

**Virginia Tech Degree Proposal**  
**Bachelor of Science Systems Biology**  
**(CIP: 26.1104)**

**Type of degree action (circle one):**  New  Spinoff  Revision  Discontinuance

**Program description**

Virginia Tech seeks approval for a new B.S. Systems Biology degree, with the anticipated initiation date of Fall, 2015. A “systems approach” to biology involves the study of the biological, chemical, and physical processes within living organisms interacting in complex ways to produce life-supporting behaviors that are not trivially reducible to the properties of the individual components. Systems-level thinking has a long and distinguished history in biology (think “organ systems” and “ecosystems”), but it has only recently permeated the field of molecular cell biology, where reductionist approaches have reigned supreme from the discovery of the structure of DNA in 1953 until the complete sequencing of the human genome in 2000. The proposed B.S. degree in Systems Biology at Virginia Tech will focus on molecular systems biology, i.e., on quantitative, computational, systems-level approaches that connect the biochemical and genetic properties of macromolecules (DNA, RNA, protein, lipids, polysaccharides) with the physiological behavior of living cells and tissues. We focus at these levels of biological organization because the gap between interacting macromolecules and cell physiology is an active area of current research and a promising area for technological and biomedical innovations. Systems-level thinking at higher levels of biological organization is already covered at VT and other Virginia institutions by programs in organismal physiology, neuroscience, ecology, and natural resources. The molecular/cell divide is the gap we intend to fill with this program of study that will train undergraduates from Virginia and other states for employment or graduate education in the burgeoning field of molecular systems biology.

A successful undergraduate program in molecular systems biology must cover two distinct and complementary areas: bioinformatics and mathematical modeling. The genomics revolution has created many new and exciting ways to collect data on the scale of the entire genome. These new technologies create vast quantities of data that can only be handled, analyzed and interpreted with the help of concepts, algorithms and software tools from the field of biological informatics. The next step is to use this curated information about molecules and biochemical interactions to understand how cells move around, feed, grow, divide, differentiate and eventually die, which is the domain of mathematical modeling. At Virginia Tech we have world-renowned research scientists in both areas of bioinformatics and network modeling. Building on their expertise, our undergraduate degree program will train students in all aspects of molecular system biology, preparing them to unravel the molecular basis of cell and tissue physiology.

In addition to novel integration of concepts and skill sets from biology, chemistry, physics, mathematics, statistics and computer science, the degree in systems biology will rely heavily on new methods of pedagogy (active learning) and will be capped off by a significant research experience in the senior year.

**Curriculum summary**

Students may enter the degree by two routes. By the “traditional” route, students must pass a series of introductory science courses equivalent to: principles of biology (8 cr), general chemistry (8 cr), general physics (8 cr), calculus and linear algebra (10 cr), statistics (3 cr) and computer science (3 cr). The “alternative” route is by the Integrated Science Course (ISC), a new series of four 8-credit courses taken during the first and second years of residency. Conducive to the goals of the systems biology degree, the ISC will provide students with basic knowledge and skills in the physical, life and mathematical sciences in an integrative, multi-disciplinary environment.

Regardless of their route of entry, students in the systems biology degree must take an 8-credit course “Introduction to Systems Biology” in year two. This course will expose students to systems-level thinking, fill in gaps in their preparation, and get them excited about a career in systems biology. Building on this foundation, the core courses of year three (“Systems Biology of Genes and Proteins” and “Network Dynamics and Cell Physiology”) will focus on functional genomics, proteomics, bioinformatics, metabolic control, signal transduction networks, dynamic modeling, experimental verification, human diseases and drug development. These courses will prepare students for a research experience in year four.

The “Research Experience in Systems Biology” (8 cr) will involve every degree student in undergraduate research, in the laboratory of an affiliated faculty member. In parallel, every major will take a course in “Professionalism in Systems Biology” (4 cr), which will include instruction in research practice and ethics, in writing and presentation skills, in grantsmanship, and in the critical give-and-take of team science. The climax of these courses will be a “capstone thesis” to be submitted one month before graduation.

The curriculum will be presented in creative ways that emphasize active learning, mastery of diverse ideas and skills, integration of ideas, problem solving and teamwork. Each of the new courses in this curriculum will be integrative in terms of scientific disciplines and methods, lectures and lab experiences, formal instruction and active problem solving, individual effort and collaborative teamwork. This integrative style will be modeled by all instructors and expected of all students in all core courses required for the major.

In summary (see below), the B.S. in Systems Biology comprises 120 credits, distributed among the following categories of courses: (1) Curriculum for a Liberal Education (40 cr), (2) Systems Biology Required Core (36 cr), (3) Additional Mathematics and Science Courses (24 cr), (4) Restricted Electives (12 cr), and (5) Free Electives (8-13<sup>§</sup> cr).

**Curriculum for a Liberal Education (40 credits; required of all students)**

Area 1: Writing and Discourse (6 cr)

Area 2: Ideas, Cultural Traditions, and Values (6 cr)

Area 3: Society and Human Behavior (6 cr)

<sup>§</sup>Area 4: Scientific Reasoning and Discovery (BIOL 1105-6, Principles of Biology, 8 cr)

<sup>§</sup>Area 5: Quantitative and Symbolic reasoning (MATH 1225-6, Calculus of Single Variable, 8 cr)

Area 6: Creativity and Aesthetic Experience (3 cr)

Area 7: Critical Issues in a Global Context (3 cr)

**Systems Biology Required Core (36 credits; required of all students)**

- \*SYSB 2025: Intro to Systems Biology (4 cr)
- \*SYSB 2026: Intro to Systems Biology (4 cr)
- \*SYSB 3035: Systems Biology of Genes and Proteins (4 cr)
- \*SYSB 3036: Systems Biology of Genes and Proteins (4 cr)
- \*SYSB 3115: Network Dynamics & Cell Physiology (4 cr)
- \*SYSB 3116: Network Dynamics & Cell Physiology (4 cr)
- \*SYSB 4065: Research Experience in Systems Biology (4 cr)
- \*SYSB 4066: Research Experience in Systems Biology (4 cr)
- \*SYSB 4135: Professionalism in Systems Biology (2 cr)
- \*SYSB 4136: Professionalism in Systems Biology (2 cr)

} Capstone Thesis

\*indicates new course

**Additional Mathematics and Science Courses (24 credits; see note below)**

- §CHEM 1035-6: General Chemistry (6 cr)
- §CHEM 1045-6: General Chemistry Lab (2 cr)
- §PHYS 2205-6: General Physics (6 cr)
- §PHYS 2215-6: General Physics Lab (2 cr)
- §MATH 1114: Elementary Linear Algebra (2 cr)
- §STAT 3615: Biological Statistics (3 cr)
- CS 1044: Introduction to Programming in C (3 cr)

**Restricted Electives (12 credits from the following):**

- |                                       |                                         |
|---------------------------------------|-----------------------------------------|
| BIOL 4104 Developmental Biology       | BIOL 4734 Inflammation Biology          |
| BIOL 4844 Proteomics & Biol Mass Spec | STAT 3104 Probability & Distributions   |
| STAT 4444 Applied Bayesian Statistics | PHYS 4714 Intro to Biophysics           |
| MATH 4254 Chaos & Dynamical Syst      | MATH 4454 Applied Mathematical Modeling |
| MATH 4445 Intro to Numerical Analysis | MATH 4446 Intro to Numerical Analysis   |
| CHEM 4615 Phys Chem for Life Sci      | CHEM 4616 Phys Chem for Life Sci        |
| CS 2114 Softw Des & Data Structures   | CS 3414 Numerical Methods               |
| ECE 3704 Cont & Discrete Systems      |                                         |

**Free Electives (8-13<sup>§</sup> credits)**

§**NOTE:** An alternative to the set of entry-level science and math courses is available for students who seek a more integrated approach to the life sciences as their core experience in this degree program. Upon acceptance of their application, select students will be admitted into the following Integrated Science Curriculum program:

**Integrated Science Course (32 credits)**

- ISC 1105, 1115: Integrated Science (8 cr)
- ISC 1106, 1116: Integrated Science (8 cr)
- ISC 2105, 2115: Integrated Science (8 cr)
- ISC 2106, 2116: Integrated Science (8 cr)

Successful completion of the full sequence of Integrated Science Curriculum (32 cr) will satisfy Areas 4 and 5 of the CLE requirements (16 cr) and most of the Additional

Mathematics and Science Courses (21 cr) listed above. The five credit hours saved by taking the ISC will be added to the Free Electives for the degree:

**Free Electives (13 credits instead of 8 credits for the option listed above)**

**Relevance to university mission and strategic planning**

The new B.S. in Systems Biology enhances the mission of the College of Science (<http://www.science.vt.edu/about/about-mission.html>) to prepare future professionals in disciplines that enhance “the well-being and development of the University, the local community, the Commonwealth, the nation, and the world.” It enriches the academic experience of undergraduate students by emphasizing interdisciplinary learning and a “capstone” research-thesis project. It fosters scholarship and professional development in key areas of “health, food and nutrition” and “innovative technologies and complex systems”. It focuses our students’ intellectual assets on societal issues (food, fiber, energy, health) that will engage the best scientific minds of the future. Moreover, the B.S. in Systems Biology will help to fulfill the official mission of the University ([http://www.president.vt.edu/mission\\_vision/mission.html](http://www.president.vt.edu/mission_vision/mission.html)) by contributing to the “discovery and dissemination of new knowledge” in the life sciences. By bringing concepts and tools from the physical, chemical and mathematical science to bear on current problems in health, agriculture and biotechnology, the new and growing field of systems biology promises to create, convey and apply knowledge across disciplinary boundaries to improve the quality of human life and to foster economic competitiveness of the Commonwealth and the nation. The new degree is fully consistent with the University’s Vision: to train productive citizens and future professionals, to blur the distinctions between basic and applied research and the boundaries between disciplines, and to foster an atmosphere of intellectual discovery and excitement (<http://www.president.vt.edu/strategic-plan/2012-plan/2012-strategic-plan.pdf>).

**Justification for the proposed program**

At present, molecular systems biology is one of the most active areas of life science research around the world, as witnessed by the growing number of graduate programs in systems biology at major universities, of new research institutes in systems biology being established worldwide, of new funding opportunities at NIH, NSF, DOE and private foundations, and of employment opportunities for systems biologists at biotech startup companies and well established pharmaceutical firms. However, few undergraduate degree programs in systems biology exist anywhere in the world.

This gap will soon be filled by colleges and universities that aspire to lead the nation in educating the next generation of systems-thinking life scientists. Virginia Tech can become a national leader in this area of undergraduate education because it is the only public university in Virginia with the depth and breadth of faculty expertise to be a strong national contender in this arena. Our proposed undergraduate degree in systems biology is perfectly in line with the report of a distinguished committee of the National Research Council<sup>2</sup> (“BIO2010: Transforming Undergraduate Education for Future Research Biologists”; [http://www.nap.edu/openbook.php?record\\_id=10497&page=27](http://www.nap.edu/openbook.php?record_id=10497&page=27)) whose #1 recommendation was:

Given the profound changes in the nature of biology and how biological research is performed and communicated, each institution of higher education should

reexamine its current courses and teaching approaches to see if they meet the needs of today's undergraduate biology students. Those selecting the new approaches should consider the importance of building a strong foundation in mathematics and the physical and information sciences to prepare students for research that is increasingly interdisciplinary in character.

The potential benefits of systems biology extend beyond basic biology to practical issues of agriculture, forestry, veterinary and human medicine, and biomimetic engineering. A solid program in systems biology at the undergraduate level will prepare the future work force of Virginia in these essential areas serving our society at large.

### **Student Demand**

The ultimate target enrollment for the systems biology degree is 65 majors total. The Department of Biological Sciences, with more than 1600 majors, provides a large pool of prospective candidates for a degree in systems biology. In a poll (Spring 2011) of freshmen in "Principles of Biology," students were informed that the College of Science is considering adding new courses and a possible new major in systems biology. When asked whether they would be interested in taking systems biology courses, 35% (102 of 291 respondents) said yes; and when asked whether they would be interested in majoring in systems biology, 12% replied affirmatively (33 of 278 respondents). Consequently, a systems biology degree could meet its enrollment goal if only half of these entry-level life science students who expressed an interest in the major were to sign up. In addition, because of the broad interdisciplinary character of the degree, it should attract students from the physical sciences and engineering at Virginia Tech, at the very least as a unique opportunity for a double major. Moreover, because this systems biology degree would be the first such program in Virginia and one of very few in the world, it is expected that additional students from out-of-state and out-of-USA will apply to Virginia Tech to take advantage of this opportunity.

Existing courses illustrate the great potential for populating Systems Biology courses. Table 1 shows total enrollment for relevant courses in biology, statistics, physics, electrical & computer engineering, mathematics, computer science, and chemistry from 2009 to fall 2013. Listed are the restricted electives for the Systems Biology curriculum, these being good indicators of student interest in the systems biology areas. Note particularly that the enrollment in almost all of these courses has grown over the five-year period.

Table 1. Total enrollment for Restrictive Elective courses in the Systems Biology curriculum from 2009 to 2013 (data retrieved from Banner on 11/26/2013, <sup>¥</sup>data retrieved from Banner on 03/17/2014, <sup>£</sup>data retrieved from Banner on 04/23/2014).

<b>Existing Courses</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>
<b>BIOL 4104</b>	NA	40	40	43	49
<b>BIOL 4734</b>	NA	NA	NA	35	50
<b>BIOL 4844</b>	NA	NA	2	NA	2
<b>CHEM 4615</b>	172	186	230	248	236
<b>CHEM 4616</b>	131	151	165	162	192
<b>CS 2114<sup>£</sup></b>	138	209	251	293	350
<b>CS 3414<sup>£</sup></b>	45	45	54	49	50
<b>ECE 3704<sup>¥</sup></b>	101	162	124	133	141
<b>MATH 4254</b>	10	9	8	6	13
<b>MATH 4445<sup>¥</sup></b>	38	40	52	61	67
<b>MATH 4446<sup>¥</sup></b>	49	36	40	51	42
<b>MATH 4454</b>	23	19	29	NA	29
<b>PHYS 4714</b>	3	11	17	15	NA
<b>STAT 3104</b>	NA	NA	11	28	21
<b>STAT 4444</b>	5	6	17	8	12

### **Market Demand**

From recent degree-related employment projections of the US Bureau of Labor Statistics and the Virginia Employment Commission, it is evident that the demand for life scientists will see robust growth over the next 5-10 years. Popular job search websites currently list thousands of public and private sector job advertisements under the search terms “systems biology”, “computational biology”, “genomics”, and “bioinformatics”, with many being open to applicants with bachelor degrees.

The bioscience field as a whole, encompassing both the public and private sectors and extending beyond obvious biomedical applications to innovations in agriculture, energy, and the environment, is one of the fastest growing sectors of the economy. According to a report ([http://www3.bio.org/local/battelle2010/Battelle\\_Report\\_2010.pdf](http://www3.bio.org/local/battelle2010/Battelle_Report_2010.pdf)) of the Battelle Institute for Private Industry, the bioscience industry added 193,748 jobs from 2001 to 2008, a hefty growth rate of 15.8 percent. This rapid rate of job growth was 4.5 times the overall growth rate for the national private sector (3.5 percent). According to the report, even with the economic recession in 2008, the national annual “employment in the bio-science industry grew at 1.4% while total private sector employment declined by 0.7%.”

As listed below, a healthy number of job prospects awaits our graduates who seek employment with their undergraduate degree.

Job listings on <http://www.simplyhired.com>

Job Title	All Job Listings	Open to B.S.
Systems Biology	9216	521
Computational Biology	1402	62
Genomics	3362	148
Bioinformatics	2395	92

In addition to employment opportunities in Virginia, there are several graduate programs in Bioinformatics, Computational Biology and Systems Biology at Virginia universities for which our graduates would be eminently qualified:

**Virginia Tech**, Graduate School

Ph.D. Genetics, Bioinformatics and Computational Biology

**George Mason University**, School of Systems Biology

M.S. Bioinformatics and Computational Biology

M.S. Bioinformatics

M.S. Biomedical Sciences (Systems Biomedicine)

Ph.D. Bioinformatics and Computational Biology

**Virginia Commonwealth University**, Center for the Study of Biological Complexity

M.S. Bioinformatics

Ph.D. Integrative Life Sciences

**Resource Needs/Savings**

The newly created Systems Biology courses will be primarily delivered by the faculty in the departments of Biological Sciences, of Chemistry, of Physics, and of Mathematics. It is anticipated that two new hires at the assistant professor rank in the field of molecular systems biology will be assigned to the Systems Biology program. These faculty members will be housed jointly within the Academy of Integrated Science and Departments within the College of Science. These hires are associated with re-distribution of faculty positions within the College of Science. The College of Science initiated cluster hiring in 2004 as a means of strategically re-aligning resources to better meet the needs of the university, of positioning the College to address interdisciplinary grand challenges in science, and of educating our students in a more comprehensive manner. Hiring in clusters, rather than specific disciplines, is a strategy for the college to seek and acquire the best faculty to promote our research and educational agenda and thereby achieve a stronger institution. Reallocation/realignment of resources to make faculty hires in Systems Biology is a continuation of our on-going strategic initiatives.

Four graduate teaching assistants (GTAs) will adequately cover the laboratory courses as well as the recitation sections throughout the curriculum.

No additional library or telecommunication resources will be required for the program beyond those that already exist.

In terms of space and equipment, we will be using a synergistic combination of existing resources, which includes faculty research laboratories and existing teaching laboratory spaces:

- The college has recently constructed three dynamic, interdisciplinary lab spaces which will be shared in the initial stages of the program. This space is uniquely positioned within the Biological Sciences and adjacent to the Physics department.
- The laboratory space that is available to Systems Biology students comprises chemical hoods, instrumentation, team bench spaces, cell culture facilities, and team data discussion spaces.
- The university has instituted a mechanism by which lab fees can be collected to help maintain equipment and supplies.
- As the program matures, the expectation is that the planned science research lab building will house these laboratory courses.

<b>RESOURCE</b>	<b>ESTIMATED COSTS (NA: not applicable)</b>
<b>Faculty</b>	\$199,120 (salary and benefits for 2 positions)
<b>Administrative Staff</b>	NA
<b>Graduate Teaching/ Graduate Research Assistants</b>	\$113,564 (stipend, benefits and tuition for 4 graduate teaching assistants)
<b>Space</b>	NA
<b>Library</b>	NA
<b>Equipment</b>	\$800,000 (as part of startup for 2 positions)
<b>Other</b>	\$4000/y for software licenses; laboratory costs will be recouped from student lab fees



**College of Science**  
**Bachelor of Science in Systems Biology**  
**Major in Systems Biology**  
**For students graduating in calendar year 2016**

**I. Curriculum for Liberal Education (40 credit hours)**

All courses used for the Curriculum for Liberal Education must be on the University's approved list.

**Area 1 - Writing and Discourse (6 credit hours)**

\_\_\_\_\_ 3\_\_ \_\_\_\_\_ 3\_\_

**Area 2 - Ideas, Cultural Traditions, and Values (6 credit hours)**

\_\_\_\_\_ 3\_\_ \_\_\_\_\_ 3\_\_

**Area 3 - Society and Human Behavior (6 credit hours)**

\_\_\_\_\_ 3\_\_ \_\_\_\_\_ 3\_\_

**Area 4 - Scientific Reasoning and Discovery (8 credit hours)**

BIOL 1105 Principles of Biology\*§ 3\_\_ BIOL 1106 Principles of Biology\*§ 3\_\_

BIOL 1115 Principles of Biology Lab\*§ 1\_\_ BIOL 1116 Principles of Biology Lab\*§ 1\_\_

**Area 5 - Quantitative and Symbolic Reasoning (8 credit hours)**

MATH 1225 Calculus of Single Variable\*§ 4\_\_ MATH 1226 Calculus of Single Variable \*§ 4\_\_

**Area 6 - Creativity and Aesthetic Experience (3 credit hours)**

\_\_\_\_\_ 3\_\_

**Area 7 - Critical Issues in a Global Context (3 credit hours)**

\_\_\_\_\_ 3\_\_

**II. Systems Biology Required Core (36 credit hours)**

SYSB 2025 Intro to Systems Biology\*# 4\_\_ SYSB 2026 Intro to Systems Biology\*# 4\_\_

SYSB 3035 Syst Biol Genes Proteins\*# 4\_\_ SYSB 3036 Syst Biol Genes Proteins\*# 4\_\_

SYSB 3115 Newt Dyn & Cell Physiol\*# 4\_\_ SYSB 3116 Newt Dyn & Cell Physiol\*# 4\_\_

SYSB 4065 Res Exp Syst Biol\*# 4\_\_ SYSB 4066 Res Exp Syst Biol\*# 4\_\_

SYSB 4135 Professionalism in Syst Biol\*# 2\_\_ SYSB 4136 Professionalism in Syst Biol\*# 2\_\_

**III. Additional Mathematics and Science (24 credit hours)**

MATH 1114 Elementary Linear Algebra§ 2\_\_ STAT 3615 Biological Statistics\*§ 3\_\_

CHEM 1035 General Chemistry\*§ 3\_\_ CHEM 1036 General Chemistry\*#§ 3\_\_

CHEM 1045 General Chemistry Lab\*§ 1\_\_ CHEM 1046 General Chemistry Lab\*#§ 1\_\_

PHYS 2205 General Physics\*#§ 3\_\_ PHYS 2206 General Physics\*#§ 3\_\_

PHYS 2215 General Physics Lab\*§ 1\_\_ PHYS 2216 General Physics Lab\*#§ 1\_\_

CS 1044 Intro Programming in C\* 3\_\_

#### IV. Restricted Electives (12 credit hours)

BIOL 4104 Developmental Biology*#	3__	BIOL 4734 Inflammation Biology*#	3__
BIOL 4844 Proteomics & Biol Mass Spec*#	3__	STAT 3104 Probability & Distributions*#	3__
STAT 4444 Applied Bayesian Statistics*#	3__	PHYS 4714 Intro to Biophysics*#	3__
MATH 4254 Chaos & Dynamical Syst*#	3__	MATH 4454 Applied Math Modeling*	3__
MATH 4445 Intro to Numerical Analysis*#	3__	MATH 4446 Intro to Numerical Analysis*#	3__
CHEM 4615 Phys Chem for Life Sci*#	3__	CHEM 4616 Phys Chem for Life Sci*#	3__
CS 2114 Softw Des & Data Structures*#	3__	CS 3414 Numerical Methods*#	3__
ECE 3704 Cont & Discrete Systems*#	3__		

#### V. Free Electives (8-13<sup>s</sup> credit hours)

_____	---	_____	---
_____	---	_____	---
_____	---	_____	---
_____	---	_____	---

\*Courses used to calculate in-major GPA

#### #Prerequisites

Some courses in the major requirements listed above may have prerequisites. Students are required to double check course prerequisites and equivalents. Please see your advisor or consult the Undergraduate Course Catalog for more information.

#### § Substitutions for Integrated Science Curriculum (ISC)

BIOL 1105-1106, BIOL 1115-1116, CHEM 1035-1036, CHEM 1045-1046, PHYS 2205-2206, PHYS 2215-2216, MATH 1114, MATH 1225-1226, STAT 3615 can be substituted with ISC 1105-1106<sup>#</sup>, ISC 1115-1116<sup>#</sup>, ISC 2105<sup>#</sup>-2106<sup>#</sup>, and ISC 2115<sup>#</sup>-2116<sup>#</sup>. Students taking ISC courses are required to take 13 Free Elective credits in order to meet the minimum 120 credit hours for graduation.

#### Foreign Language

In order to graduate, students must meet a language study requirement. The College of Science requires three units of a single foreign or classical language (or American Sign Language) during high school or the second semester of a college-level foreign or classical language (or American Sign Language). These credit hours do not count toward the total minimum hours required for the declared degree program.

#### Satisfactory Progress Towards Degree

In order to continue in the major to the core 3000-level courses (SYSB 3035 and 3115), students must have completed all 1000-and 2000-level core required courses and STAT 3615 with grades of C or better in two or fewer attempts (including attempts that were withdrawn), and they must have an overall GPA of at least 2.5 in these courses that are required for the major.

#### Graduation Requirements

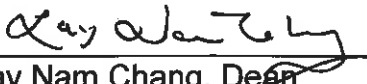
120 credit hours are required for graduation. These credits must include the courses required for the major (see above section). To graduate, a student must have at least a 2.0 in-major GPA and overall GPA. All required courses in SYSB, BIOL, CHEM, PHYS, MATH, STAT, and CS must be passed with a grade of C or better. If 120 credit hours are reached and a student does not meet the GPA requirement, the student must take additional in-major courses to raise the in-major GPA to a 2.0.



MEMORANDUM

Re: B.S. Degree in Systems Biology

The College of Science wishes to express its support for the Systems Biology degree proposal put forth by its Academy of Integrated Science. Included in the Systems Biology requirements and electives are several courses from among the following College of Science departments: Biological Sciences, Chemistry, Mathematics, Physics, and Statistics. By this memorandum, the College certifies that the projected Systems Biology enrollments can be accommodated within these courses.

  
\_\_\_\_\_  
Lay Nam Chang, Dean  
College of Science

3/28/14  
\_\_\_\_\_  
Date



**TO:** Curriculum Approval Committees

**FROM:** Calvin Ribbens *Cal Ribbens*  
Associate Department Head for Undergraduate Studies

**RE:** Systems Biology Major

**DATE:** April 17, 2014

The Department of Computer Science supports the proposed undergraduate major in Systems Biology (SYSB). Students majoring in SYSB will have the opportunity to take the three CS courses listed as possible courses for this new major: CS 1044, CS 2114 (as well as prerequisite CS 1114), and CS 3414. Capacity in each of these courses is limited; it is our understanding that the anticipated demand from the SYSB program will be less than ten students per course, per year.

Note that Computer Science is making no commitment at this time to provide faculty members to teach new courses created as part of the SYSB degree.

**From:** Jaime De La Ree jreelope@vt.edu  
**Subject:** ECE3704 as Systems Biology Elective  
**Date:** April 8, 2014 at 9:07 AM  
**To:** long@vt.edu, tyson@vt.edu

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Gary/John:

The Electrical and Computer Engineering Department would be happy to allow a few SYSB majors, say five or so a year, to take ECE 3704 as an elective course. Please note that ECE 3704 has a prerequisite of ECE2704, and ECE has a prerequisite of ECE2004 which students will also be allowed to take, and students will have to request that the department force add them to the courses as we are a restricted major.

Best

Jaime

Dr. Jaime De La Ree  
Associate Department Head and Associate Professor  
ECE Department  
Virginia Tech  
Blacksburg, VA 24061-0111  
(540) 231-6625 Office  
(540) 231-3362 FAX  
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jreelope@vt.edu E-Mail



VirginiaTech

College of Science

Department of Mathematics

460 McBryde Hall (0123)

Blacksburg, Virginia 24061

540/231-6536 Fax: 540/231-5960

[www.math.vt.edu](http://www.math.vt.edu)

April 3, 2014

Gary Long  
Associate Dean for Curriculum and Instruction  
College of Science

Dear Gary:

Thank you for sending the proposal for a degree program in Systems Biology. I note that the program will require Math 1225, 1226, and 1114 or their equivalents. Based on the proposal's estimate of fewer than 20 majors per year, the Math Department expects to be able to provide instruction without requiring new resources.

Sincerely yours,

Peter E. Haskell  
Professor and Chair  
Department of Mathematics

*Invent the Future*



**Eric P. Smith**  
**Department of Statistics**  
**Virginia Tech**  
Blacksburg, Virginia 24061  
540/231-5657 Fax: 540/231-3863  
E-mail: epsmith@vt.edu  
[www.stat.vt.edu](http://www.stat.vt.edu)

April 4, 2014

Gary Long  
Systems Biology  
College of Science

Gary,

Thank you for the requesting to use STAT 3615 as a required class and STAT 4444 and STAT 3104 as elective courses in the new Systems Biology degree program. We support the use of these classes and will allow those students to enroll in the classes.

We do face enrollment pressures on our undergraduate classes, especially STAT 3615; but as long as enrollment support keeps pace with our increasing enrollments and as long as your program does not grow much beyond its existing numbers, we should be able to offer your students the required statistics class without our needing any additional resources.

Sincerely,

Eric P. Smith  
Professor and Department Chair



VirginiaTech

College of Science

**Department of Biological Sciences**

2125 Derring Hall (MC 0406)

Blacksburg, Virginia 24061

540/231-8930 Fax: 540/231-9307

E-mail: [winkel@vt.edu](mailto:winkel@vt.edu); [rawalker@vt.edu](mailto:rawalker@vt.edu)

[www.biol.vt.edu](http://www.biol.vt.edu)

To: University Curriculum Committee

Re: B.S. Degree in Systems Biology

Date: April 1, 2014

The Department of Biological Sciences supports approval of the Systems Biology B.S. degree proposal, as well as the use of four BIOL courses (1105, 1115, 1106, 1116) as degree requirements, and three BIOL courses (4104, 4734, 4844) as restricted electives. We will accept Systems Biology students into these courses subject to available resources. Biological Sciences does face enrollment pressures on its undergraduate classes, but as long as enrollment support keeps pace with increasing enrollments, and the Systems Biology degree program does not grow beyond its projected size, these BIOL courses should be able to accommodate Systems Biology students.

The Department of Biological Sciences understands that the Systems Biology degree program will be administered through the Academy of Integrated Science within the College of Science, and that the Academy is responsible for program administration including SYSB course scheduling and student advising. Program oversight, including performance tracking and consideration of programmatic changes as needed, will be provided by the Executive Committee of the Academy's Systems Biology Division, to include one Biological Sciences faculty member.

Sincerely,

Brenda S.J. Winkel  
Department Head

Richard A. Walker  
Associate Head

*Invent the Future*

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

*An equal opportunity, affirmative action institution*