

**Reviewer's Report for the
Program of Physical Sciences
College of Arts and Sciences
Dakota State University**

Date of on-site visit: Tuesday, April 21, 2015

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Part 1: Executive Summary of Findings

The Physical Science program at Dakota State University is a unique program combining chemistry, physics and mathematics in a computer-integrated curriculum. This is a small program at DSU, but other majors take courses within the program. Most of the graduates of the program have been very successful, either continuing on to graduate school or placed in a job related to their major.

The Physical Science program is run by two very competent and hard-working faculty members, whose dedication to their students should be applauded. They often teach heavy loads, including laboratories and directed studies and also are actively involved in undergraduate research. They luckily work in a newly renovated building with easy access to technology. The physics laboratory and general chemistry laboratory seem well suited for teaching and laboratory studies, however, the organic chemistry laboratory may need to be redesigned. Also, additional space for undergraduate research should be found. Lab fee funds help in keeping the laboratories equipped with supplies, but may not be adequate for big-ticket items.

There are a variety of assessment measures used by the faculty to assess both the Physical Science program and overall student satisfaction and these are administered routinely. The assessment plans have provided insights in the past that have led to positive changes in the program.

The low enrollment in the program can be a curse and a blessing. The one-on-one collaboration is a positive quality of the program as mentioned by students and could be used as a recruiting incentive. Possible ways to increase enrollment are outlined below and include increasing the collaboration between Black Hills State University or even start a collaboration with Earth Science and Physics departments at the University of South Dakota. Another suggestion would be to increase the university's pre-professional programs similar to the Rural Health Opportunities Program (RHOP) in Nebraska.

Part 2: Schedule of On-Site Visit

9:00 – 09:30 AM	Dr. Judy Dittman, Academic Vice President, Heston Hall 314
9:30 – 10:00 AM	Assessment – Kristy Ullom, Interim Director of OIEA, Heston Hall
10:00 -10:30 AM	Benjamin F Jones, Dean of College of Arts and Sciences, Beadle Hall 114
10:30 – 11:00 AM	Risë Smith, Karl Mundt Library
11:00 – 12:00 PM	Barbara Szczerbinska, Physics Faculty, SC 146C
12:00 – 1:00 PM	Lunch, Marketplace

1:00 – 2:00 PM	Michael Gaylor, Chemistry Faculty, SC 146H
2:00 – 2:30 PM	Physical Science Students, SC 132
2:30 - 3:00 PM	Game Design Students, SC 132
3:00 – 3:30 PM	Dale Droge, Math and Science Coordinator 146D, Tour facilities SC 146D
3:30 – 4:00 PM	Other interviews if desired, preparation time
4:00 – 5:00 PM	Exit Interview with Dr. Dittman, VPAA and Benjamin Jones Dean College of Arts and Sciences, Dale Droge Math and Science Coordinator, SC 132

Part 3: Program Evaluation

Program Goals and Strategic Planning

Goals of the Physical Science program are four-fold and tie in effectively with the institutional mission, being a technology-based program. Students will: 1) have a basic knowledge of chemistry, physics and physical science, 2) use their knowledge to solve problems, 3) have a high degree of proficiency in computer technology, and 4) be able to communicate. Several of these goals are accomplished by students participating in undergraduate research projects. Based on discussions with both the faculty and the students and as evidenced by internship placement and graduate school placement, it is evident that these goals are being met. While this program is unique, students that graduate seem very successful.

As outlined below, courses within the Physical Science program are utilized by other programs across DSU from biology to computer programming. Also, many of the course offerings can be used to fulfill general education requirements. Therefore, the courses within this program and the program itself contribute positively to DSU's mission.

Program Resources

Faculty

There are two faculty members that offer the bulk of the courses within the Physical Science Program. Both faculty members hold PhD degrees in their area, one in Physics and one in Environmental Chemistry. The two faculty within the program are extremely hardworking, including taking on directed studies, student research projects, and science outreach as well as conducting their own scientific research. In other larger science departments it is common to have more than one faculty member per subject area, for example an organic chemist, a physical chemist, a biochemist, an inorganic chemist, and maybe even an analytical chemist. This broadens the expertise in the department, and ultimately benefits the students by exposing them to other professors with different backgrounds and experiences. Also, additional faculty would help spread the load of laboratory sections and upper level courses. Even a lecturer with a Master's degree may be able to facilitate with the laboratory load and increase the knowledge base of the faculty.

It was pointed out in the Self-Study report that there is a need for a dedicated lab technician or lab manager. There is a lab manager as part of the department, but through discussions with the faculty, this person is more comfortable working with biology labs as opposed to chemistry labs. Setting up and tearing down the laboratory is time intensive. The program has been utilizing willing students to facilitate in this role and while this is a unique educational experience for them, it still uses up large amounts of the faculty time.

The low student-to-faculty ratio has many advantages, including recruitment of students. Faculty are accessible to students and get to know their students on a personal level. But, the low student enrollment in the program means that the students themselves have few peers. Those students that were spoken to did not seem to mind, but they also did not know any other way. The low ratio also meant that each student in the program was working one-on-one with a faculty on a research project (or would be in the future). This advantage results in a large proportion of students attending graduate school (or seeking to attend), publishing papers, attending REUs (Research Experience for Undergraduates), and working in research facilities.

Classroom Facilities

The Science Center was remodeled in 2010 and the new facility offers updated classrooms, laboratory space, conference rooms, and faculty offices. The building and rooms were inviting and conducive to learning science with electrical outlets everywhere as well as LCD projectors. The rooms were designed in a way to be multi-functional, especially the open conference rooms. There is easy access to the network.

Laboratory Facilities and Equipment

There are three laboratory rooms designated for the Physical Science program, one physics laboratory and two chemistry laboratories (general chemistry laboratory and an organic chemistry laboratory). There are also attached storage spaces. The physics laboratory and storage space is well utilized with multiple worktables, dry-erase board configurations and plenty of storage. There are a few problems with the chemistry spaces, including a few design defects. One such design issue was in the organic chemistry lab. There are only a few hoods (5 total), definitely not enough hoods for a good hood/student ratio. At Wayne State College there is one hood per student in our organic chemistry laboratories and the laboratories typically have twelve students. This is mainly for safety.

The faculty are actively involved in undergraduate research, but there is not a designated space for them to perform this research. Instead, research must be conducted in classroom laboratories when class is not in session. This may be an area of improvement in the future.

In terms of equipment, there are always needs and repairs. If the chemistry part of the program is going to expand, they are in need of analytical equipment. The physics laboratory equipment was updated in the last two years.

Financial Support

There are lab fee funds, shared with Biology, which can be used for supplies and low-cost equipment. The main financial concerns would be funding big-ticket equipment, which may be dependent on successful outside support (i.e. NSF and other granting agencies).

Program Curriculum

The Bachelor of Science in Physical Science is a rather unique program with students required to take foundation courses in chemistry, physics, and mathematics (total of 30-31 credit hours), upper level physical science courses of their choosing (chemistry or physics; 18-24 credit hours), and upper level computer science courses (9 credit hours). An undergraduate research project is included within the foundational courses. Additional free electives are required to make 120 credit hours and most students choose to take additional science electives (15-22 credit hours). Students take a larger number of mathematics courses compared to other science programs. This is an advantage for the DSU program because many students, even science students, do not always have a strong mathematical background.

Several of the 100-200 level courses (and some 300 level courses) offered by the Physical Science program serve the needs of other programs on campus. Eight courses offered through the Physical Science program also meet Goal 6: Natural Sciences of the General Education Program. These courses include a survey course in chemistry, general chemistry I and II, organic and biochemistry, introduction to physics I and II, and university physics I and II. Many of these courses are required by other majors including Biology, Exercise Science, Computer Game Design as well as other courses within the Physical Science program. Students in other majors may elect to include a minor in either chemistry or physics.

Technology Integration

Students utilize their laptop computers in both the chemistry and physics classrooms and laboratories. Laboratory experiments and exercises make use of Pasco and Vernier probes and other data collection equipment that connect to students' laptops where the data can then be analyzed. Desire2Learn is used as a course management site for all courses with the program. Students also have access to computational and modeling programs such as Maple and Stella via network servers.

Program Assessment

There are a variety of measurement tools used to assess the Physical Science program including both direct and indirect measures. Students have been taking the Major Field Assessment Test (MFAT), a nationally recognized standardized test, since 1998. As noted in the Self-Study, students either take the chemistry MFAT or the physics MFAT, but each exam includes subject areas in which they have not had courses in, since the Physical Science Program contains courses within both disciplines. This may have caused the outcome of only one-third of DSU students scoring within one standard deviation of the national user norm as pointed out in the Self-Study report. Several surveys are also used including employer and graduate surveys, but the lower number of students and low return rate make the data statistically unreliable. In recent years, formal exit interviews have not been performed according to discussions with faculty. This is mostly due to the close nature of the students and faculty. Program changes have been made, as outlined in the Self-Study, as a result of assessment practices. These program changes, including trying to offer upper level courses more regularly, developing new courses, and modifying existing courses, should have a positive impact on the program.

DSU conducts additional assessment through several surveys including the National Survey of Student Engagement (NSSE). This particular survey is used to gauge the students' satisfaction with programs and services across campus. Results are presented to all faculty. Additionally, students evaluate teaching and learning via IDEA Ratings of Instruction Survey every semester for each class.

Student Support/Student Enrollments

Students graduating within the Physical Science program have had a successful time seeking graduate school or placement in a job related to their major. The Self-Study indicated that 90% of the graduates have found placement since 2010. Since 2008/2009 there have been a total of eleven graduates. Students have found employment through Los Alamos National Laboratories and Fermi Lab. These are impressive, highly competitive places for students with only a bachelor's degree.

Student enrollment in the program has wavered a bit since 2007 with as many as twelve students enrolled in the spring of 2009, to two students in the spring of 2011. Currently the enrollment as of the fall of 2014 is four. While this is small, the students interviewed liked the one-on-one interaction that a small program offers. Students all have an equal advantage and are able to perform more time-intensive undergraduate research projects. The individualized attention is exemplified in the

number of students that have been accepted into summer research opportunities, including REUs, into graduate schools, and into national laboratories. Students are also presenting their research at regional and national meetings and publishing their findings.

Low enrollments do mean that upper level courses are more challenging to offer. These courses often become directed studies, which put an additional burden on the faculty, who teach these intensive upper level courses on top of their normal load. Students commented that the faculty are always busy due to their workload (normal class load and directed studies plus undergraduate research).

Many of the students interviewed did not start out with the Physical Science program, but found their way to Physical Sciences via the introductory courses. Most started out in with a computer programming emphasis.

Program Strengths and Areas for Improvement

One of the major strengths of this program is the dedicated faculty that are involved in it. Both Dr. Szczerbinska and Dr. Gaylor seem to work tirelessly. They are both active teachers and active researchers in their field. They have dedicated large amounts of time to their students as exemplified in the students' accomplishments. As mentioned earlier, several students have taken part in REU experiences and other summer research projects. Most of the students that graduate are applying to or are accepted to graduate school. Students have been involved in writing grant proposals, co-authored publications, and co-authored presentations. It would be easy for these faculty members to become absorbed in their teaching load, but they know that teaching does not only happen in the classroom. While student research is dependent on the students involved, a dedicated faculty member plays an incredibly key role. The one-on-one collaboration between student and faculty is the one major advantage of a small program.

That being said, one area of improvement would be to attempt to increase enrollment in the program. The accomplishments of the current students and alumni should help attract more students to the program if their achievements are hailed. Some potential ways to recruit students to the program or at least to increase the number in upper level courses are outlined below.

Specific Issues Identified by the University

One of the main issues identified was recruitment of new students to the program. See comments below.

Part 4: Recommendations for Change

Based on the discussions I had with faculty, students, the dean, and the VPAA, the following are recommendations to increase enrollment:

One would be to increase the ties between the programs at Dakota State and Black Hills State. A discussion of a collaboration with BHSU was indicated in the Self-Study report, but could be further expanded. Both science programs are small with few faculty, but revising the curriculum to include common courses shared by both universities, in a sense the program would increase in size. Courses could be taught online or via Skype sessions. Field trips could be combined to co-mingle the students, including trips to the Sanford Underground Research Facility. Another connection could be to faculty in the Earth Science or Physics programs at the University of South Dakota. There are only three tenured faculty in Earth Science and they may benefit from a connection. The Physics program is also in a state of growth and could potentially provide additional student opportunities and faculty collaboration.

Another possible suggestion is to increase the enrollment in lower level courses by increasing the enrollment in pre-professional programs (if possible). Wayne State College and the two other

Nebraska State Colleges are involved in a cooperative program with the University of Nebraska Medical Center (UNMC). The program is called the Rural Health Opportunities Program or RHOP and is tasked in recruiting and educating students from rural Nebraska. There are restrictions from where these students reside from and they must make a commitment to return to the rural setting to practice their profession. Students in the RHOP program receive a tuition waiver for their initial undergraduate education and are guaranteed admissions to UNMC. There are various RHOP programs with different positions available and expected times at either the colleges or UNMC until graduation (see <http://www.wsc.edu/rhop/programs.php> for more information; some programs only spend 2-3 years at the colleges before moving to UNMC). RHOP programs include: clinical lab science, dental hygiene, dentistry, medicine, nursing, pharmacy, physical therapy, physician assistant, and radiography. The RHOP students are then enrolled in either WSC's the Health Sciences Concentration through Biology or through Chemistry. Both programs include a variety of physics and chemistry courses including general chemistry I and II, physics I and II, organic chemistry I and II, biochemistry I, and a choice of chemistry electives. Students in WSC RHOP program are generally the top of their classes and come to WSC because of the small feel of campus and the more one-on-one interactions with faculty. Other students, not in the RHOP program, come to WSC in part because they know that there is a proven link between WSC and UNMC. The program has a positive impact on student recruitment.

Another suggestion would be for faculty and the administration to explore the idea of hiring a laboratory manager/instructor. This person would free up time for the faculty, but would also provide another resource in the program for the majors.