

# **VIRGINIA COMMONWEALTH UNIVERSITY B.S. IN SCIENCE DEGREE PROGRAM**

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## **Abstract**

The initiation of the Virginia Commonwealth University B.S. in Science program was reported in this journal Fall 1999 as a program designed to meet the academic content major of a teacher preparation program for elementary and middle school mathematics and science teachers [1]. This paper reports the current status of the interdisciplinary B.S. in Science degree program including program enrollment data and trends. Also described are refinements in the required curriculum, which include a newly developed geometry, a mathematical computing course, and an emerging teaching technology course featuring graphing calculators, CBLs, and computer software applications.

## **Program Description at Virginia Commonwealth University**

The B.S. in Science degree program at Virginia Commonwealth University (VCU) was structured to meet the new licensure requirements for elementary and middle school teachers which were adopted by the Virginia Department of Education in 2001 [2]. The purpose of this interdisciplinary mathematics and science program is to provide students with a broad, yet fundamental, grounding in the sciences. The B.S. in Science degree program is interdisciplinary breadth in mathematics and science training without including theoretical senior level/graduate level discipline courses in mathematics and science, which are structured as foundations for M. S. degree programs in the discipline. The program features strong courses, extending through a calculus course, a modeling course, and a linear algebra course in mathematics, as well as science courses in oceanography, meteorology, climatology, and ecology. Introductory courses in biology, chemistry, and physics are also included. The aforementioned courses are also components of VCU's B.S. degree programs in engineering, mathematics, statistics, and the sciences. Some National Science Foundation (NSF) scholarships, including those offered to students with a financial need through the Computer Science, Engineering, and Mathematics Scholarships (CSEMS), support the program.

### Program Outline

The outline of the program is given below.

<b>Core Courses for Mathematics or General Science Tracks</b>	<b>Credits</b>
<i>BIOL 101 - Life Science, OR BIOL 102 - Science of Heredity, OR BIOL 103 - Environmental Science, OR BIOL 151 - Intro to Biological Science, with labs</i>	4 – 5
<i>CHEM 101 - General Chemistry, OR CHEM 110 - Chemistry and Society, with labs</i>	4 – 5
<i>PHYS 101, L101 - Foundations of Physics, OR PHYS 107 - Wonders of Technology, OR PHYS 201 - General Physics, with lab OR PHYS 207 - University Physics, with lab</i>	4 – 5
<i>INSC 300 - Experiencing Science (Science Museum of Virginia)</i>	3
<i>INSC 301 - Interdisciplinary Math and Science</i>	3
<i>MATH 151 - Pre-Calculus</i>	4
<i>MATH 200 - Calculus I</i>	4
<i>STAT 208 - Statistical Thinking, OR STAT 210 - Basic Practice of Statistics</i>	3
	<b>29 – 32</b>

<b>Additional Courses in General Science Track</b>	<b>Credits</b>
<i>BIOL 315/ENS 314 - Man and Environment, or BIO 331/ENVS 330 - Environmental Pollution, or BIOL 317 - Ecology</i>	3
<i>ENVS/GEO 401 - Meteorology and Climatology</i>	3
<i>ENVS/GEO 411 - Oceanography</i>	3
<i>PHYS 103 and L103 - Astronomy</i>	4
<i>PHYS 105 and L105 - Physical Geology</i>	4
Second Introductory course in Biology, Physics, and Chemistry, with laboratories	12-15
Two additional courses at the 200-level or higher in mathematics, science, teaching mathematics and/or science	6
	<b>35-38</b>

<b>Additional Courses in Mathematics Track</b>	<b>Credits</b>
<i>MATH 255 - Mathematical Computing or CMSC 255 - Structured Programming</i>	3
<i>MATH 492 - Using Graphing Calculators and CBLs in Teaching Mathematics and Statistics Topics</i>	3
<i>MATH 131 - Contemporary Mathematics</i>	3
<i>MATH 211 - Mathematical Structures</i>	3
<i>MATH 303 - Geometry</i>	3
<i>MATH 310 - Linear Algebra</i>	3
<i>MATH 317 - Mathematical Modeling</i>	3
<i>MATH 351 - Applied Abstract Algebra</i>	3
Two additional courses at the 200-level or higher in mathematics, science, teaching mathematics and/or science.	6
	<b>30</b>

Many of the courses in this program were developed and/or refined under a grant to the Virginia Collaborative for Excellence in the Preparation of Teachers (VCEPT), through the Division of Undergraduate Education at the NSF. All of these courses feature participatory, hands-on, discovery oriented learning. These courses were developed by teams of college faculty and practicing teachers, and were initially tested in team teaching efforts involving faculty from several VCEPT institutions. Some of these courses, including *Geometry*, *Linear Algebra*, *Wonders of Technology*, and *Experiencing Science*, were extended to graduate level offerings in the NSF-sponsored GK-12 Program. Through this program, twenty-four middle school teachers earned interdisciplinary mathematics and science master's degrees from VCU in a cooperative program with the University of Virginia (UVA) [3].

### **Program Highlights**

The *Experiencing Science (INSC 300)* course was developed with VCEPT support in conjunction with the Science Museum of Virginia [3]. Offered at the Science Museum, this course takes advantage of the exhibits and experimental apparatus available there. Course prerequisites include four credits in biology, four credits in physical science, three credits in mathematics, and three credits in statistics. Instructor David Hagan and other VCU and Science Museum staff lead students in the study of the methods and processes used by scientists in investigations. This course features guided, active replications of great discoveries in major scientific disciplines in physical science, life science, and earth science.

The initial development of the *Investigations in Geometry (MATH 303)* course was done under the leadership of Loren Pitt at UVA [4]. Aimee Ellington has refined and adapted this course at VCU for the B.S. in Science program. The *Contemporary Mathematics (MATH 131)* course and three credits in statistics are course prerequisites. The course features a study of topics in Euclidean geometry including congruence, similarity, measurement, coordinate geometry, symmetry, and transformation in both two and three dimensions. These topics are investigated using manipulatives and computer software.

The *Investigatory Mathematics and Science (INSC 301)* course was based on a VCEPT course developed by Dr. Phillip McNeil at Norfolk State University and team-taught by Dr. William Haver, VCU Department of Mathematics, and Dr. Joseph Chinnici, VCU Department of Biology. Course prerequisites are identical to those for *INSC 300* described above. In this course, students investigate real-world science problems, formulate model solutions to the problems, produce project reports, and present their solutions to the class. Problems are selected from areas including water quality, epidemics and spread of diseases, heat loss and gain, genetics, and drugs in the body.

## **Conclusion**

All of these courses have been highly acclaimed by VCU students. Enrollments at a maximum capacity of thirty-five to forty have prompted a demand for multiple section offerings.

At a glance, the total number of credits required for the B.S. in Science degree seem somewhat excessive. However, a careful inspection reveals that the credit requirements are comparable to: the B.S. in Mathematical Sciences which requires forty-one credits, plus sixteen additional credits in physical and life sciences; and, the B.S. in Biology which requires forty credits, plus thirteen credits in mathematics and statistics, plus eight credits in physics.

We are optimistic that the B.S. in Science degree curriculum will lead to a significant increase in the number of middle school mathematics and science teachers who complete their studies at VCU. There are currently twelve upper-division majors in the Math Track and eighteen in the General Science Track. Another promising indicator is that the Spring 2004 enrollment in

the *Teaching Middle School Mathematics* course is twenty-one, compared with an enrollment of nine for Spring 2003. ■

### References

- [1] R.W. Farley, "Virginia Commonwealth University's Program for K-6 and 6-8 Teachers: The Interdisciplinary B.S. in Science," *The Journal of Mathematics and Science: Collaborative Explorations*, 2(2) (1999) 13-18.
- [2] *Virginia Licensure Regulations for School Personnel*, Virginia Department of Education, Richmond, VA. Internet: <http://www.pen.k12.va.us/VDOE/Compliance/TeacherEd/nulicvr.pdf>
- [3] D.L. Neely-Fisher and D.B. Hagan, "Experiencing Science, An Introduction to 'Real' Methods of Science for the Pre-Service Teacher," *The Journal of Mathematics and Science: Collaborative Explorations*, 2(2) (1999) 159-163.
- [4] L.D. Pitt, "Informal Geometry in the Preparation of Teachers: A New Mathematics Course at the University of Virginia," *The Journal of Mathematics and Science: Collaborative Explorations*, 2(2) (1999) 117-120.