer technologies are now integrated into these scientific pursuits in countless ways at all levels and this will only intensify in the coming years.

At the local and national levels, there continues to exist a critical shortage of broadly trained physical scientists (and especially physical science teachers) who are well versed in the many sub-disciplines that now exist under the physical science umbrella. For example, locally, the Deep-Underground Science and Engineering Lab (DUSEL) at the former Homestake mine in the Black Hills of South Dakota has emerged to be one of the great frontiers in physics, making the need for a local supply of trained physical scientists essential. With the dizzying technological advances of the 21<sup>st</sup> century have also come 10,000 new chemicals per year in commerce in just the U.S. alone. Virtually all of these chemicals will enter the natural environment and pose known and (in the case of the vast majority) unknown risks to human and environmental health. Accordingly, there exists a pressing need to measure, monitor and understand how this plethora of chemical contaminants moves into and through natural environments and impacts humans and environmental systems. This is by no means a trivial task and it requires physical scientists who have not only the requisite training in the more traditional sub-disciplines of chemistry and physics, but who also possess comprehensive understanding and appreciation of the life- and geo-sciences, as well as toxicology, ecotoxicology, forensics and mathematical modeling. The dawn of the 21<sup>st</sup> century has also brought with it unprecedented efforts/advances in space exploration, and especially investigations into the origins and evolution of life on our planet and on other worlds throughout the galaxy (and the cosmos). Such sophisticated scientific inquiry further demands that physical scientists also receive training in the nascent fields of astrobiology, astrochemistry and prebiotic chemistry. Life in the technology intensive 21<sup>st</sup> century also demands accelerated research and development of novel energy sources and materials (especially nano-materials) able to provide an overpopulated planet with reasonable/sustainable standards of living, as well as remediation (and preferably prevention) of the inevitable commensurate environmental degradation.

National concerns about reduced program enrollments in the physical sciences (which has spawned an entire revolution in local-, state- and federally-funded S.T.E.M. education and recruiting initiatives) continue to dominate the headlines as well, while the numbers of students majoring in the physical sciences in other countries continues to increase sharply. This disparity undermines U.S. technological innovation and competitiveness on the world stage, as scientific and other high-tech jobs are increasingly exported across our borders. Reduced physical science program enrollments also highlight a paramount need for highly trained educators (especially at the primary and secondary levels) who are well versed in all aspects of scientific problem

solving and who are not only adept practitioners of physical science, but who are also genuinely passionate about the study of science.

### **Ways in which trends have influenced academic programs, as well as ways in which the trends are likely to influence programs in the future**

Academic programs are charged with the task of educating students to be effective and productive in continually evolving fields. Programmatic and graduate trends have fluctuated wildly, but one constant is providing students with the absolute best and broadest backgrounds possible to ensure their successes in emergent areas that may not have existed (or had not fully evolved) at the beginning of their undergraduate career. Although some universities have chosen to focus undergraduate education on areas related to specific trends, others have sought to provide a solid but more generalized foundation intended to enable students to thrive as new discoveries challenge the discipline to change in response to new developments. The physical science program at DSU continues to pride itself on doing just this—providing students with strong technology focused academic foundations grounded firmly in the core principles and practices of the physical and chemical sciences. Because of these strengths, the physical science program focuses on the fundamental science commonalities between chemistry and physics and their myriad sub-disciplines. The result continues to be broadly trained scientist graduates who are capable of working effectively across multiple sub-disciplines within the physical and chemical sciences. Moreover, the strong technology emphasis provides graduates with highly transferrable skill sets that ensure that they will be able to continually adapt and innovate in response to the frequent changes occurring across the scientific professional landscapes of the 21<sup>st</sup> century.

### **Program limitations relative to trends (concerns related to human, financial and physical resources)**

Physical science program limitations are inextricably linked to human and financial resources. The program is currently operated with only a single chemistry and a single physics professor, both of whom teach all of the sub-disciplines within their respective fields (and then some). The large numbers of students taking the first-year courses as general education courses intensifies this problem (course enrollments for physics and chemistry courses are included later in this document). Because major enrollments are perennially low, the program does not generate sufficient lab and program fees each year to finance all of the equipment purchases and upgrades needed for a program with such lofty curricular ambitions. As a consequence, lab fees must accumulate for several years before purchases can be made, making it difficult to strategize the purchase of new equipment (especially specialized equipment). For example, analytical instrumentation considered standard in most university lab settings are very slow in coming to our program, which necessitates significant improvisational teaching on the part of the faculty. Such creativity certainly has the power to inspire/serve our students in imaginative ways, but the lack of instrumentation translates into our students entering the professional world (or graduate education) lacking essential skill sets. Indeed, the current lab equipment situation often requires the faculty to create/conduct labs with grossly insufficient and/or just plain malfunctioning equipment. While the faculty continue to actively pursue small grant opportunities for much-needed new equipment (and existing equipment upgrades), given the constraints of faculty

teaching loads, they are afforded little time or institutional support for developing competitive grant proposals. Worse, as DSU is not known for its scientific accomplishments, even strong grant proposals are not well received by major funding agencies. This is related to a lack of understanding among administrators of the diverse and sophisticated equipment and instrumentation needed to properly train physical science students (and especially of its high costs). These problems make it very difficult for the physical science faculty to work creatively outside the constraints of teaching demands. Research activities and service to the community are also limited by high teaching loads, especially with faculty often teaching well outside their core areas of expertise. However, one strength of the program continues to be its location in the Science Center, with the science and math faculty housed in a single building. Such proximity under one roof brings faculty from all disciplines together as neighbors, greatly increasing the possibilities of cross-collaborative creativity and continually demonstrating to students the strongly collaborative nature of the scientific enterprise.

## **Part 3 - Academic Program and Curriculum**

### **Academic Degrees Offered**

The program leads to a Bachelor of Science in Physical Science. Additionally, majors in other programs may elect to minor in either Chemistry or Physics. A number of biology students have pursued a minor in chemistry.

### **Curricular Options**

The curriculum for Physical Science can be found in Appendix A. Students majoring in Physical Science must complete 30-31 credits of required coursework providing a foundation in chemistry, physics and mathematics. An undergraduate research experience is usually included in this required section. In keeping with the mission of integration of computer technology into programs at Dakota State, 9 credits of upper level computer science courses are required. In addition to this required core, students also elect 6 courses (18-24 credits) from an approved list of physical science courses. In this way, students may choose to follow a specialization in an area of physical science. To complete the 120 credit hours required for a degree, students take from 15 to 22 credits of free electives. Most physical science majors often choose to take additional science courses as electives.

### **Comparison with Other Regional Programs**

There is a great need in South Dakota and the surrounding region for physical science graduates in education, the health professions and industry as evidenced by the high placement rate of our graduates. The demand is especially high for those professionals who are computer literate and understand the impact of information technology on society. The mission of Dakota State University makes it an ideal institution for providing an environment wherein basic education in physical sciences is integrated with robust training in computer technology.



Most of the colleges and universities in the region offer individual chemistry and physics degree programs. All of the institutions in the South Dakota Board of Regents (SDBOR) system have chemistry programs, and all, except Northern State University have a physics or physical science program. The physical science degree at DSU is unique, however, with emphasis placed on the integration of subjects common to both chemistry and physics and the integration of computer technology. The institution's wireless mobile computing initiative brings the expectation of even greater use of computer technology across all programs and disciplines. As a consequence, the level of computer integration into the physical science curriculum is unmatched in the region.

Black Hills State University has a separate chemistry degree, but collaborates with Dakota State University for a Physical Science program. Both institutions offer the core courses in chemistry and physics, as well as math support classes. Students at both campuses may select elective courses from either institution. Black Hills offers courses in geology, and Dakota State has a greater selection of computer science options for students. Since the joint program was initiated, there has been little evaluation of the value of the collaboration to either school. In general, the number of students at both campuses remains low. Students at DSU have engaged in activities at the underground lab, but these efforts have not been specifically associated with Black Hills State University. At this point, the joint program does not seem to have any negative effects on either program, but neither program is realizing any measurable benefits from the collaboration.

## **Special Strengths of the Physical Science Program**

### **Integration of Computer Technology**

As stated in the previous section, the physical science program at Dakota State University is unusual in the emphasis placed on the use of computer technology both in the classroom and in research. All students at DSU lease a Tablet PC (currently a Fujitsu T1010, or comparable computer). A wireless network is available throughout the entire campus.

The physical science faculty have embraced the use of these computers in the classroom and lab. All courses have a course management site developed with the Desire2Learn platform which facilitates communication, provides a portal for posting information, submitting assignments and checking grades. In addition, simulation software, spreadsheets, and graphing programs are used in all courses to accomplish myriad teaching and research objectives. Special analog-to-digital converters by Pasco and Vernier, which interface directly with student tablets provided through the DSU wireless mobile computing initiative, are used to connect a variety of data collection probes.

### **Interaction of Faculty and Students**

One of the great strengths of the program is the student focus, which provides opportunities for enhanced student-faculty collaboration. As a small program without graduate assistants, students interact personally/intimately with the faculty. This permits the faculty to get to know the students and to better understand their academic and career ambitions, which makes it possible for the faculty to tailor student experiences in such a way that best serves their interests and goals. Students also have the chance to become involved in faculty research, thereby greatly

improving their undergraduate learning experiences and maximizing their preparedness for the ever-changing professional scientific world they will enter after graduation.

### **Undergraduate Research**

The physical science program places a high priority on students conducting significant undergraduate research projects. This includes not only capstone courses and internships, but also opportunities for students (especially those who know they want to pursue graduate degree programs) to become involved in faculty research very early in their academic career (oftentimes beginning as early as the first semester of their freshmen year). Typically, two or three students per year avail themselves of such opportunities, permitting these students enriching academic/intellectual experiences that result in presentations at regional and national meetings and even peer-reviewed publications. As an example of the latter (and of the transdisciplinary nature of the program), two chemistry students have recently co-authored (as lead authors) manuscripts entitled: *Prebiotic synthesis of a primitive phospholipid from reduced phosphorus on the primordial Earth: a proposal* (currently in peer review for the TriBeta National Biological Honors Society journal *BIOS*) and *Does Individual Personality Type Influence Dietary Taste Preference Among South Dakota State University (SDSU) Students?* (published in *Proc. S. Dak. Acad. Sci.* 2013, 92:135-147). The students participating in these experiences have demonstrated marvelous dedication and enthusiasm for their projects have gone on to esteemed post-graduate research opportunities and graduate and professional schools. A listing of student projects for the last seven years, including capstone experiences, can be found in Appendix B.

### **Supporting the System-wide Goals for General Education**

The physical science courses that satisfy the general education curriculum are designed with the goal of understanding fundamental principles of the natural sciences and applying methods of scientific inquiry. Students learn problem solving techniques, explore real world problems, develop and test hypotheses, and relate course content to contemporary issues as well as other disciplines. In addition to being in the Physical Science degree requirements, CHEM 112, CHEM 114, PHYS 111, PHYS 113, PHYS 211, and PHYS 213 can also be used to satisfy the SDBOR general education natural science requirement.

All general education science courses at Dakota State University meet the following system (SDBOR) goal:

**Regental General Education Goal (#6): Students will understand the fundamental principles of natural sciences and apply scientific methods of inquiry to investigate the natural world.**

**Student Learning Outcome 1:** Demonstrate the scientific method in a laboratory experience.

**Student Learning Outcome 2:** Gather and critically evaluate data using the scientific method.

**Student Learning Outcome 3:** Identify and explain the basic concepts, terminology, and theories of natural sciences.

**Student Learning Outcome 4:** Apply selected concepts and theories of the physical sciences to contemporary issues.

## **Student Progression**

Ideally, an incoming freshman student has the appropriate math placement score to enroll in Math 123: Calculus I in the first fall semester. Then they should follow this with Math 125: Calculus II in the spring. Students not prepared to start the calculus sequence in their freshman year will have difficulty graduating in four years.

Most new physical science majors take CHEM 112 General Chemistry I (fall) and CHEM 114 General Chemistry II (spring). Freshman also are advised to complete the introductory computer science courses in the first year. CSC 105 Introduction to Computers (fall) and CSC 150 Computer Science I (spring) are the usual recommended courses.

Students usually take PHYS 211 University Physics I (fall), PHYS 213 University Physics II (spring) during their second year to complete the prerequisite courses for the major. These courses develop a broad content background and level of skills needed for most upper level physical science courses. During their third and fourth year students should enroll in upper-level electives that are available.

A student's academic record at DSU is accessible to his or her advisor through a web-based interface called WebAdvisor. Advisors and students can view schedules and transcripts. Also, they can perform a program evaluation that indicates which requirements remain in a student's program. WebAdvisor allows for online searching of courses, and students may register for classes after consulting with their advisor.

## **Curriculum Management**

The Physical Science degree requirements (see Appendix A) consists of 32 credit hours of required mathematics coursework for all students in the program. Students whose only major is Mathematics for Information Systems must also complete 18 credits leading to a minor in Information Systems and 18-21 credits leading to a minor in an applied field. The mathematics coursework consists of a required 20 credit core (including Math 123: Calculus I which also satisfies a SDBOR General Education requirement) and an additional 12 credits of higher-level mathematics electives.

Required courses in the core (CHEM 112, CHEM 114, PHYS 211, PHYS 213, MATH 123, MATH 125) of the Physical Science degree are offered every year. At present, CHEM 326 Organic Chemistry I is offered every fall and support courses in computer science are also offered at least once a year. The upper level chemistry and physics courses in the elective block are offered on an every other year schedule. The goal has been to offer 1-2 of these higher-level electives each semester so that students have the opportunity to complete their degree requirements in a timely fashion.

*Table 1: Schedule of Offerings for Upper Division Courses*

<b>Fall - Even-numbered Years</b>	<b>Spring - Odd-numbered Years</b>
PHYS 341 Thermodynamics PHYS 343 Statistical Physics	CHEM 460 Biochemistry PHYS 471 Quantum Mechanics
<b>Fall - Odd-numbered Years</b>	<b>Spring - Even-numbered Years</b>
PHYS 421 Electromagnetism Or PHYS 451 Classical Mechanics	CHEM 328 Organic Chemistry II Or CHEM 492: Topics: Environmental Chem.  PHYS 331 Intro. Modern Physics

## Enrollment Statistics for Course Offerings

Enrollment numbers for the past 7 academic years are shown below. Although enrollment in the introductory courses has been good, the upper division courses attracted very low numbers of students. The Board of Regents policy only allows a very small percentage of sections to be offered with fewer than 10 students enrolled. Consequently, upper level chemistry and physics courses were frequently offered as independent study. We are anticipating increased numbers in PHYS 111/113 and PHYS 211/213 due to the growing interest in the Computer Game Design program on campus (these students are required to take one of the introductory physics sequences as part of that program).

*Table 2: Enrollment in Physical Science Courses by Semester and Academic Year*

Course Name	Fall 07	Spring 08	Fall 08	Spring 09	Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13	Fall 13	Spring 14	Fall 14
CHEM 112 General Chemistry I	73		55		51		43		58		61		45		45
CHEM 114 General Chemistry II		17		21		22		12		17		16		20	
CHEM 326 Organic Chemistry I	14		7		13		9		6		8		6		13
CHEM 328 Organic Chemistry II		7				6				8					
CHEM 332 Analytical Chemistry				13				4							
CHEM 452 Inorganic Chemistry		12				4									
CHEM 460 Biochemistry				12				6				9			
CHEM 491 IS: Adv Tech Comp Chem									1						
CHEM 491 IS: Astrobiology/Chem Origins														1	
CHEM 491 IS: Quantum Chemistry						2									
CHEM 492 Top: Environmental Chemistry												1		6	
CHEM 498 Undergrad Research/Scholarship				3	1	2			3						
PHYS 111 Introduction to Physics I		37		44		30		23	8		38		33		26
PHYS 113 Introduction to Physics II	4		7				4			4		19		24	
PHYS 211 University Physics I		11		5		5		11	7		13		8		10
PHYS 213 University Physics II	3		10		7		3		9	7		12		13	
PHYS 291 IS: Und Sci & Part Astrop										1					
PHYS 421 Electromagnetism		5			1								3		
PHYS 451 Classical Mechanics			6				3				7				
PHYS 491 IS: Statistical Physics					4										3
PHYS 491 IS: Thermodynamics		9			3										3
PHYS 492 Top: Intro to Quantum Mechanics	3			6								7			
PHYS 492 Top: Statistical Mechanics						4									
PHYS 492 Top: Modern Physics						4				8				3	
PHYS 492 Top: Nobel Lecture Universe													3		3
PHYS 498 IS: Astrophysics												4			
PHYS 498 Undergrad Research/Scholarship										1			1	1	1

## Relationships with Other Programs at Dakota State University

Several of the courses in the physical science program are required for students in other majors.

Students in Biology are required to take CHEM 112 General Chemistry I and CHEM 114 General Chemistry II as part of the science core. Students that plan to apply to graduate programs (especially in the health professions) also take CHEM 326 Organic Chemistry I, and may choose CHEM 460 Biochemistry, as well. Biology students seeking admission to certain health profession programs (e.g. medical, dental, optometry, and physical therapy) will also take two semesters of introductory physics courses (PHYS 111/211 and PHYS 113/213).

Students in the Exercise Science major are required to take CHEM 112 General Chemistry I, and many that plan to apply to graduate programs also take CHEM 114 General Chemistry II, CHEM 326 Organic Chemistry I, and may choose CHEM 460 Biochemistry, as well. Exercise Science students seeking admission to physical therapy programs will also take two semesters of introductory physics courses (PHYS 111/211 and PHYS 113/213).

Students majoring in Computer Game Design are required to take PHYS 211 University Physics I and PHYS 213 University Physics II to fulfill their general education science requirement.

Students in other majors, especially secondary education, may select a minor in either chemistry or physics. The minors consist of the following courses:

Chemistry Minor (19-20 credits)		Physics Minor (18-20 credits)	
CHEM 112 Gen. Chemistry I	4 credits	PHYS 211 University Physics I	4 credits
CHEM 114 Gen. Chemistry II	4 credits	PHYS 213 University Physics II	4 credits
CHEM 326 Organic Chem. I	3 credits	PHYS 331 Intro. Modern Physics	3 credits
CHEM 326L Organic Chem. I Lab	1 credit	SEED 303* Secondary/Middle	1 credit
CHEM 332 Analytical Chem. I	3 credits	Content Area: Minor	
CHEM 332L Analytical Lab	1 credit		
SEED 303* Secondary/Middle	1 credit		
Content Area: Minor			
Three credits from the following:		Two courses from the following:	
CHEM 328 Organic Chem. II	3 credits	PHYS 421 Electromagnetism	4 credits
CHEM 328L Org. Chem. II Lab	1 credit	PHYS 451 Classical Mechanics	4 credits
CHEM 452 Inorganic Chemistry	3 credits	PHYS 471 Quantum Mechanics	3-4 cred. (3 req.)
CHEM 460 Biochemistry	3 credits		
PHYS 341 Thermodynamics	2-3 cred. (2 req.)		
* Required for education majors only			

## **Instructional Methodologies**

The faculty utilizes a variety of instructional methods including lecture, laboratory, multimedia, and use of other computer technology. Most classes typically involve some combination of lecture, class discussion and hands-on problem solving (such as writing to learn, cooperative learning, flipped classroom and other contemporary collaborative group learning approaches). And intensive computer usage in both classroom and laboratory environments is certainly prevalent.

Most courses except some special topics offerings include laboratory exercises. Over the last several years, a greater emphasis has been placed on oral and written presentations by students. Computer use in the classroom and laboratory is required and creative ways to integrate technology are highly encouraged. Additionally, the faculty has put a great deal of time and effort into creating documents and course materials that are accessible online.

## **Part 4 - Program Enrollment and Student Placement**

The Office of Institutional Effectiveness and Assessment provides frequently updated data on program enrollments and graduation rates. The link below accesses that information. Choosing statistics will present the data for Dakota State University as a whole. Data for the physical science program can be found by selecting physical science from the pull-down menu.

<http://iii.dsu.edu/Charts/>

The following statements describe how the data were collected for each graph.

### **Total Enrollment**

Program enrollment is based on the number of students enrolled in at least one DSU class with an active program of Physical Science as of fall census. If a student is seeking a major in more than one program, they will be counted in both programs.

College enrollment is based on the number of students enrolled in at least one DSU class with an active program in the College of Arts & Sciences as of fall census.

University enrollment is based on the number of students enrolled in at least one DSU class as of fall census. If a student is enrolled in multiple programs, they are only counted once at the university level.

## Degrees Awarded

This table includes the number of degrees awarded by academic year.

*Table 3: Number of Degrees Awarded by Academic Year*

Program	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
<b>Bachelor of Science in Physical Science</b>		1	4	3	1	1	1

An academic year is defined as summer, fall, and spring for the purpose of this report.

## Persistence

Persistence is defined as: The proportion of a student cohort who enrolled for the first time in a given fall semester and then re-enrolled in a subsequent spring semester. The student must be enrolled in at least one DSU class to be considered persisted. For persistence purposes, a specific population is used: first-time, full-time, baccalaureate degree-seeking freshmen. A student may be counted more than once. If the student is a double major they will be counted in each major.

## Retention

Retention is defined as: The proportion of a student cohort who enrolled for the first time in a given fall semester and then re-enrolled in a subsequent fall semester. The student must be enrolled in at least one DSU class to be considered retained. For retention purposes, a specific population is used: first-time, full-time, baccalaureate degree-seeking freshmen. A student may be counted more than once. If the student is a double major they will be counted in each major.

## Graduation

Graduation is defined as the number of the first-time, full-time, baccalaureate degree-seeking freshmen who enrolled at DSU in the fall and received a baccalaureate degree from DSU within five or six years. If a student graduated with an associate degree, they are counted as not graduated. A student may be counted more than once. If the student is a double major they will be counted in each major.



## Employment Potential and Placement

Although there is very little data due to the small number of students, it appears that nearly 90% of graduates from the Physical Science program found placement in either an appropriate position or chose to continue their education in graduate school. The following table shows the positions and geographic locations of student (for whom data is available) placement since the last program review.

Term	Employer	Position	City
2009FA			
2009SU			
2010FA	Continuing Education	Graduate Student	University of South Dakota
2010SP	Los Alamos National Lab Continuing Education	Graduate Student	Los Alamos, NM
2012SP			
2013FA			
2014FA	FermiLab	Intern	Chicago, IL

## Part 5 - Faculty Credentials

The principal instructors in the Physical Science degree program are listed below.

Barbara Szczerbinska, Professor of Physics, Ph.D., University of South Carolina  
 Michael Gaylor, Assistant Professor of Chemistry, Ph.D., College of William and Mary

A vita for each faculty member is contained in Appendix C.

## Anticipated Changes in Staffing

There are no anticipated changes at this time. However, the program does not currently have a dedicated support lab technician/lab manager, which requires the faculty to oversee all aspects of lab management and setup/validation/breakdown, safety/training, chemical supply ordering/inventory etc. Though this has opened up unique niches for student involvement in the physics and chemistry labs (which has yielded significant learning benefits for student workers), this is clearly not an ideal/sustainable situation.

## Faculty Research

### Dr. Michael Gaylor

Dr. Gaylor's student-centered research foci lie within the broader areas of environmental and analytical chemistry, prebiotic chemistry (chemical origins of life studies), biogeochemistry, ecotoxicology and marine science. Since joining the faculty in 2012, he has established a dynamic and highly interdisciplinary undergraduate research program that has already yielded several student co-authored peer reviewed publications, as well as several student presentations at local, regional and international scientific meetings and the South Dakota State Capitol. He has also been successful in bringing in more than \$100,000 in new analytical instrumentation for the chemistry program. His dedication to authentic outside-the-box undergraduate research/scholarship has also resulted in several of his students being accepted into renowned summer REU and post-baccalaureate research fellowship programs and P.A., M.D. and Ph.D. programs. Most recently, one of his students earned a prestigious U.S. EPA National Undergraduate Environmental Research Fellowship in the amount of \$50,000. In collaboration with physics professor, Dr. Barbara Szczerbinska, he also contributed significantly to development and implementation of DSU's inaugural (South Dakota NASA Space Grant Consortium-funded) *STEM Institute* program (summer 2014) intended to recruit and retain high-achieving incoming students in the DSU STEM majors. In his brief tenure at DSU, he has published multiple papers in and reviewed well over a dozen manuscripts for the top peer reviewed journals in his fields. He has also recently served on an international student research funding committee for the Society of Environmental Toxicology and Chemistry (SETAC) and has established (and is working diligently to nurture) nascent collaborative ties with the NASA Astrobiology Institute and a variety of other national and international (private sector and government) scientific agencies

### **Dr. Barbara Szczerbinska**

Dr. Szczerbinska established in 2011 the Center for Theoretical Underground Physics and Related Areas (CETUP\*). The mission of the CETUP\* is to promote an organized research in physics, astrophysics, geoscience, geomicrobiology and other fields related to the underground science via individual and collaborative research in dynamic atmosphere of intense scientific interactions. The main goal of the Center is to bring together scientists scattered around the world, promote the deep underground science and provide a stimulating environment for creative thinking and open communication between researches of varying ages and nationalities. Long term CETUP\* envisions a diverse group of theoretical and experimental physicists, astrophysicists, and geoscientists in year-round internet-based communication. To complement the virtual communication there will be resident- based research as well as different programs available allowing face-to-face collaborations focusing on different overlapping sub-disciplines of underground science. CETUP\* also encourages educational scientific collaborations which will be essential in building a critical mass of outstanding scientists of international caliber and attracting rising young scientists to the program.

The research objectives of CETUP\* are closely related to her own research interests: neutrino physics (both from particle physics and nuclear physics point of view), geo-neutrino detection and dark matter detection. Her current neutrino research focuses on the neutrino interactions in the quasi-elastic and inelastic reaction channels which are very important for the current and future oscillation experiments, including LBNE (Long Baseline Neutrino Experiment). In the geo-neutrinos (electron antineutrinos obtained in radioactive decay of uranium, thorium, potassium) based research she focusses on seeking a modification to existing detectors and/or development of new targets that would allow for a detection of low energy potassium neutrinos. Her dark matter research efforts are concentrated on detectors that are using high purity and low background radiation sodium iodide crystals. Such detectors require an extremely low background from radioactive elements like previously mentioned uranium, thorium and potassium to avoid the interaction between the neutrinos produced during the decay process with the detector itself. The background estimates require a good understanding of the low energy neutrino – nucleus cross sections which connect to her neutrino physics interest.

## Service to Community

Despite being a relative newcomer to the DSU faculty (2012), Dr. Gaylor has actively served the greater community by providing *pro bono* scientific consulting and teaching expertise to individual citizens and schools etc. on demand.

Dr. Szczerbinska is involved in multiple projects meant to promote STEM programs to community, some of the examples:

- Design Challenge – Kirby Science Discovery Center, Washington Pavilion - judge;
- Science Festival – Sanford Research Facility - organizer;
- Spooky Science Night – Kirby Science Discovery Center, Washington Pavilion - judge;
- Science Fair Showcase – Kirby Science Discovery Center, Washington Pavilion - judge;
- BIG Event – Girls Scouts Dakota Horizons at Sioux Falls Convention Center – two booths: “Optics Hunted House” and second booth with multiple activities run by Donna Hazelwood, Kim Jones and Nevine Nawar
- PROMISE Science Discovery Day – Sanford Research, Sioux Falls – keynote speaker “*STEM Careers – Where Your Strengths Meet the World’s Needs*”;
- PROMISE Science Discovery Day - Sanford Research & Washington Pavilion joined project – speaker for the opening of the Dark Matter exhibit: “*Dark Matter*”-lecture given at the Belbas Theater at the Washington Pavilion;
- Alliance for Science, Washington Pavilion - speaker;
- LEGO League State Tournament organized by South Dakota Robotics Association hosted at Augustana College - judge;
- Sidewalk Arts Festival, Washington Pavilion – Board Member representative;
- Osher Lifelong Learning Institute (OLLI) – lecturer (“*Universe: It’s Past and Future*” – part I and II)

## Description of Student Organizations/Initiatives

Women in Science and Technology (WIST) – a student organization at Dakota State University that is open to all female undergraduates who are majoring in fields where women are typically under-represented such as science and technology. The purpose of this group created in 2007 is to provide support and networking opportunities to women that will benefit from them as they pursue the careers in STEM fields.

Throughout the academic years the WIST members were actively involved in multiple outreach activities. Let's take year 2015 as an example: On April 5<sup>th</sup> 2014 three students participated in the Red Planet Rover Design Challenge at the Science Discovery Center in Washington Pavilion. The students were judging designs created by the K-12 students. On May 2<sup>nd</sup> three WIST members were judging the science projects at the regional Science Fair Showcase created by middle school students – event hosted at the Science Center in Washington Pavilion. On October 18<sup>th</sup> one student participated in the Spooky Science Night organized by the Kirby Science Discovery Center at the Washington Pavilion running an activity booth. The event brought several hundred children with their parents to celebrate science in a Halloween settings. WIST students also helped at the Kelly Sweet's guest lecture at DSU. Two of the WIST students participated during one week long STEM Institute project during which they served as student mentors for 16 freshmen students who came to DSU campus a week prior the official start of the Fall semester.

WIST students are strongly encouraged to participate in the events which may lead to networking opportunities. On March 26<sup>th</sup> several students participated in Women's Day luncheon with First Lady Linda Dugaard who gave a speech on "Celebrating Women of Character, Courage and Commitment". On April 5<sup>th</sup> one WIST member participated in a seminar by Erin Cambier: Salary Negotiation 101 organized by Sioux Falls Business and Professional Women. The participating student gathered information and tips on how to get ready for the interviews, how to negotiate salary, how to negotiate a raise etc., presented by the keynote speaker and reported to WIST and other students interested in the subject on the DSU campus.

On April 2<sup>nd</sup>, 2014 WIST obtained the **SD Board of Regents Academic Excellence Award** – a great recognition for hard work of WIST students and their involvement in multiple projects and activities that promote DSU to community. The group also obtained Student Organization Recognition Certificate of Merit. Both awards required a submission of a formal application.

Dakota State University, as many other higher education institutions, continues to struggle with recruitment and retention of especially underrepresented students within STEM majors. Data show that 40-50% of our incoming STEM majors switch to non-STEM majors during their first year. To address this alarming trend, Dr. Szczerbinska proposed a creation of STEM Institute – a multidimensional, interdisciplinary STEM awareness and education program aimed at maximizing student recruitment and retention for STEM majors. The Institute was funded by SD NASA Space Grant Consortium and Dakota State University. Sixteen freshmen students majoring in STEM programs moved on campus week prior the beginning of the spring semester. During 4.5 days they were exposed to:

- Interaction with both faculty and upper division students
- Hands-on STEM activities conducted by faculty intended to emphasize truly interdisciplinary critical thinking, peer learning and diverse real-world examples of STEM at work in industry (faculty involved in the project: Glenn Berman, Dawn Dittman, Dale Droge, Nate Edwards, Michael Gaylor, Donna Hazelwood, Jenifer Nash, Ashley Podhradsky, Kevin Smith, Barbara Szczerbinska)
- Site visits at EROS Data Center and Sanford Research Facility
- Meetings with staff researchers and technologists, learning about research conducted within their respective facilities and the importance of industry STEM activities to local and regional communities and economies
- Intensive panel discussion with 5 speakers on importance of STEM, career paths, job recruitments, interviews preparation

Several students from the STEM Institute participated in the 50<sup>th</sup> Nobel Conference hosted at Gustavus Adolphus College in St. Peter, MN focused on “*Where Does Science Go from Here*”.

The survey conducted at the end of the summer program and the follow up discussions with the students throughout the fall semester emphasized the tremendous benefits of the STEM Institute and help in a smooth transition from the high school environment to college life – a great example was a letter sent to the DSU president by one of the STEM Institute student. All students remained in STEM majors which is a great success. This group will be tracked throughout their college career to see if the STEM Institute could be a solution to our retention problem in STEM majors.

## **Part 6 - Academic and Financial Support**

Resources providing academic support to faculty and students in physical science include the Karl E. Mundt Library, a wireless computer infrastructure, and classrooms equipped with computer projection systems.

### **Karl E. Mundt Library & Learning Commons**

The Karl E. Mundt Library & Learning Commons provides a wide range of library services as well as a diverse collection of reference and informational materials for the use of the faculty and staff of Dakota State University. The Library exists to serve as an archive of accumulated knowledge, a gateway to scholarship, and a catalyst for the discovery and advancement of new ideas. In fulfilling its obligation to provide knowledge to the University and the scholarly community at large, the Library collects, organizes, and provides access to recorded knowledge in all formats. The Library faculty initiates discussions and proposes creative solutions to the information challenges facing the University and the scholarly community. The Library's faculty and staff actively participate in providing quality service, access, instruction, and management of scholarly information. It is one of the main sources of knowledge and reference for students in mathematics.

The mission of the Karl E. Mundt Library & Learning Commons is to meet the information needs of the students, faculty, and staff of Dakota State University and to support the University's stated

mission and goals. The college and library faculty work together to plan the development of library resources in order to purchase the most appropriate materials to achieve the educational objectives of Dakota State University. The total collection contains approximately 175,000 items (physical and electronic), ranging from books, journals, and other formats that support all subjects the University offers.

The Karl E. Mundt Library boasts tremendous access to the resources needed by anyone pursuing a mathematics related research topic. Even though the library does not have an extensive list of books related to mathematics, they are readily obtainable through interlibrary loan. The library also has subscriptions to 115 full text online publications in the mathematical sciences, plus access to citation/abstract information in MathSciNet (1799 journals), Dissertation Abstracts, and other research databases. The Library tracks periodical and research database usage and subscribes to titles most in demand.

These and additional resources are available through a variety of means: the South Dakota Library Network (SDLN), EBSCO Academic Search Premier, ProQuest Research Library, OCLC FirstSearch, the Internet, and the various indexes accessed by the Mundt Library. In short, there is little the Library cannot acquire to fill student or faculty needs.

## **Computer Infrastructure**

Within the unit of Computing Services, the Network Services group is responsible for planning, implementing, and securing network services for campus computing resources. A variety of servers in the Server Room provides applications hosting home directories, web space, e-mail, and other central applications. The use of the VM server allows students to access Stella and Maple through the internet.

Working in partnership with the colleges and the institution's academic support areas, Network services develops the image of applications installed on student tablets. Network Services operate a Repair Center, staffed primarily by students, to quickly respond to any computing or network access problems in campus offices or computing laboratories or with students tablet PC's.

## **Advisory and Support Staff**

Benjamin Jones, Dean of Arts and Sciences

Dale Droge, Math and Science Academic Coordinator

Ethelle Bean, Director of the Library

Nancy Presuhn, Senior Secretary for the College of Arts and Sciences

David Overby, Chief Information Officer

Craig Miller, Computing Services Manager - Network Services

Tyler Steele, Communication Network Specialist, E – Education Services

## Financial Support

There are two sources of funds that support the physical science program. State funds are used for general operating expenses of the Science Center and support of instruction including printing, office supplies, and some support of travel. The funds in this account are shared by all programs within the College of Arts and Sciences, and the Dean of the College approves the expenditures from this account.

Additional support for professional development and training is provided from funds allocated through the Vice-President for Academic Affairs office. Faculty may apply for support and up to \$1200 per year is available for each faculty member.

In addition to the resources available through state funds allocation, a lab fee of \$51.40 is assessed for each student taking a laboratory course. The lab fees are placed in a local account and support courses in Biology and Physical Science. Funds that remain in the lab fees account at the end of the fiscal year are placed in a reserve account. The academic coordinator in the Science Center supervises the lab fee account.

## Budget for Science Programs 2007-2014

<b>Fiscal Year</b>	<b>Local Funds</b>
<b>2007-2008</b>	<b>\$30,000</b>
<b>2008-2009</b>	<b>\$30,700</b>
<b>2009-2010</b>	<b>\$30,000</b>
<b>2010-2011</b>	<b>\$32,000</b>
<b>2011-2012</b>	<b>\$32,000</b>
<b>2012-2013</b>	<b>\$32,000</b>
<b>2013-2014</b>	<b>\$32,000</b>

## Major Financial Concerns

It is expected that state support of the College of Arts and Sciences, and therefore of the physical science program, will continue at current levels. Lab fees are generally adequate to fund the costs of supplies and low-cost equipment. In addition, more extramural support will be sought in the future (e.g. CCLI grant from the National Science Foundation).

## Part 7 - Facilities and Equipment

### Current Facilities

In 2010, a 5 million dollar extensive renovation of the DSU Science Center was completed. The building did not increase in size, but every room was remodeled and updated. Faculty offices moved to the outside of the building and classrooms were added to the central area. The following statements describe rooms of the Science Center that are frequently used by the physical science faculty and students:

#### General Chemistry Lab 136 (1260 sq. ft.)

Introductory chemistry laboratory investigations take place here. Versatile snorkel hoods extend from the ceiling to exhaust fumes from anywhere on the lab benches. Special supports to hold students' tablet computers are located at each work station. Distilled water is piped directly to the sinks at the end of the benches. Safety precautions like eyewash stations and showers are incorporated into the design of the lab.

#### Advanced Chemistry Lab 139 (1110 sq. ft.)

Upper division courses such as organic chemistry, analytical chemistry and biochemistry are taught in the this specialized lab. Large amounts of open counter space can be used for almost any specialized experimental apparatus and large fume hoods line one of the walls. Storage area and bench space is available for individual student research projects. Rooms with analytical balances and other specialized instruments open off the rear of this laboratory.

#### Chemistry Preparation and Storage 137

A combined chemical storage and preparation room is located between the two chemistry labs.

#### Physics Laboratory 143 (1330 sq. ft.)

Introductory and upper division physics courses including mechanics, electromagnetism and quantum mechanics are taught in this room. The long tables facilitate the arrangement of tracks and other experimental installations. Electrical outlets are available throughout the room for easy integration of computer technology. Sliding doors for most of the storage areas are white boards that can be used for instruction and experimental design.

#### Physics Preparation and Storage 142

A large room for lab preparation and storage of physics equipment is located adjacent to the physics teaching laboratory.

#### Conference Rooms 132 and 133

These two rooms are designed to be used for a variety of purposes. Faculty, staff and student groups schedule meetings here and specialized courses such as seminars and discussion groups often are conducted in these rooms.



### Auditorium SC 135

Larger courses such as introductory biology, chemistry, physics are taught here as well as anatomy and several courses from other disciplines in the College of Arts and Sciences. Tables in front of the more than one hundred seats facilitate computer use along with an abundance of electrical outlets. Students enjoy the comfortable seating and excellent sight lines provided by the gently sloping floor. Two large multimedia projectors give a large, high resolution image and the theater surround sound system and specialized design features provide an excellent acoustic environment.

### **Quality of the Facilities**

After the remodeling project, the facilities are very good.

### **Additional Facilities Needed**

With increasing faculty and undergraduate research, more spaces dedicated to those efforts would be beneficial.

### **Quality of Current Equipment**

Some of the current equipment is in good condition and works reasonably well. However, much of the major equipment is antiquated/dysfunctional and should be replaced to ensure that our majors continue to receive training in the use of the contemporary laboratory equipment and instrumentation that they will encounter in workplaces and graduate programs after graduation.

### **Additional Equipment Needed**

To better support the technology-across-curricula mission of the university, existing laboratory equipment must be upgraded and new equipment purchased. Included in this list would be the Pasco and Vernier probeware equipment related to basic experiments in mechanics, optics, electricity and magnetism etc. (for physics labs) and basic experiments in acid-base chemistry, chemical equilibria, quantum chemistry, kinetics and electrochemistry etc. (for chemistry labs). To ensure that our majors are properly trained in/on contemporary chemical techniques and technologies, acquisition of a diverse inventory of modern bench top analytical instrumentation (e.g. ASE, HPLC, ICP-AES, LC-MS etc.) is essential.

### **Capital Equipment**

Computer equipment for classroom and lab:

Computer interfaces, software, and data probes

Sharp Projectors mounted in all teaching laboratory spaces

Available for Faculty Use:

Networked laser printer/copier, flatbed scanner, and other office equipment located in the Science Center office

## **Physical Science Laboratory Equipment**

See list in Appendix D.

## **Part 8 - Assessment and Strategic Plans**

### **Brief History**

Assessment of program quality and student outcomes is an important component of program enhancement in the Physical Science Program at Dakota State University. The faculty in this program developed assessment plans which include student learning outcomes evaluated by multiple measures. The common set of assessment measures include the following direct and indirect measures: standardized exams, course grades, placement statistics, graduate surveys, and employer surveys. Faculty annually review assessment data and recommend changes for improvement, if necessary. The complete assessment plans, summary analysis and changes for improvement are available at

<http://public-info.dsu.edu/academic-assessment/major-field-undergrad-table/>

In addition to the annual faculty review of assessment results in each major, the Dean of the College of Arts and Sciences provides a report to the Assessment Coordinating Committee each fall. This report summarizes the significant finds based on assessment data and summarizes the proposed program improvements and is also available at the above site (see Annual Reports).

### **Goals and Objectives of the Physical Science Program**

**Goal Statement:** Graduates of the Physical Science program will possess the knowledge and skills to gain admission to graduate programs or professional schools or be able to gain employment in business and industry where an understanding of the world of business, information systems, chemistry, physics, and related math and science areas is required or desirable.

#### **Physical Science graduates will:**

#### **Goal 1. Graduates will have a basic knowledge of the principles of chemistry, physics and physical science.**

- a. Graduates will understand the important concepts and methods of the major disciplines of the physical science program.
  - 1) Course Grades: 95% of graduates will successfully complete upper division coursework with a minimum grade of C in each course.
  - 2) Minimum GPA in Major Field: 100% will have a min. GPA of 3.0 in chemistry, physics and physical science courses.
  - 3) Major Field Assessment Test (MFAT): 90% will score no lower than 1 SD below the user norm.

- 4) Exit Interview: 90% of graduates will indicate that they are satisfied that they have the content knowledge to be successful in research, industry, or other areas related to the physical science curriculum.

**Goal 2. Students will be able to use their knowledge of concepts in physical science to solve new problems.**

- a. Students will understand the process of science including the basic steps of the scientific method and use this ability to conduct research in physical science.
  - 1) Undergraduate Research: 100% will complete Undergraduate Research with a minimum grade of B.
  - 2) CAAP science reasoning exam: 100% will score at or above the 50<sup>th</sup> percentile.
- b. Graduates will think logically and be experienced problem solvers.
  - 1) Exit Interview: 90% will indicate that they are satisfied with their problem solving skills.
  - 2) Employer Survey: 90% of employers will be satisfied with graduate's ability to solve problems. (Average of questions 8 and 9)

**Goal 3. Have a high degree of proficiency in the use of computer technology.**

- a. Students will be proficient users of computer technology to find information, acquire and analyze data, and communicate results and conclusions.
  - 1) Undergraduate Research: 100% will complete Undergraduate Research with a minimum grade of B. The project will require extensive use of technology.
  - 2) Exit Interview: 95% of graduates will indicate that the physical science program provided good to excellent preparation in the use of computer technology.
  - 3) Technology Exam: 100% will pass the standardized online computer exam on the first attempt.
- b. Graduates will be able to successfully use technology in their post-graduate career:
  - 1) Exit Interview: 90% of graduates will indicate that they are satisfied that they have the technology skills and computer knowledge to be successful in their chosen career.
  - 2) Graduate Survey: 90% of graduates will be satisfied with their technology preparation in the program. (Average of questions 1 and 4)
  - 3) Employer Survey: 90% of employers will be satisfied with the technology preparation of the graduate. (Average of questions 1 through 3)

**Goal 4. Students will be able to communicate their knowledge and results effectively for a wide range of purposes and intended audiences.**

- a. Graduates can effectively communicate information in writing.
  - 1) Writing Intensive Course: 95% of graduates will successfully complete an upper level writing intensive course with a minimum grade of C for the course.
  - 2) Undergraduate Research: 100% will complete Undergraduate Research with a minimum grade of B. The project will require a final paper written in proper scientific format.
  - 3) Graduate Survey: 90% of graduates will indicate that they are satisfied with their written communication skills. (Question 5)

- 4) Employer Survey: 90% of employers will indicate that the graduate has adequate to very good writing skills as they relate to the graduates position. (Question 4)
- b. Graduates are effective speakers communicating information to a variety of audiences.
  - 1) Undergraduate Research: 100% will complete Undergraduate Research with a minimum grade of B. The project will require a final oral presentation to faculty and students.
  - 2) Exit Interview: 90% of graduates will be satisfied with their ability to be effective speakers communicating information to a variety of audiences.
  - 3) Graduate Survey: 90% of graduates will be satisfied with their oral communication skills. (Question 6)
  - 4) Employer Survey: 90% of employers will be satisfied with the oral communication skills of the graduate. (Question 5)
- c. Graduates have solid social skills.
  - 1) Graduate Survey: 90% of graduates will be satisfied with their interpersonal skills. (Question 8)
  - 2) Employer Survey: 90% of employers will be satisfied with the interpersonal skills of graduates from the program. (Question 7)

## Evaluation of Assessment Data

All candidates for graduation complete an assessment activity prior to graduation. Since 1998, all Physical Science majors take the Major Field Assessment Exam (MFAT) in either chemistry or physics. The exams are produced by Educational Testing Service. Only about one-third of the DSU students' average score was within one standard deviation of the national user norm. The very low sample size makes any conclusions difficult, but several problems exist with this assessment. By design, the physical science program consists of a number of courses from both physics and chemistry. To our knowledge, a national exam of that nature does not exist. Instead our students take either subject which will include many areas of the discipline in which they have not had any instruction. A local problem is that most students have been given the chemistry test regardless of their specialization within our curriculum. Finally, the results have no consequences for the student, so their motivation is questionable.

Assessment Tools (Evaluation Measures)	Bench- marks	2013- 14	2012- 13	2011- 12	2010- 11	2009- 10	2008- 09	2007- 08
1. Major Field Assessment Test (MFAT): Will score no lower than 1 SD below the user norm.	90%	N=0	N=1 100%	N=1 100%	N=1 0%	N=3 0%	N=4 25%	N=0

The Office of Institutional Effectiveness and Assessment has additional information on the Employer and Graduate Surveys and the major-field assessment tests.

### **Changes made to the curriculum or to the program as a result of assessment findings**

The monitoring of student progress is a critical component of program assessment and provides the faculty, students and administrators with vital information about program quality. The curriculum is reviewed on a regular basis and program modifications are submitted to the University's Academic Council and Curriculum Committee. Information from graduate and employer surveys and meetings with prospective employers are used to revise the curriculum to ensure it meets the needs of the marketplace. Students' scores on the major field assessment exams are used as another means of evaluating the curriculum.

Based on the limited assessment data available, several changes have been made to physical science courses since the last review. The upper-level physics and chemistry courses were changed to facilitate a regular schedule of offerings that would allow students to complete the requirements in four years. Thermodynamics and statistical physics are now offered concurrently. To meet demand for more interdisciplinary courses that benefit students from other majors (principally biology) a new course in environmental chemistry was developed. In addition to changes in course offerings, faculty have revised course assignments and lab activities to increase the use of scientific inquiry to study applied problems and contemporary issues affecting science and society.

### **Other measures the college faculty use on a regular or periodic basis to aid in the evaluation of the curriculum and the effectiveness of the teaching/learning process**

DSU regularly conducts several surveys that provide information for faculty and administrators to use in the evaluation of the effectiveness of the teaching and learning process. The Noel Levitz Student Satisfaction Inventory (SSI), the National Survey of Student Engagement (NSSE) and the Faculty Survey of Student Engagement (FSSE) provide valuable information on student satisfaction with DSU's programs and services and the level of engagement of students in various areas. A summary of the results of the NSSE/ FSSE is presented to the faculty and staff during orientation in the fall. Each college receives the results of the Student Satisfaction Inventory for students in their majors; this data provides information on satisfaction with academic advising, course scheduling and other areas related to students' academic success.

DSU graduates are surveyed at one and three years following graduation. Employers of DSU graduates are surveyed on an annual basis. From 2007-2013, the number of returned surveys was 2 from recent graduates and only one employer survey. The small number of graduates and low return rate of surveys makes the analysis of such data essentially anecdotal.

Students evaluate the teaching / learning process each semester in each class using the IDEA Ratings of Instruction Survey.

### **Interrelationships between the curriculum in the academic programs being reviewed and the introductory courses in the discipline that are included in the**

- system-wide general education core requirements and proficiency testing
- institutional graduation requirements
- institutional technology / literacy requirements and proficiency testing

DSU monitors students' academic progress through the three-tiered assessment program: upon entry into the University, after completion of 32 or 48 credit hours (general education assessment) and during the semester in which they graduate (major-field assessment). Incoming students are evaluated using ACT or COMPASS scores to place them into the appropriate entry-level courses. Students' general education knowledge is evaluated after completion of 32 credit hours for associate degrees or 48 credit hours for baccalaureate degrees. For the past 18 years, students completed the ACT CAAP proficiency testing in math, reading, English and science reasoning. In addition, all DSU students take a locally developed computer skills exam as a requirement for completion of their general education computer courses.

### **Strategic Plan of Dakota State University**

Excellence through Innovation 2020 has been developed in consideration of:

- DSU's 133 year history starting as a Normal School and then becoming a comprehensive public institution with a wide variety of majors.
- DSU's explicitly-defined legislative mission integrates technology across the curriculum through unique degree options delivered by an outstanding and dedicated faculty and staff; and
- DSU's history of continuous improvement.

This strategic plan highlights our strengths, considers our challenges, honors our prior investments and achievements, and reflects widespread stakeholder involvement into the planning process.

DSU's primary assets lie in a growing reputation for excellence, the technology-enhanced quality programs we offer, and the students those programs attract. These qualities are enhanced through our committed faculty, staff and administration. DSU's reputational capital is built on our technology-rich, discipline-focused educational programs. DSU meets the talent needs of both South Dakota and the surrounding region in cybersecurity, business, finance, K-12, and healthcare

sectors. We are committed to providing educational opportunities that empower our students to enrich their communities through innovative thought and action.

DSU's challenges include limited state funding and a need to grow other revenue.

Grounded in a spirit of continuous improvement, the DSU community is committed to our students' success, our distinctive mission, and university-wide excellence. DSU is dedicated to the personal and professional development of a diverse campus community of students, faculty, and staff. The university contributes to an exceptionally welcoming and intentionally inclusive, accessible campus community and inspires educational, personal, social and professional achievement.

**Goal 1: Educate to Inspire: Dedicated to Academic Quality and Excellence.**

DSU promotes active engagement in scholarship, teaching and learning to prepare students to excel in their disciplines and be leaders in their communities.

**Goal 2: Grow to Thrive: Dedicated to Student Access and Success.**

By improving access and opportunity, DSU will enroll, retain, and graduate a larger, more diverse, student body.

**Goal 3: Innovate to Transform: Dedicated to Continuous Improvement.**

Continuously enhance our academic programs, university facilities, student services and campus technologies to become a more effective and efficient university.

**Goal 4: Collaborate to Lead: Dedicated to External and Internal Partnerships.**

By fostering collaborative relationships with internal and external stakeholders, DSU will expand educational opportunities for students.

## **Strategic Goals of the College of Arts and Sciences**

The College of Arts and Sciences has produced a plan that encompasses the DSU strategic initiatives, but focuses on how the goals and objectives will be addressed at the college level.

## **Appendix A – Physical Science Degree (Catalog Description)**

Students majoring in this program will be prepared to become employees as chemists or physicists for the science-based industries and agencies that use modern technology. They will also be prepared to pursue an advanced degree in chemistry, physics, engineering or medicine. This program provides an excellent background in business and computer science/information systems technology as well as a solid foundation in supporting sciences and mathematics. The graduates of the program will be capable of entering industry in traditional technical positions available to physicists and chemists, or in marketing, business, computer support or information systems. The combination of traditional science and modern computational methods will be especially valuable in science-based information industries. In particular, in the emerging biotechnology industry, this kind of background in science and technology is increasingly necessary.

### **General Education Requirement (30 Credits)**

Majors must take CHEM 112, MATH 123 and PHYS 211 as part of the System-wide General Education Requirements.

### **System-wide Institutional Graduation Requirement (11 Credits)**

Majors must take CSC 150 as part of the Institutional Graduation Requirement.

### **Required Courses (30-31 Credits)**

**CHEM 114 - General Chemistry II 4 credits**

**ENGL 379 - Technical Communication 3 credits**

**MATH 125 - Calculus II 4 credits**

**PHYS 213 - University Physics II 4 credits**

**Select one course from the following (3-4 Credits)**

**MATH 225 - Calculus III 4 credits**

**MATH 281 - Introduction to Statistics 3 credits**

**MATH 315 - Linear Algebra 3-4 credits (3 credits required)**

**MATH 316 - Discrete Mathematics 2-3 credits (3 credits required)**

**MATH 318 - Advanced Discrete Mathematics 3 credits**

**MATH 321 - Differential Equations 3-4 credits (3 credits required)**

**MATH 413 - Abstract Algebra I 3 credits**

### **Select 12 credits from the following (12 Credits)**

**CHEM 492 - Topics 1-4 credits (3 credits required)**

**CHEM 498 - Undergrad Research/Scholarship 1-12 credits (3-6 credits required)**

**PHSI 492 - Topics 1-4 credits (3 credits required)**

**PHSI 498 - Undergraduate Research/Scholarship 1-6 credits (3-6 credits required)**



**PHYS 492 - Topics 1-4 credits (3 credits required)**

**PHYS 498 - Undergraduate Research/Scholarship 1-12 credits (3-6 credits required)**

**Computer Science Component (9 Credits)**

**CSC 250 - Computer Science II 3 credits**

**CSC 260 - Object Oriented Design 3 credits**

**CSC 300 - Data Structures 3 credits**

**Select six courses from the following (18-24 Credits)**

**Some of the courses below are offered by Black Hills State University.**

**CHEM 326 - Organic Chemistry I 3 credits**

**CHEM 328 - Organic Chemistry II 3 credits**

**CHEM 332 - Analytical Chemistry 3 credits**

**CHEM 452 - Inorganic Chemistry 3 credits**

**CHEM 460 - Biochemistry 3 credits**

**GEOL 201 - Physical Geology 4 credits**

**GEOL 310 - Volcanology 3 credits**

**GEOL 340 - Mineralogy and Petrology 3 credits**

**GEOL 360 - Geochemistry 3 credits**

**GEOL 370 - Hydrogeology 3 credits**

**PHYS 331 - Introduction to Modern Physics 3 credits**

**PHYS 341 - Thermodynamics 2-3 credits (3 credits required)**

**PHYS 343 - Statistical Physics 2-4 credits (3 credits required)**

**PHYS 361 - Optics 3-4 credits (3 credits required)**

**PHYS 421 - Electromagnetism 4 credits**

**PHYS 424 - Digital Electronics 3-4 credits (3 credits required)**

**PHYS 433 - Nuclear and Elementary Particle Physics 3 credits**

**PHYS 451 - Classical Mechanics 4 credits**

**PHYS 471 - Quantum Mechanics 3-4 credits (3 credits required)**

**PHYS 481 - Mathematical Physics 3 credits**

**Electives (15-22 Credits)**

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## Appendix B- Undergraduate Research Projects

### Student Internships:

- Kyle Weis – Kennedy NASA Space Center - Summer 2007, Fall 2007
- Heather Specht - Representative Stephanie Herseth-Sandlin Office, Washington DC, Spring 2008
- Jenna Liliquist – Los Alamos National Laboratory, Summer 2008
- Dan Moore, Joel Maassen - Los Alamos National Laboratory, Summer 2009
- Joel Maassen - Los Alamos National Laboratory, Summer 2010
- Joel Maassen - Los Alamos National Laboratory, post bachelor internship, Spr/Fall 2011
- Steven Walders, Erica Zetterlund – Dakota State University, Geoneutrinos, Summer 2010
- Dylon Kiley, Galacia Barton – Black Hills State University, Summer 2011
- David Verhey – Princeton University, Summer 2012
- Alexander Kramer – Black Hills State University/ Sanford Underground Research Facility/Center for Theoretical Underground Physics, Summer 2014
- Clay Barton – Louisiana State University, Summer 2014

### Alexander Kramer:

In summer 2014 he had the opportunity to be involved in couple very exciting projects that are highly relevant to his physics major at Dakota State. For the first half of his summer break he worked at Black Hills State University along with a couple of undergraduates from that school to do "Acid Etching" of lead components that were to be used as detector shielding for the Majorana Demonstrator, an experiment in the SURF (Sanford Underground Research Facility) lab at the Homestake mine looking for so-called neutrino-less double-beta decays in germanium crystals. The hyper sensitive detectors used in the experiment require ultra-low background (ambient) radiation so that they can see the very faint signals of the types of radiation the physicists are hoping to detect. Building the experiment so deep underground removes much of this background radiation but the subterranean rocks are an additional source of radiation that while harmless to humans, far exceeds the acceptable thresholds for the purpose of the experiment. This is why a lead shield is used around the detector (along with several other shielding layers) however after the machining process of the lead components even the oxides and residues left of the surface is "hot" enough to be a problem. A full clean room was therefore set up at BHSU to provide a space where lead could be processed through acid baths in order to remove any surface contaminants. In addition to being able to clean the lead parts Alex needed to be able to assay (or analyze) the quality of the cleaned lead to determine its suitability for use in the experiment. In total nearly 10,000 components were processed resulting in hundreds of tons of lead, the process spanned multiple years and Alex's involvement only included the last 20% or so of the project through its completion.

After finishing with that project towards the middle of his break, Alex had a very different but equally valuable opportunity working with Dr. Szczerbinska and CETUP\* summer program which brings physicists from around the world together for a collaboration lasting a few weeks each summer. His role in CETUP\* was primarily logistical support to Dr. Szczerbinska handling much

of the transportation and working facilities for the group. He did however get plenty of exposure to an incredibly diverse group of professionals working on problems that are highly relevant to his own career path (neutrino physics) and this of course included invaluable networking connections with people at labs and universities worldwide.

### **Clay (CJ) Barton:**

Dakota State University junior, Clay Barton, a physical science major from Webster, S.D., was awarded a \$2,500 educational stipend from the NASA South Dakota Space Grant Consortium Management Team for the 2014-2015 school year. The purpose of the stipend was to reward past accomplishments and recognize potential future achievements in space exploration, scientific discovery and aeronautics research. To qualify for the scholarship, Clay must submitted a cover letter explaining how they plan to use the stipend to assist in their educational studies, and a career goal statement that describes their views of careers in the science, technology, engineering and mathematics (STEM) disciplines. Also, Dr. Barbara Szczerbinska, associate professor of physics and faculty advisor, submitted a letter of recommendation for Barton stating his qualifications for the scholarship.

As the link between NASA and the citizens of South Dakota, the Consortium's mission is to instill the spirit of exploration and discovery in students, educators, and the general public. It also promotes a special focus on the fields of science, technology, engineering, and mathematics that are essential for the development of the nation's work-force.

CJ also participated in the REU (Research Experiences for Undergraduates) in Physics & Astronomy Program at Louisiana State University in summer 2014 where he worked on the muon background analysis for the Long Baseline Neutrino Experiment. Only 10 students out of more than 300 applicants were accepted to the 10-week program. CJ presented a poster "Study of Cosmic Muons for the LBNE Prototype Detector" at the 2014 Student Research Conference in Glendale, AZ – fully supported by the NSF REU program. Second poster on Study of Stopped Cosmic Muons in the Long Baseline Neutrino Experiment – 25 Ton Liquid Argon Detector was presented at the 2<sup>nd</sup> Workshop on Germanium-Based Detectors and Techniques (Sept 14-17), USD, Vermillion, SD

The REU program introduced CJ to the nature of research-oriented careers in physics and astronomy, and fosters development of research-related skills and knowledge. All participants were matched with faculty mentors based on student interests. Weekly seminars, field trips and workshops provide students with additional skills development, professional development topics such as ethics and patents/intellectual property, and an introduction to common research resources.

After graduating from DSU in December 2014 CJ accepted a temporary position at Fermi National Laboratory near Chicago IL. There he is a research technician attached to the Muon g-2 particle physics experiment. His current position involves the study of vacuum fluctuations by studying particles travelling through a vacuum at nearly the speed of light. He also applied to Graduate School at the University of South Carolina.

## Appendix C – Faculty Vitas

**Michael Gaylor, Ph.D.**  
 College of Arts and Science  
 Dakota State University  
 Madison, SD 57042  
 605-256-5822  
[michael.gaylor@dsu.edu](mailto:michael.gaylor@dsu.edu)  
[www.michaelgaylor.com](http://www.michaelgaylor.com)

### Education

**Ph.D.** Marine Science (Environmental Chemistry and Ecotoxicology), College of William and Mary, 2010.

Dissertation: Bioavailability of Biosolid- and Consumer Product-Associated Polybrominated Diphenyl Ether Flame Retardants to Ecologically Distinct Invertebrates (advisor: Dr. Robert Hale).

**M.A.** Chemistry (Environmental Chemistry), The College of William and Mary. 1997.

Thesis: Development of Off-line Supercritical Fluid Extraction (SFE) for the Determination of Polychlorinated Biphenyl (PCB) Congeners in Biological Sample Matrices (advisor: Dr. Robert Hale).

**B.S.** Biology (Departmental Honors; Chemistry Minor), Christopher Newport University. 1990.

Thesis (Biology): Fate and Effects of Tributyl Tin (TBT) in the Marine Environment (advisor: Dr. Harold Cones).

Thesis (Chemistry): Photochemical and Microbial Degradation of Polycyclic Aromatic Hydrocarbons (PAH) in Estuarine Surface Microlayers (advisor: Dr. Ken Chang).

### Employment

- 2012 to present—Assistant Professor of Chemistry, Dakota State University
- 2010 to 2012—Assistant Professor of Chemistry and Environmental Science, Davis and Elkins College
- 2009 to 2010—Graduate Assistant, College of William and Mary
- 2005—Adjunct Chemistry Instructor, Medical Careers Institute
- 2005 to 2008—Adjunct Science Instructor, University Instructors
- 2003 to 2012—Scientific/Educational Consultant (Founder-Owner), Red Metric Enterprises LLC
- 2003 to 2004—Staff Scientist, College of William and Mary
- 1999 to 2003—Graduate Assistant, College of William and Mary
- January to August 1999—Staff Scientist, College of William and Mary
- 1998 to 1999—Chemical Engineer, SONY Technology Center
- 1991 to 1997—Staff Scientist, College of William and Mary

### **Recent Publications**

\*N.W. Fitch, \*K.L. Even and **M.O. Gaylor**. Prebiotic Synthesis of a Primitive Phospholipid from Reduced Phosphorus on the Primordial Earth: A Proposal. *BIOS*. In review.

**\*Undergraduate author**

**M.O. Gaylor**, E. Harvey and R.C. Hale. 2014. Systematic Investigation of Factors Controlling Supercritical Fluid Extraction (SFE) of Spiked and Aged PCBs from Edible Tissues of the Blue Crab (*Callinectes sapidus*). *Bull. Environ. Contam. Toxicol.* 94:23-28.

**M.O. Gaylor**, E. G. Mears, E. Harvey, M.J. La Guardia and R.C. Hale. 2014. Polybrominated Diphenyl Ether Accumulation in an Agricultural Soil Ecosystem Receiving Wastewater Sludge Amendments. *Environ. Sci. Technol.* 48:7034-7043.

**M.O. Gaylor**, E. Harvey and R.C. Hale. 2013. Polybrominated Diphenyl Ether (PBDE) Accumulation by Earthworms Exposed to Biosolids-, Polyurethane Foam Microparticle- and Penta-BDE-Amended Soils. *Environ. Sci. Technol.* 47:13831-13839.

\*N.W. Fitch and **M.O. Gaylor**. 2013. Does Individual Personality Type Influence Dietary Taste Preference Among South Dakota State University (SDSU) Students? *Proc. S. Dak. Acad. Sci.* 92:135-147.

**\*Undergraduate author**

**M.O. Gaylor**, E. Harvey and R.C. Hale. 2012. Crickets Can Accumulate Polybrominated Diphenyl Ethers (PBDEs) Directly from Polyurethane Foam Common in Consumer Products. *Chemosphere* 86:500-505.

### **Recent Grants**

Development of an Environmentally Benign (*Green*) Supercritical Fluid Extraction (SFE) Approach for Characterizing a Suite of Chemical Contaminants in Land-Applied Sewage Sludge Biosolids. **M.O. Gaylor (PI)**, \*G.M. Estridge (co-PI), \*L. Leinen (co-PI), \*T. Telkamp (co-PI). Submitted to the College of Arts and Science Faculty Research Grant Program, Dakota State University. Awarded: \$1000.

**\*Undergraduate author**

Characterization of Changes in Gut Microbial Community Structure in Soil Invertebrates Exposed to Pesticides and Contaminated Wastewater Residues Under Lab and Field Conditions. \*G.M. Estridge (PI), **M.O. Gaylor (co-PI)** and D. Hazelwood (co-PI). Submitted to the U.S. EPA Greater Research Opportunities (GRO) Environmental Undergraduate Fellowship Program. Awarded: \$50,000.

**\*Undergraduate author**

Coupling Novel Analytical and Information Technologies to Transform DSU's Traditional Chemistry Lab Curriculum to One Centered on Emerging Technologies and Green Inquiry-Based Pedagogical Techniques. **M.O. Gaylor (PI)** and \*J.L. Drake (co-PI). Submitted to the Technology Fellows Program, College of Business and Information Systems, Dakota State

University. Awarded \$5000 to support undergraduate Science and Technology Fellow for academic year 2014-2015.

**\*Undergraduate author**

Using The *Spe-ed SFE Prime* to Transform Dakota State University's Traditional Chemistry Lab Curriculum to One Centered on Green Chemistries and Guided Inquiry-Based Pedagogies. Submitted to Applied Separations Supercritical Fluids Education Grant Program. **M.O. Gaylor (PI)** and \*G.M. Estridge (co-PI). Awarded \$35,000 *Spe-ed SFE Prime* educational instrumentation package.

**\*Undergraduate author**

The STEM Institute: A Proposed Interdisciplinary Program for Maximizing Student Recruitment and Retention in STEM Majors at Dakota State University. B. Szczerbinska (PI), **M.O. Gaylor (co-PI)**, G. Berman (co-PI), D. Dittman (co-PI), D. Droge (co-PI), D. Hazelwood (co-PI), J. Nash (co-PI), C. Noteboom (co-PI), A. Podhradsky (co-PI) and K. Smith (co-PI). Submitted to the NASA South Dakota Space Grant Consortium. Awarded \$10,000.

Characterizing the Risks of Human Exposure to Chemical Additives in High-Volume/High-Contact Consumer Products: An Analysis of Bisphenol-A (BPA) and Phthalate Plasticizer Levels in Plastic Jewelry and Cash Register Receipts. \*Michele Rogers (PI) and **M.O. Gaylor (co-PI)**. Submitted to the DSU Student Research Initiative (SRI). Awarded \$500.

**\*Undergraduate author**

Characterizing Gut Microbiota Community Changes in Cohabitant House Crickets (*Acheta domesticus*) in Contact With Consumer Products Containing Hazardous Chemical Additives. \*G.M. Estridge (PI), **M.O. Gaylor (co-PI)** and D. Hazelwood (co-PI). Submitted to the DSU Student Research Initiative (SRI). Awarded \$500.

**\*Undergraduate author**

Do Invasive Insects Accumulate Toxic Flame Retardant Additives in the Course of their Incursions into a Human Dwelling in Madison South Dakota? **M.O. Gaylor (PI)** and \*G.M. Estridge (co-PI). Submitted to the Dean's Office of the College of Arts and Science, Dakota State University. Awarded \$1,000.

**\*Undergraduate author**

A Proposal for New Analytical Instrumentation to Support Undergraduate Environmental, Atmospheric and Origin of Life Chemistry Research Initiatives at DSU. **M.O. Gaylor (PI)** and \*G.M. Estridge (co-PI). Submitted to the Dean's Office of the College of Arts and Sciences, Dakota State University. Awarded \$50,000 for purchase of new GC-MS instrument.

**\*Undergraduate author**

### **Recent Presentations**

Student-Centered Supercritical Fluid Extraction (SFE) and Green Chemistry Research Initiatives at Dakota State University. **M.O. Gaylor**. Department of Chemistry Graduate Student Orientation Seminar, South Dakota State University, August 8, 2014.

Polybrominated Diphenyl Ether (PBDE) Accumulation in an Agricultural Soil Ecosystem Receiving Long-Term Wastewater Sludge Amendments. 2014. **M.O. Gaylor**, G. L. Mears, E. Harvey, M.J. La Guardia, \*K.L. Even and R.C. Hale. Society of Environmental Toxicology and Chemistry (SETAC) North America National Meeting, Vancouver BC, Canada.

**\*Undergraduate author**

Utility of Biomimetic Passive Sampling Devices for Estimating Brominated Flame Retardant Bioavailability in Sewage Sludge Intended for Land Application. 2013. \*K.L. Even, **M.O. Gaylor** and R.C. Hale. South Dakota Academy of Science Annual Meeting, Sioux Falls, SD.

**\*Undergraduate author**

Does Individual Personality Type Influence Dietary Taste Preference in College Students? 2013. \*N.W. Fitch and **M.O. Gaylor**. South Dakota Academy of Science Annual Meeting, Sioux Falls, SD.

**\*Undergraduate author**

### **Recent Invited Peer Review**

- Chemosphere
- Ecological Indicators
- Ecotoxicology and Environmental Safety
- Environmental Pollution
- Environmental Science and Pollution Research
- Environmental Science and Technology
- Environmental Toxicology and Chemistry
- Science of the Total Environment

### **Recent Accolades**

- Supercritical Fluids/Green Chemistry Teaching Award, American Chemical Society (ACS) 18<sup>th</sup> Annual Green Chemistry & Engineering Conference, Bethesda MD, June 2014.
- Continuous Quality Improvement (CQI) Program award for curriculum innovation within the new Arts and Sciences Honors Program at Dakota State University. Spring 2014.
- Continuous Quality Improvement (CQI) Program award for design and implementation of a new Arts and Sciences Honors Program at Dakota State University. Spring 2013.

### **Recent Affiliations**

- American Chemical Society (ACS)
- Society of Environmental Toxicology and Chemistry (SETAC)
- South Dakota Tunable Solvents Research Network
- South Dakota Academy of Science

## Barbara Szczerbinska

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 Dakota State University  
 Madison, SD 57042  
 Telephone: 605-256 5183  
[barbara.szczerbinska@dsu.edu](mailto:barbara.szczerbinska@dsu.edu)

### Education

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1999 – 2006	University of South Carolina, - PhD Theoretical Nuclear Physics
1998 – 1999	The Institute of Nuclear Physics, Krakow, Poland
1992 – 1998	University of Wroclaw, Wroclaw, Poland – M.S. Theoretical Physics

### Employment

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2006 – present	Dakota State University
1998 – 1999	The Institute of Nuclear Physics, Krakow, Poland

### Activities and Affiliations

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2005 - present	Member, South Carolina Academy of Science
2002 - present	Member, American Association of Physics Teachers
2001 – 2003	Vice President, Physics Graduate Student Association
1994 – 1997	Organizer, Winter Schools of Theoretical Physics for Students (in affiliation with the Department of Theoretical Physics), University of Wroclaw
1993 – 1997	President, Theoretical Physics Student Association, University of Wroclaw

### Publications

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2007	“Dynamical model of electroweak pion production in the resonance region”, T.Sato, B.Szczerbinska, K.Kubodera and T.-S.H.Lee, nucl-th/0601069, submitted for the publication at <i>Physics Letters B</i>
2006	“Neutrino-nucleus reaction in delta resonance region”, B.Szczerbinska, K.Kubodera, T.Sato Nucl. Phys. B, Proc. Suppl. 159 (2006), 141-146



- 2002 “Hadrons and Quark-Gluon Plasma”, Rafelski, J. and Letessier, J.;  
corrections and editing under the advisement of J. Rafelski
- 2000 “Chiral Restoration in Effective Quark Models with Non-Local  
Interactions”, B.Szczerbinska, W.Broniowski,  
Acta Phys. Polon. B31 835-845

### Recent Presentations

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- March 2006 “Neutrino-nucleus reactions relevant to the atmospheric neutrino and  
K2K experiments” – South Carolina Academy of Science, Columbia
- June 2003 “Neutrino Oscillations” - HUGS Summer School, Jefferson  
Laboratory
- May 2003 “The Bag Model & Axial Coupling Constant” - Nuclear Physics  
Group Seminar, Columbia
- March 2003 “Chiral Symmetry” - Nuclear Physics Group Seminar, Columbia

### Recent Conferences and Workshops

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- February 2007 Homestake Mine – collaboration meeting between physicists from South  
Dakota and Argonne National Laboratory
- March 2006 South Carolina Academy of Science, 2006 Annual Meeting
- December 2005 Nuclear Effects in Neutrino Interactions – 20<sup>th</sup> Max Born Symposium
- October 2005 Theoretical Problem in Fundamental Neutron Physics Workshop
- April 2004 Carolina Neutrino Workshop
- June 2003 HUGS Summer School at Jefferson Laboratory
- March 2000 Carolina Symposium on Neutrino Physics
- May 1999 Zakopane Conference on Nuclear Physics
- 1993 – 1998 Series of Winter Schools of Theoretical Physics, Uni. of Wroclaw

### **Work in Progress**

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“Neutrino-Nucleus Reactions relevant to the atmospheric neutrino and K2K experiments” in close collaboration with Professor Kuniharu Kubodera; University of South Carolina, Columbia SC, Professor Toru Sato; Osaka University, Japan and Professor T.-S. H. Lee; Argonne National Laboratory.

In our research we focus on the quasi-elastic neutrino nucleus reactions, which play important roles in the atmospheric and solar neutrino oscillation experiments. Their description involves various nuclear effects like final state interactions, initial binding effects, etc. To interpret the experimental results we need to find a reliable model describing those effects. As the first step towards this goal we concentrate on the Fermi gas model, which provides a simple description of the neutrino-nucleus reactions. We include the Fermi motion, Pauli blocking and the effects of the initial nucleon binding energy. We compare our results with those obtained with the use of a realistic spectral function. We also compare our calculations with the experimental data for carbon and oxygen.

## Appendix D:

### Chemistry Lab Equipment

Item	Quantity
Vernier shared equipment, including data collectors, pH electrodes, ion selective probes, temperature probes, pressure probes, colorimeters and supporting software	10
Digital Balance with 0.1 g accuracy	4
Digital Balance with 0.01 g accuracy	4
Analytical Balance with 0.0001 g accuracy	1
GC-MS (electron impact only)	1
Supercritical fluid extractors	2
Water circulator (antiquated-needs replacing)	1
Oven (antiquated-needs replacing)	1
Furnace (antiquated-needs replacing)	1
UV/Vis spectrophotometer	1
FTIR Spectrophotometer (function status unknown)	1

### Physics Lab Equipment

Item	Quantity
Pasco 750 Interfaces	8
Pasco 850 Interfaces	8
Fujitsu laptops	8
Optics benches	8
Multimeters	10
Photogates	
1m, 2m tracks	
Variety of sensors: force, charge, voltage, rotary motion, light	

Equipment in the lab was updated over last two years to support experiments conducted in general physics labs – examples:

Mechanics/thermal physics labs:

- Force table
- Free fall (free fall apparatus, photogates)

- Static and kinetic friction (tracks, blocks, balances, weights)
- Simple pendulum (timers, photogates, pendulum apparatus)
- Projectile motion (pendulum, projectile motion apparatus, photogates)
- 2<sup>nd</sup> Newton's law (tracks, carts, photogates, weights, balances)
- Uniform circular motion (centripetal force apparatus)
- Archimedes principle (beakers, scales, overflow cans, graduated cylinders)
- Speed of sound (tubes, tuning forks)
- Rotational inertia (rotary motion sensors, rotational accessories, mass sets, calipers, balances)
- Vibrating string (PASCO vibrator, weights, scales)

Electricity/Magnetism/Optics labs:

- Electrostatic Charge (Faraday's ice pail, charge producers, charge sensors)
- Ohm's Law (electronic boards)
- RC circuit (electronic boards, voltage sensors, LCR meters)
- LRC circuit (electronic boards, voltage sensors, LCR meters)
- Resistors in parallel and series (electronic boards)
- Induction (electronic boards, voltage sensors, magnets)
- Transformer (voltage sensor, primary/secondary coils)
- Light intensity in double-slit and single-slit diffraction pattern (optics systems, diode lasers, light sensors, rotary motion sensors, aperture brackets, linear translator, slit accessory)
- Light intensity versus position (optics system, aperture brackets, light and rotary motion sensors)
- Polarization (optics system, aperture bracket, polarization analyzer, light and rotary motion sensors)