University of Colorado at Colorado Springs
College of Letters, Arts and Sciences

Disciplines of Physics, Mathematics and Applied Bioscience

Proposal for a
Ph.D. Program in Applied Science

June 24, 2008
Revised January 14, 2009

Proposal for a Ph.D. in Applied Science

Highlights

- Program to be initially comprised of faculty from biology (applied bioscience), mathematics, and physics.

- These three disciplines have a base of 672 undergraduate students and 58 graduate students.

- Surveys indicate that 27 of our current students "would definitely apply" for this program.

- The faculty involved generate about half of the total research expenditures at UCCS indicating that the research strength is appropriate for a Ph.D. program.

- The Ph.D. program is in complete support of the UCCS Vision Statement:

  > ***"The University of Colorado at Colorado Springs will provide … outstanding research and creative work that serve our community, state, and nation, and result in our recognition as the premier comprehensive, regional research university in the United States."***

  Clearly, a Ph.D. level program in the sciences is necessary so that UCCS could become the "premier, comprehensive regional research university."

- The proposed Ph.D. program has strong support from local industry and institutions. The Air Force Academy, for example, has promised to support two graduate students in physics. Lockheed-Martin has required some of its employees to obtain a Ph.D. In addition to the high-tech firms such as Atmel, Honeywell, and Lockheed Martin, a growing biotechnology sector, 22 companies in the Colorado Springs area, also has need for Ph.D. graduates.

- All of the departments currently graduate Master's level students, so much of the coursework for the degree is already in place.

A. Description of the Program

1. Describe the basic design of this program

Faculty in three disciplines, Biology (specifically, Applied Bioscience), Mathematics and Physics, at the University of Colorado at Colorado Springs (UCCS) propose establishing a Ph.D. in Applied Science. As outlined below in section B.2., the proposed program fits within the UCCS mission to serve the Pike's Peak Region and southern Colorado and is designed to meet student and employer demands for professionals with skills to address technical and societal needs. The proposed degree provides a needed connection between scientific education at UCCS and specific training for leadership positions in technical employment and research institutions in Colorado.

As in the majority of Ph.D. programs, the student will be expected to complete all course work with a grade of B, or better, pass a qualifying exam, and write and defend a thesis worthy of being awarded a Ph.D. Unlike many programs, however, this program allows a lot of flexibility for the student. For example, a student may wish to (1) emphasize only one of the disciplines, taking course work in that one discipline only, and writing an appropriate Ph.D. thesis. Or, a student may wish to (2) take courses which are more interdisciplinary in nature, taking courses in two or three disciplines and writing a thesis more appropriate to an interdisciplinary approach. Regardless of which of the two options above are chosen by the student, minimum course work, qualifying exams and a thesis are still required. Complete program description and curriculum options are described for either of these two options in sections 2a, 2b and 2c of this document.

At the present time, faculty from three disciplines are involved in the proposed Applied Science Ph.D.: Biology (Applied Bioscience), Mathematics and Physics. The overall administration and oversight of the program will be provided by a multi-disciplinary committee comprised of members from the disciplines involved. This program will follow the graduate school rules of the University of Colorado-Colorado Springs (as currently outlined on pages 35-41 in the 2008-2009 UCCS Bulletin). This program also has the flexibility to expand in the future so that it is possible that the program will eventually be joined by faculty from Chemistry, Geography and Environmental Studies, or any other natural science discipline in the College of Letters, Arts, and Sciences, if the faculty within that discipline so desire.

2. What are the student learning goals for this program?

The mission of the proposed Ph.D. program in Applied Science is to serve the people of the State of Colorado, the nation, and the world through leadership in education and research in applied bioscience, mathematics and physics.

Our general goals are as follows: we will (i) instill in our future Ph.D. students the skills, attitudes, values, and vision to prepare them for successful high level careers in physics, applied bioscience, and mathematics; (ii) prepare students for a lifetime of continued learning and research; (iii) prepare students to remain at the vanguard of international

research in science, generating new knowledge and working to apply the fundamental advances in science to the benefit of society; (iv) prepare students to provide future leadership to our disciplines and public institutions.

The Applied Science degree graduates should have achieved these specific goals:

- Students will have a comprehensive knowledge of their graduate-level discipline.
- Students will have the ability to conduct original research.
- Students will have a thorough knowledge of mathematics and an understanding of computational techniques applied to the study of their discipline.
- Students will have an ability to use this knowledge to assess and solve real applied science problems.
- Students will have an ability to communicate effectively, both verbally and in writing.
- Students will have a mastery of the concepts and the literature of a specific sub-discipline of applied science.

B. Concerns to be Addressed

1. Bona Fide Need: Student Demand and Workforce Demand

a. Student Demand

Enrollment Projections

During the spring of 2006, an informal survey was given to the graduate students in the three programs. In addition, senior biology students were also interviewed. The individual surveys varied slightly from department to department, but essentially asked the students whether they were in one of three categories in regard to a possible Applied Science Ph.D. program: 1) Would definitely apply, or 2) Might apply or 3) Would not apply.

The results of the survey indicate strong student demand. In the initial survey a total of 27 students said they "would definitely apply." We note that the Biology Department clearly has a much larger number of undergraduate majors than the other two departments involved in the program. However, our survey showed approximately equal numbers of students were interested in the Ph.D. program for each of the three departments. We also point out that even though the Biology Department as a whole will not initially be participating in this program, the biology students who are interested in a Ph.D. are all ones who are interested in the Applied Bioscience option.

We make a conservative estimate that only 20% of these students will be accepted into the program in the first year. This gives us about 5 students.

In addition, one can expect that there are additional people in local high-tech firms or biotechnology firms who might be interested in a Ph.D. program. The three disciplines typically get a combined total of 10 serious enquiries each year about Ph.D. programs. We again assume that only 20% of the inquiries would lead to an enrolled student. This gives us about 2 students.

Adding the measured current-student demand and the external demand, we estimate that the program will start with a total of about 7 students.

What will happen in the second year? From our survey, we can expect some additional students who responded they "would apply" will, in fact, now apply. We now take 20% of the remaining "would definitely apply" students. Therefore we assume 4 new students, and add one additional student from external demand. This would indicate an additional 5 students. However we must also subtract for attrition, which we estimate at about 2 students per year. Over most of the years, this is about 10–15% of the headcount from the previous year, a typical number in a graduate program.

In the remaining years we continue to assume about 5–6 acceptances per year (we assume that applications will increase slightly as the program becomes better known) and the same attrition rate. We also have to factor in graduations. The typical time to graduation in a Biosciences, Mathematics or Physics Ph.D. program is 5.5 years to 6.5 years. We anticipate a few early graduations based on people who start the program with a MS degree already awarded.

Below is a table indicating how the headcount numbers are developed in a year by year fashion.

	1st year	2nd year	3rd year	4th year	5th year
Acceptances	7	5	5	6	6
Attrition	0	2	2	2	2
Graduates	0	0	0	1	2
Total Headcount	7	10	13	16	18

Using the estimates from the table above, we can create the required table, Table 1, on headcounts and FTE for the program. See Table I – Enrollment Projections for details in Appendix A.

National and Local Enrollment Trends

Nationally, science graduate enrollment has been steadily growing in the past 8–10 years. Fig. 1 (below) shows national graduate enrollments in the disciplines of biology, mathematics and physics for the last ten years. All three disciplines have shown substantial growth. In fact, over the 10 year span from 1996-2006, Biological Science graduate enrollment was up 17.4%, Mathematical Sciences were up 13.5% and Physics was up 14.5 % (National Science Foundation, December 2007).

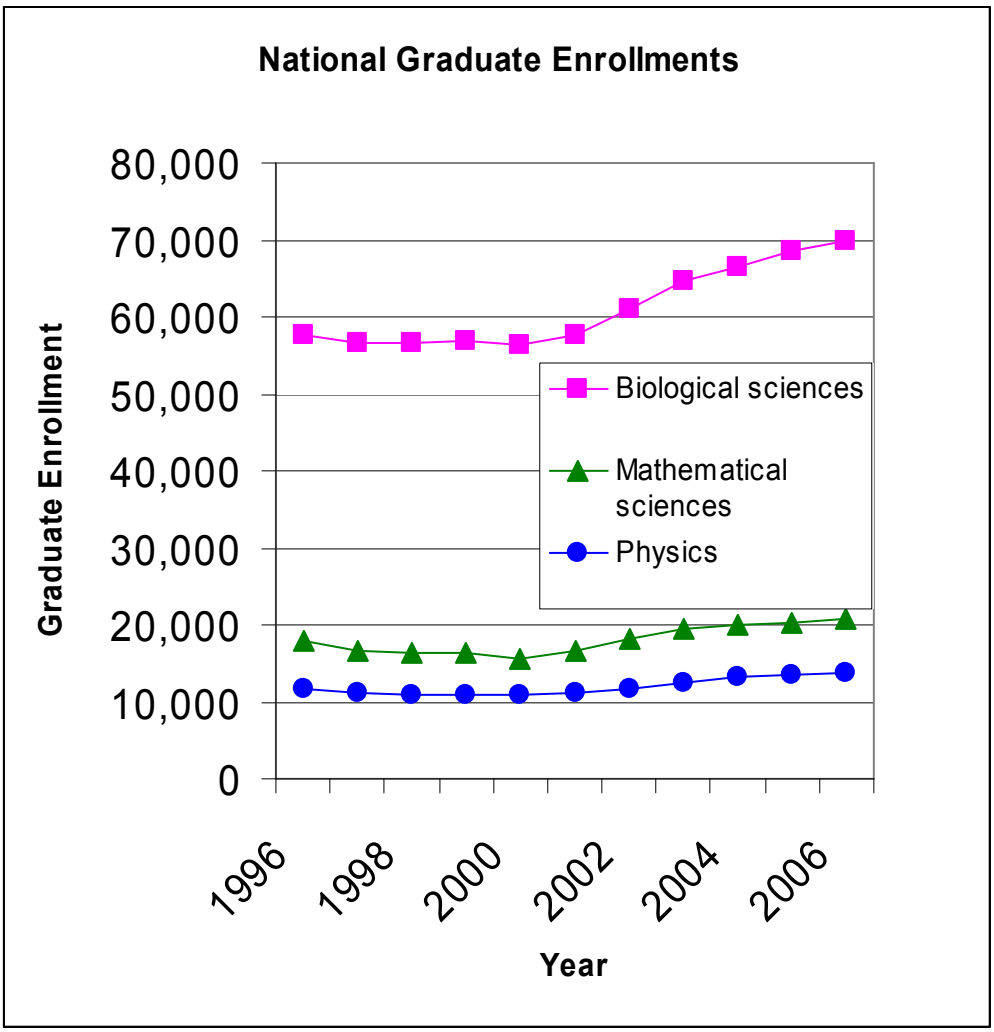

Figure 1: National Graduate Enrollments in Biology, Mathematics and Physics
Source: National Science Foundation
(http://www.nsf.gov/statistics/infbrief/nsf08302/)

At UCCS, all three departments have shown a steady increase in total number of credit hours taught. In fact, over the last 10 years, Biology has grown 72%, Mathematics has grown 22% and Physics has grown 47% (See Fig. 2). These compare to an overall campus growth of 38% over that same time period.

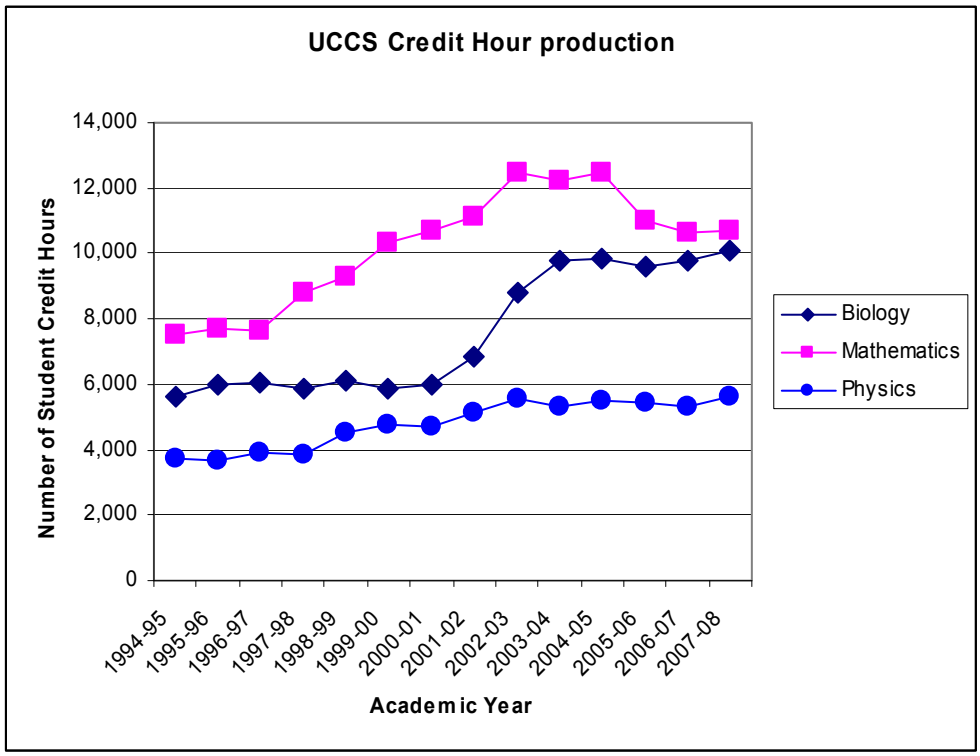

Figure 2: Total credit hour enrollments at UCCS for the three departments.
Source: UCCS Institutional Research

All three departments have also had increases in the number of graduates as is seen in Fig. 3. Biology has had a 96% increase in degrees conferred over the last 10 years and Mathematics degrees increased by 45% in that same time. The number for Physics shows more variation since overall numbers are small.

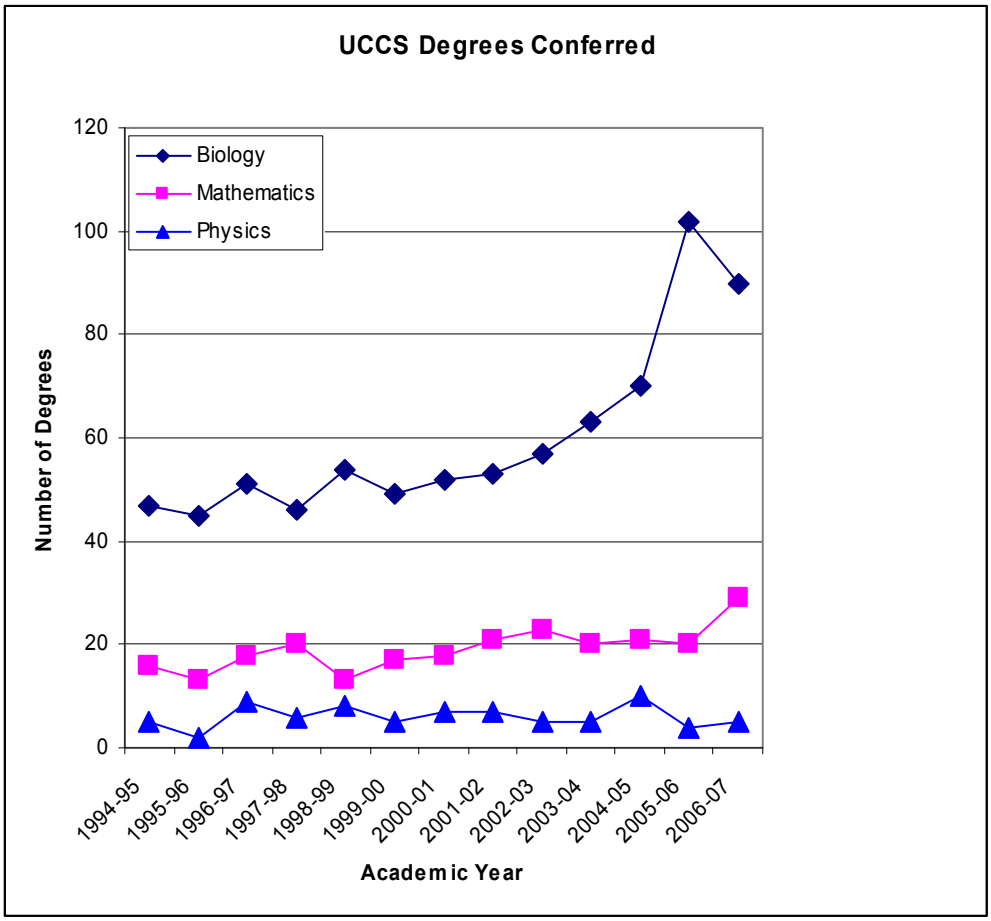

Figure 3: Total degrees conferred at UCCS for biology, mathematics and physics. Source: UCCS Institutional Research

Annual Pool of Potential Applicants

There are also strong graduate numbers for each of the three departments. Of the graduate students currently enrolled in the existing Master of Sciences (MSc) program, 11 of those are Physics majors and 17 are majoring in Biology. The Mathematics department has 30 graduate students enrolled in their Master's programs. Thus, the total base of current graduate students for the Ph.D. program is 58 graduate students. Our graduate students were surveyed on whether they would apply to the Ph.D. program if it existed. The results are below.

Biology—The Department of Biology did an initial survey of seniors and graduate students on their interest in the proposed Ph.D. program. Twelve students responded that they "would apply" for the Ph.D. program if it existed and 37 responded that they "might apply."

Mathematics—The Department of Mathematics participates in the Engineering Ph.D. program through the mathematics track and currently has four enrolled students. This option is no longer admitting students due to a restructuring of the Engineering Ph.D. A Ph.D. interest questionnaire was completed by 26 students in a mixed senior and graduate level course. Four students expressed serious interest in a Ph.D. program in mathematics or physics (one is already enrolled in the mathematics track of the engineering Ph.D.).

Physics—The Department of Physics graduate students were surveyed about their interest in a Ph.D. program at UCCS. Eight of the students "would apply" to pursue a Ph.D. here at UCCS and an additional five students "might apply" for the Ph.D. program.

When we add the results from the three programs together, we find that of the students surveyed, 23 students are "definitely interested" in the Ph.D. in Applied Science. When we add the students currently enrolled in the Mathematics Ph.D. program, we have a base of 27 students to start this program. In addition, we can expect some students from the community will also want to enroll in this program.

Addressing the Needs of Part-Time Students

We note that this program is designed, in part, to help support the needs of working students who need to enhance their education. Much of the graduate coursework is already offered in the evening so as to be available for working students. Furthermore, the faculty is already experienced in dealing with the needs of working students because about half of the students in our current MSc programs are working.

We comment on the issue of attracting and retaining under-represented students in this Ph.D. program. Often the students who come from under-represented groups may not fit into standard graduate programs because they do not have exactly the right educational background or their interests do not fall neatly into standard categories. Larger, more established, Ph.D. programs generally will not accept such students. However, the faculty in the Applied Science Ph.D. program have experience with such students, and know that they can be among the best of our graduates. We are therefore more likely to accept students from under-represented groups and give them a chance. It is the personal relationship between students and faculty that will help meet the needs of and retain the student from under-represented groups.

b. Workforce Demand

According to the U.S. Department of Labor ten year projections, from 2002–2012 there will be 2 million job openings in computer science, mathematics, engineering and physical sciences (*i.e., physics and chemistry*).

It has been estimated that 90,000 new jobs will be available in Colorado in the fields of science, engineering, and biotechnology within 10 years. In particular, the bioscience field is expanding as a discipline, and it is likely to be one of the fastest growing interdisciplinary areas, including bioengineering, computational biology, and

bioenergetics. A Ph.D. program in Applied Science could educate and train students with the technical skills necessary to support the new jobs in science and biotechnology.

With the current economic revival in the technology sector, the high technology firms (such as Atmel, Lockheed-Martin, LSI , Intel, HP, FedEx) in the Pikes Peak region have a substantial workforce need. Employees who have experience in physical science, applied mathematics and bioscience are, and will continue to be, in demand by the local aerospace, semiconductor, and biotech firms. We note that many of our current graduate students are employed by local companies. Many of these companies pay for the graduate education of their employees, and some companies (Lockheed Martin for example) are insisting that their employees obtain a Ph.D. degree. The Air Force Academy has also expressed an interest in having a local Ph.D. program in order to allow their employees and military instructors to enhance their research skills and education.

The Physics Department has strong contacts to companies and research institutions throughout Colorado. In particular, the National Institute of Standards and Technology has needs for research scientists in magnetism, a strength of the department. The Physics department also has received support from companies which specialize in optics, including Meadowlark Optics (Frederick, CO), and DisplayTech (Boulder).

Mathematics graduates are in demand in a variety of employment sectors, including education, finance, government, and engineering. A relevant sector of particular importance in Colorado is the aerospace industry. Major corporations in Colorado include Lockheed Martin, Ball Aerospace and Technologies Corp., Boeing Company, ITT Industries, Northrup Grumman, and Raytheon. Civilian aerospace employment in Colorado was approximately 25,000 in 2005. Mathematics graduates, particularly those with graduate degrees, are often employed in the aerospace industry for software algorithm design, requirements definition, and system performance modeling and analysis.

There is also strong support for the Ph.D. program from local biotech firms. In fact, Colorado Springs is becoming a center for start-up biotech firms, with 22 such businesses in the local area. Many of these companies, including Aspire Biotech, Hemogenix and others already have ties to the Bioenergetics Institute at UCCS.

Colorado Springs and Southern Colorado have had a long-standing relationship with the military, including the Air Force Academy, US Air Force, Army and the Northern Command. Most recently, the newly established Homeland Security efforts have been a strong presence in the community and at UCCS. Included are newly established collaborations with Bioenergetics, Physics, and Mathematics.

We note that the US has recently imported many of its scientists from other countries. Between 1990 and 2000, the number of foreign-born U.S. workers with bachelor's degrees in science and engineering rose from 11 to 17 percent; those with master’s degrees rose from 19 to 29 percent; and the number with Ph.D.s rose from 24 to 38 percent (National Science Board. “An Emerging and Critical Problem of the Science and

Engineering Labor Force", 2004). However, as more foreign nations are making concerted efforts to retain their own citizens by creating more job opportunities, this will require additional graduates, particularly at the Ph.D. level, who are educated and trained here in the U.S. In fact, the first conclusion from a recent National Science Board report was:

> "Global competition for science and engineering (S&E) talent is intensifying, such that the United States may not be able to rely on the international S&E labor market to fill unmet skill needs"

2. Role and Mission Criteria

As stated in the legislatively approved UCCS Mission Statement:

"The Colorado Springs campus of the University of Colorado shall be a comprehensive Baccalaureate university with selective admission standards. The Colorado Springs campus shall offer liberal arts and sciences, business, engineering, health sciences, and teacher preparation undergraduate degree programs, and a selected number of masters and doctoral degree programs. "

Further, in the UCCS Vision Statement it states:

"The University of Colorado at Colorado Springs will provide … outstanding research and creative work that serve our community, state, and nation, and result in our recognition as the premier comprehensive, regional research university in the United States."

The proposal to create a Ph.D. in Applied Science is completely supported by the UCCS Mission and Vision Statements. It is hard, if not impossible, to imagine that UCCS could be the "premier, comprehensive regional research university" without a Ph.D. level program in the sciences. We note that in terms of research, Physics, Biology, and Mathematics already provide about 50% of the total research expenditures for the campus. A Ph.D. program in these science disciplines seems appropriate and necessary.

We also note that recent Program Reviews have strongly supported Ph.D. programs in Physics and in Applied Biosciences. The <u>first</u> recommendation of the external reviewers for Physics (2005) saw the Ph.D. program as an "urgent need." In addition, the Board of Directors for the CU Institute of Bioenergetics has strongly recommended a Ph.D. program in order to ensure the success of that institute, and a program in Applied Biosciences will accomplish this. Finally, we note that mathematics has already been part of a Ph.D. program in Engineering. However, with the move of Mathematics to LAS, their long-term participation in the Engineering program is ending. Thus a Ph.D. program involving Applied Bioscience, Mathematics, and Physics seems particularly appropriate.

Finally, we note that the "applied" focus of the degree also fits very well with the vision and mission statements. There are several reasons for the emphasis on applied studies:

1) The applied focus is an effort to coordinate with the local community as much as possible. For example, "applied" in the biosciences option indicates a concentration on applications of biological discoveries that could be tied to the local biotechnology industry.

2) The applied focus indicates that there are limits to the extent of the program. Such limits are necessary for smaller programs. For example, the physics program will not be studying particle physics or string theory, but will pursue topics such as liquid crystals which have direct application to practical devices and local interests.

3) The applied focus complements the more traditional programs at other universities.

3. Duplication

There is not an equivalent Applied Science Ph.D. program in Colorado or in the region. This is not to say that a Ph.D. in Applied Science is so unusual that it would be unique, however. There are many examples of Ph.D. programs in Applied Science throughout the US and the world. Typically such programs include several of the following disciplines: Mathematics, Biology, Bio-technology, Computer Science, Physics, and Engineering.

We illustrate the philosophy and operation of Applied Science Ph.D. programs with excerpts from the descriptions of several of these programs.

1) Department of Applied Science, University of California, Davis

The UC Davis Department of Applied Science has been in existence for over forty years, and has graduated more than 350 Ph.D. students, many of whom have obtained positions in the national laboratories or in Silicon Valley companies. The program specializes in virtually all combinations of traditional fields, with emphasis on laser physics and technology, plasma diagnostics, fusion energy, accelerator technology, computational sciences, bioscience and biotechnology, materials technology, and environment/energy sciences.

2) The Graduate Program in Applied Science and Technology, UC Berkeley

The Graduate Program in Applied Science and Technology (AS&T) focuses on studies involving the application of physical and mathematical techniques to fundamental investigations and emerging areas within the physical and life sciences. Major areas of emphasis are in applied physics, engineering sciences, and mathematical sciences. AS&T is a Ph.D. program.

3) Ph.D. in Applied Science, College of William and Mary

> The Department of Applied Science is an interdisciplinary graduate department that offers M.S. and Ph.D. degrees in the physical and natural sciences. The program is offered by the core faculty of Applied Science in cooperation with affiliated faculty from the Departments of Biology, Chemistry, Computer Science, Mathematics, Physics, and the Virginia Institute of Marine Science (VIMS), as well as from the NASA Langley Research Center (LaRC) and the Thomas Jefferson National Accelerator Facility (JLab).

These examples show that several large universities have an Applied Science Ph.D. program. There are also examples of small university programs similar to the one proposed here. For instance, the University of Arkansas at Little Rock has an Applied Science Ph.D. which has options in biotechnology, applied chemistry, applied computer science, engineering science, and applied physics, but there are no individual Ph.D. programs in the individual disciplines. This program graduates an average of 4 Ph.D.s per year. This University was included in a 2006 list of potential UCCS Peers based on IPEDS data.

Oakland University, one of our UCCS peers, offers a Biomedical Sciences Ph.D. degree that involves the Physics, Biology and Chemistry departments. Again, none of these departments has a Ph.D. option outside of this joint program. In 2007, the program had 18 students enrolled in the Medical Physics option, 14 students enrolled in the Biomedical Environmental Chemistry option and 4 students in the Biological Medical Science specialization. This program typically graduates 3–4 Ph.D.s per year, a reasonable rate for a small program.

It is clear that there is a well-established tradition of Ph.D. programs in Applied Science. The combination of disciplines proposed at UCCS also clearly is quite typical for such a program.

4. Statutory Requirements

The proposed program conforms to all appropriate statutory requirements and the Student's Bill of Rights for a graduate program.

C. Program Quality and Institutional Capacity

1. Admission, Transfer and Graduation Standards

Applicants must:

- Hold a baccalaureate degree in biological sciences, mathematics, physics or equivalents from an accredited college or university.
- Have an undergraduate GPA of at least 3.00 ("A" is equivalent to 4.0).
- Non-English speaking applicants must complete the TOEFL exam with a minimum score of 525 (paper-based exam) or 200 (computer-based exam). If the

student has completed one year of full-time academic study at a U.S. institution, this requirement can be waived.
- Provide three letters of recommendation.
- Promising students who do not meet all of the requirements may be considered as provisional applicants.
- Graduate level courses completed outside UCCS prior to admission may be transferable into the program- up to 9 credit hours. Applicants with previous graduate coursework may request a review of their transcript and related materials to determine whether additional credits may be transferred.

These admission and transfer requirements are in agreement with general campus and college requirements. Individual options within the program may include additional entrance requirements, such as a GRE or a higher GPA.

Graduation standards for Ph.D. Degree in Physics, Mathematics, and Applied Bioscience:

To obtain a Ph.D. in Applied Science, a graduate student without a Masters degree must:
- Complete a minimum of 30 hours of course work, with at least a "B" in each class.
- Accumulate at least 30 hours of dissertation credit
- Accumulate the minimum number of credits required for graduation under the current UCCS Graduate School rules.
- Minimum GPA—3.0 on coursework
- Pass the Ph.D. Qualifying Examination.
- Meet with, and obtain a progress report from, thesis committee once each year after committee is formed.
- Submit an acceptable thesis reporting original research approved by the thesis committee.
- Pass a final oral examination by a committee (thesis defense).

Students transferring into the program with a Master's degree in an appropriate discipline also need to satisfy all the standards above. However, students may request a review of their existing credits and may have the number of credits required reduced at the discretion of the appropriate graduate advisor. If appropriate, the entire set of Master's degree courses can be applied to the Ph.D. program.

The standards listed above apply as minimum standards for all options within the Applied Science Ph.D. program. Specific disciplines may impose stricter requirements. The requirements for each of the options are listed below.

2. Curriculum Description and Assessment Process

a. Description of Program Requirements

We will have four options within the Ph.D. program, one for each of the disciplines involved, and a combined program which allows students to create a degree involving two or more of the base disciplines. Each of the individual disciplines will have fairly standard curricula with a core of required courses, additional elective courses, and qualifying exams covering 4–6 fundamental topic areas.

Program requirements: Physics

Complete a minimum of 36 hours of course work:
- 21 hours of Core courses
- 15 hours of Specialization, Elective or Interdisciplinary courses

Complete a minimum of 30 hours of dissertation work.

Total hours of course work and dissertation work must be 75.

Program requirements: Mathematics

Complete a minimum of 30 hours of course work:
- 24 hours of core course
- 6 hours of Specialization, Elective or Interdisciplinary courses

Complete a minimum of 30 hours of dissertation work.

Total hours of course work and dissertation work must be 75.

Program requirements: Applied Bioscience

Complete a minimum of 38 hours of course work:
- 30 hours of Core courses
- 8 hours of Specialization, Elective or Interdisciplinary courses

Complete a minimum of 30 hours of dissertation work.

Total hours of course work and dissertation work must be 75.

Program Requirements: Interdisciplinary

We will offer an additional option for students who desire a tight integration of two disciplines within the program. These students will have co-advisors from the two different disciplines. The student and the advisors will design a sequence of courses which is appropriate for the student's research direction and maintains academic rigor. Because the student in the interdisciplinary option will straddle two disciplines, the student will not be expected to take the full set of qualifying exams for both disciplines. However, the student must take two Ph.D. level qualifying exams from one or both disciplines, demonstrating an appropriate expertise in the selected interdisciplinary areas.

We note that the interdisciplinary aspect of the program is strongly supported by the three departments. Biology and Physics have had an ongoing collaboration for the past several

years. In addition, mathematics and physics are natural partners for an interdisciplinary program since they both use many of the same tools of mathematical analysis. These interdisciplinary areas also provide the opportunity for additional grants and contracts. There are frequently "calls for proposals" from the NSF, NIH and other agencies specifically to fund interdisciplinary work.

Complete a minimum of 36 hours of course work.
Complete a minimum of 30 hours of dissertation work.

Total hours of course work and dissertation work must be 75.

b. Courses supporting this program:

Physics Core courses: (21 hours)

Mathematical Physics	PHYS 503-3
Statistical Mechanics	PHYS 541-3
Theoretical Mechanics	PHYS 621-3
Electromagnetic Theory I	PHYS 631-3
Electromagnetic Theory II	PHYS 632-3
Quantum Mechanics I	PHYS 625-3
Quantum Mechanics II	PHYS 626-3

Physics Specialization and Elective courses:

Solid State Laboratory	PHYS 515-3
Thin Films Laboratory	PHYS 516-1
Computational Physics	PHYS 520-3
Physics of Materials	PHYS 542-3
Solid State Physics	PHYS 546-3
Surface and Interface Physics	PHYS 548-3
Physics of Thin Films	PHYS 549-3
Stellar Structure and Evolution	PHYS 572-3
Nonlinear Dynamics	PHYS 595-3
Magnetism and Magnetic Materials	PHYS 595-3
Theoretical Physics	PHYS 595-3
Condensed Matter Physics	to be created
Liquid Crystals	to be created
Optics	to be created
Biophysics	to be created

In addition, the program would allow elective graduate level courses from Mathematics, Biology and Engineering.

Two year course schedule for Physics

To minimize the request for resources many of the Ph.D. courses will be taught on an every-other-year schedule. This will also be done in the other disciplines. A detailed two-year plan for the course delivery for the physics courses is below.

Existing courses are shown in black. Courses which are to be introduced into the regular schedule are indicated in red italics. Some of these courses (Surface Physics, Magnetism, Solid State Theory and Nonlinear Physics) have been taught as a teaching overload, or taught irregularly by the department. Other courses (Liquid Crystals, Laser Physics and Optics and Math Methods II) are completely new courses designed to support the primary research interests of the department.

Year A

Fall	Spring
Phys 503 Math Methods in Physics I	*Phys 504 Math Methods in Physics II*
Phys --- Surface Physics	Phys 541 Statistical Mechanics
Phys 625 Quantum Mechanics I	Phys 626 Quantum Mechanics II
Phys --- Liquid Crystals	*Phys --- Modern Magnetism*
	Phys 515 Solid State Laboratory

Year B

Fall	Spring
Phys --- Nonlinear Physics	Phys 520 Computational Physics
Phys 621 Theoretical Mechanics	*Phys --- Laser Physics and Optics*
Phys 631 Electromag Theory I	Phys 632 Electromag Theory II
Phys --- Solid State Theory I	*Phys --- Solid State Theory II*
	Phys 516 Thin Films Laboratory

Curriculum Description - Mathematics

Present Courses

Linear Algebra	Math 513
Modern Algebra 2	Math 515
Higher Algebra 1,2	Math 517,518
Higher Geometry	Math 521
Chaos	Math 525
Algebraic Coding Theory	Math 527
Modern Analysis 2	Math 532
Measure Theory 1,2	Math 533,534
Functional Analysis	Math 535
Optimization	Math 542
Differential Equations	Math 543
Complex Analysis 1,2	Math 545,546

Applied Mathematics	Math 547
Math Modeling	Math 548
Numerical Analysis	Math 565
Scientific Computation	Math 567
Mathematical Statistics 1,2	Math 581,582
Stochastic Modeling	Math 585

New Courses

Applied Mathematics 1,2
Advanced Differential Equations 1,2
Advanced Probability and Statistics 1,2

Mathematics Core Courses (24 hours):

Normally, there is a set of year long courses that form the core of a Mathematics Ph.D. This includes:

1. Algebra
2. Complex Analysis
3. Differential Equations
4. Probability
5. Real and Functional Analysis

Students will choose four of the five core courses to meet the 24 credit hour requirement. It is anticipated that these year-long courses will be offered at least every other year, so that each student has an opportunity to take any of them in the first two years of a Ph.D. program.

The Mathematics Department provides some coverage of these courses now, but many of the existing courses are taught at the Master's degree level rather than at the Ph.D. level. In the description below, 'Ph.D.' will refer to a doctoral level course, 'M' will refer to a Master's level course, and 'I' will denote infrequently offered courses. Listed courses are one semester long.

Currently Available Courses with the "M" or "Ph.D." designation:

1. Algebra - Graduate Modern Algebra - (517 Ph.D.) and 513 (M) or 527 (M)
2. Complex Analysis - 445/545 (M) and 562 (Ph.D. – I)
3. Differential Equations – 443 (M) and 447 (M)
4. Probability -591 (Ph.D. – I) and 585 (M)
5. Real and Functional Analysis – 533 (Ph.D. – I) and 535 (M)

Two year course schedule for Mathematics.

To minimize the request for resources many of the Ph.D. courses will be taught on an every-other-year schedule will also be done in the other disciplines. A detailed two-year plan for the course delivery for the mathematics courses is below.

The table below gives a sample schedule for the mathematics track of the Applied Science Ph.D. program. Courses for students in their first year of the Ph.D. program are Masters degree level, and are offered every year. These are listed above the dotted line in each year's schedule. Courses below the dotted line comprise the regular schedule for Ph.D. students in their second and third years. The program is designed to allow students to start their Ph.D. level course work in either year A or year B.

The courses in Advanced Differential Equations, shown in blue bold, would be completely new courses developed for the Ph.D. program. Courses shown in red italics, Math 533, Math 543, Math 562, and Math 591 are existing courses that are offered irregularly or rarely. Adoption of this schedule would imply the addition of approximately four courses per year to the existing Masters program. (Some are currently being offered to the students enrolled in the mathematics track of the EAS Ph.D. program, which has been discontinued.)

Year A

Fall	Spring
Methods of Applied Mathematics (Math 547)	Modern Analysis II (Math 532)
Linear Algebra (Math 513)	*Ordinary Differential Equations (Math 543)*
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Real Analysis (Math 533)	*Functional Analysis (Math 535)*
Complex Variables (Math 545)	*Complex Variables II (Math 562)*

Year B

Fall	Spring
Methods of Applied Mathematics (Math 547)	Modern Analysis II (Math 532)
Linear Algebra (Math 513)	Ordinary Differential Equations (Math 543)
---	---
Advanced Differential Equations I (TBD)	**Advanced Differential Equations II (TBD)**
Stochastic Modeling (Math 585)	*Probability (Math 591)*

Curriculum Description – Applied Bioscience

The foundation of the program is a set of three courses, Advanced Biochemistry, Molecular Biology/Genetics, and Cell Biology. These courses are analogous to those in a typical Ph.D. core, such as for example, in the University of Colorado Health Science Center Immunology or Biophysics and Genetics programs.

The Applied Biosciences program (ABS) will be administered distinctly and separately from the undergraduate and master's degree programs in biology, even though some members of the Department of Biology will participate in the ABS program. The reason for this is that the Biology Department currently has a very large number of undergraduates and did not want to increase its responsibilities by administering the Ph.D. program. The Department of Biology collectively recognizes the importance of the Ph.D. program to its proponents and supports their involvement, thus adding to cooperation across departments and faculties. Existing courses offered by Biology will be available to students in the ABS program, and new ABS courses also will be available to students in Biology's master's degree program.

To ensure that there are sufficient faculty to offer the applied bioscience portion of the Ph.D. program and to make sure that the new courses do not negatively impact the current biology programs, we have identified highly qualified community members, in addition to the current biology faculty, who would be available and interested in teaching each of the proposed new courses.

These include Dr. Jerry Phillips and Dr. Wendy Haggren (Director of the SLC and UCCS Biology Instructor, respectively). In addition we have strong support from the local biotechnology industry community, including Dr. Ian Askill, and Dr. Ivan Rich, CEOs of local biotechnology corporations and experts in Biochemistry and in the Biochemistry of Metabolism, respectively. In this way, we have identified the majority of the needed instructors for both the existing and new courses that are listed without having to infringe upon the existing faculty whose schedules might not allow additional requirements in course work. Of course, other faculty in biology are welcome to participate and teach in the program if they have interest and the needs of the biology department are met. We included in our calculations the availability of at least 1–1.5 full time instructors.

All courses below are 3 credit hours unless otherwise noted. Courses in the Applied Bioscience program are designated as ABS courses, while other existing courses in Biology are listed as Bio courses.

Core Courses: required of ALL students

ABS 610	Advanced Biochemistry	
ABS 611	Molecular Biology/Genetics	
ABS 612	Cell Biology	
Phil 540	Phil 540, Philosophy of Science,	or
Phil 517	Health Care Ethics	

ABS 600	Graduate Bio Statistics
Bio 535	Tech Transfer and Biotechnology
ABS 650	Journal Club (1 credit/semester) 3 cr hours total
ABS 630	Research Lab Rotation (1-2 credit/semester) 6 cr hours total
ABS 670	Biochemistry of Metabolism

These core courses total 30 credit hours.

Electives

Methods in Immunology and Cell Biology	Bio 509
Advanced Immunology	Bio 531
Pathobiology	Bio 590
Principles of Virology	Bio 514
Principles of Epidemiology/Current Topics	Bio 500
Cancer Biology	ABS 620
Principles of Flow Cytometry	ABS 640
Bioinformatics	ABS 680
DNA Damage Repair	Bio 6xx
Physical Chemistry	Chem 451
Bio-Physical Chemistry	Chem 450

Two year course schedule for Applied Bioscience

To minimize the request for resources many of the courses will be taught on an every-other-year schedule as is also done in the other disciplines. A detailed two-year plan for the course delivery for the Applied Bioscience option is given below.

Existing courses are shown in black, and new courses which are to be introduced into the regular schedule are indicated in red italics. Among the new courses are ones designed to support the primary research interests of the department. This schedule includes existing courses offered by other departments which would be applicable to the Ph.D. degree.

We note that Lab Rotation plays an important role in the Applied Bioscience program. A particular advantage of the close contact to the local biotechnology community is that we have arranged that students will also be able to do lab rotations at these local industries. This will help students in the Ph.D. program gain a significantly enhanced perspective on research.

Year A

Fall	
Bio 509	Methods of Immunology
Bio 514	Principles of Virology
ABS 600	*Graduate Bio Statistics*
ABS 610	*Advanced Biochemistry*

ABS 620	*Cancer Biology*	
ABS 630	*Lab Rotation*	*(2 credit hours)*

Spring

Bio 531	Advanced Immunology	
Bio 535	Technology Transfer	
Bio 500	Principles of Epidemeology	
ABS 611	*Molecular Biology/Genetics*	
ABS 640	*Principles of Flow Cytometry*	
ABS 631	*Lab Rotation*	*(2 credit hours)*
ABS 650	*Journal Club*	*(1 credit hour)*
Chem 450	Bio-Physical Chemistry	
Phil 441	Philosophy of Biology	

Year B

Fall

Bio 509	Methods of Immunology	
Bio 590	Pathobiology	
ABS 600	*Graduate Bio Statistics*	
ABS 610	*Advanced Biochemistry*	
ABS 612	*Cell Biology*	
ABS 632	*Lab Rotation*	*(2 credit hours)*

Spring

Bio 531	Advanced Immunology	
Bio 535	Technology Transfer	
Bio 500	DNA Damage Repair	
ABS 670	*Biochemistry of Metabolism*	
ABS 633	*Lab Rotation*	*(2 credit hours)*
ABS 651	*Journal Club*	*(1 credit hour)*
ABS 680	*Bioinformatics*	
Chem 450	Bio-Physical Chemistry	
Phil 441	Philosophy of Biology	

c. Sample Curriculum - Coursework

Physics Sample curriculum – Experimental specialization – regular track

Semester 1: Mathematical Physics I, Quantum Mechanics I
Semester 2: Quantum Mechanics II, Modern Magnetism
Semester 3: Theoretical Mechanics, Electromagnetic Theory I, Solid State I
Semester 4: Electromagnetic Theory II, Laser Physics and Optics, Solid State II
Semester 5: Liquid Crystals, Surface Physics
Semester 6: Solid State Laboratory, Statistical Mechanics

Physics Sample curriculum – Theoretical specialization – regular track

Semester 1: Theoretical Mechanics, Electromagnetic Theory I
Semester 2: Electromagnetic Theory II, Computational Physics
Semester 3: Mathematical Physics I, Quantum Mechanics I
Semester 4: Quantum Mechanics II, Mathematical Methods II, Statistical Mechanics
Semester 5: Nonlinear Physics, Solid State I
Semester 6: Solid State II, Laser Physics and Optics

Mathematics Sample curriculum

Semester 1: Methods of Applied Mathematics (Math 547), Linear Algebra (Math 513)
Semester 2: Modern Analysis 2 (Math 532), Ordinary Differential Equations (Math 543)
Semester 3: Real Analysis (Math 533), Complex Variables (Math 545)
Semester 4: Functional Analysis (Math 535), Complex Variables II (Math 562),
Semester 5: Advanced Differential Equations 1 (TBD), Stochastic Modeling (Math 585),
Semester 6: Advanced Differential Equations 2 (TBD), Probability (Math 591)

Applied Bioscience Sample Coursework Curriculum

Semester 1: Advanced Biochemistry, Lab rotation, Grad Bio Statistics
Semester 2: Molecular Biology, Adv. Immunology, Philosophy of Biology, Journal Club
Semester 3: Cell Biology, Methods of Immunology, Lab rotation
Semester 4: Biochem of Metabolism, DNA Damage Repair, Lab rotation, Journal Club
Semester 5: Virology, thesis research
Semester 6: Tech Transfer, Principles of Flow Cytometry, Journal Club, thesis research

Interdisciplinary track Sample curriculum (Mathematics and Physics)

Semester 1: Differential Equations (Math), Electromagnetic Theory l (Physics)
Semester 2: Statistical Mechanics (Physics), Electromagnetic Theory II (Physics)
Semester 3: Statistics and Probability (Math), Quantum Mechanics I (Physics)
Semester 4: Scientific Computation (Math), Computational Physics (Physics)
Semester 5: Stochastic Modeling (Math), Nonlinear Dynamics (Physics)
Semester 6: Solid State (Physics), Math Modeling (Math)

d. Assessment plan for the Ph.D. degree

1. Evaluation of Student's Ability to Conduct Original Research

Students are expected to be able to produce publishable papers and present the papers at conferences. The number of papers and quality of the papers will be monitored. Students are expected to have an average of two publications or presentations by the time they graduate. Quality will be measured, in part, by the number of citations an individual

publication receives. We expect that, on average, there will be 2 citations on each published paper within a 5-year period after publication. (This assesses specific goals in section A.2.; goal 2, goal 4 and goal 6.)

2. Graduate Examinations

Ph.D. candidates will be required to pass three exams. The two qualifying exams will be a (1) written exam covering the core topics of the individual discipline(s) and (2) an oral exam that also covers the core topics. The final oral exam, at which the candidate presents the results of his or her dissertation research, is the last requirement for the Ph.D. These exams will be produced and evaluated by a group of graduate-school faculty in the appropriate discipline or disciplines. (This assesses specific goals in section A.2.; goal 1, goal 3 and goal 5.)

3. Exit Survey

Upon completion of their Ph.D. program, we will ask each student to fill out an exit survey. We will use these surveys to obtain information on the student's future plans and to determine the student's perception of his or her Ph.D. education. (This assesses specific goals in section A.2.; goal 1, goal 2 and goal 4.)

4. Ph.D. Dissertation

Candidates seeking the Ph.D. will be required to produce a written thesis, based on their original research projects, in order to obtain their degrees. As noted in the previous section, the final exam is an oral defense of the written thesis. The written dissertation will be evaluated by a group of graduate-school faculty from the appropriate discipline or disciplines. (This addresses specific goals in section A.2.; goal 2, goal 4, goal 5 and goal 6.)

5. Career Development

Long-term studies of the program’s impact on career development will be measured. We will gather feedback from students' employers and from other testing scores to change teaching methods and/or the curriculum as necessary. (This addresses the general goals outlined in section A.2.)

6. Program Advisory Board (External Review Team)

The Program Advisory Board, a committee composed of leaders primarily from industry and academia, will meet with the faculty to discuss the mission and performance of the graduate program at UCCS. The Board will be charged with providing advice and guidance to the program leadership on (i) maintaining the excellence of our education and research programs; (ii) developing stronger ties with the industries that hire our students; and (iii) establishing and maintaining an infrastructure to support life-long

learning. The periodic reports of the Program Advisory Board will be circulated to the faculty. (This supports the general goals indicated in section A.2.)

7. Alumni Surveys

With help from the University of Colorado Alumni Association and the Office of Institutional Research, we will create a survey of our alumni. The survey will be designed to determine whether our general and specific learning goals for our students were achieved, and if these goals were indeed relevant to the alumni's current work.

8. Exit Interviews

By conducting formal exit interviews, we hope to reach all graduates. The interview process should allow for more in-depth and individual information. Since our graduating classes will be relatively small, personal interviews are practical and will be conducted by the appropriate disciplines.

3. Professional Requirements or Evaluations

a. Professional Accreditation

There are no professional accrediting associations or licensing requirements associated with this program.

b. Timetables set to meet Professional Accreditation

There are no timetables that are required to meet any professional accrediting or licensing.

c. The qualifications of the faculty:

The program will be supported by individual faculty members within the departments of Biology, Physics, and Mathematics. Currently 5 faculty from Physics, 3 faculty and 1 instructor from Biology, and 9 faculty from Mathematics have expressed strong interest in the program. In addition, the Applied Bioscience option would be supported by at least two adjunct faculty from local industry. This would give a total faculty of about 20 for the Ph.D. program. This puts the proposed program in line with the Geropsychology Ph.D. program which has about 17 faculty members.

All of the faculty involved have a Ph.D. and are members of the UCCS or UC Denver graduate school. All of the faculty involved are tenured or tenure-track faculty, or instructors working under the direct supervision of a tenured or tenure-track faculty member. As mentioned earlier, Physics, Biology, and Mathematics already provide about 50% of the total research expenditures (using 2005 data) for the campus so the research component of the Ph.D. program seems very strong.

A one page vita of each person teaching in the program is included at the end of this proposal in Appendix B. Below is a one paragraph description of the faculty involved:

Gene D. Abrams has been a faculty member of the mathematics department at UCCS since Fall 1983. He has over 30 research publications and 6 pedagogy publications. He has traveled on sponsored visits to research institutions throughout the U.S. and Europe. His primary area of research is in algebra, specifically in the module categories over noncommutative rings. He is a winner of the UCCS campus-wide teaching award, and is a President's Teaching Scholar for the CU system.

James F. Burkhart: Professor Burkhart has been a faculty member of the Physics department for 30 years and has been chair of the department for 20 of those years. His research expertise is in radiation physics where he has been an active researcher. He has also collaborated with M. K. Newell in Bioenergetics. He is also very involved in the professional field of radon measurement/research, where he is the editor of the annual proceedings for the international radon meeting of the American Association of Radon Scientists and Technologists (AARST), serves on the board of directors of AARST, the board of the National Environmental Health Association Radon Program, the Colorado Radiation Advisory Board and the University of Colorado Radiation Safety Board. Dr. Burkhart is a President's Teaching Scholar for the University of Colorado and serves on the editorial board for the University Press of Colorado.

Robert E. Camley: Professor Camley has been a faculty member of the Physics department at UCCS for 24 years. He has over 170 research publications and over $5 million in research support as a PI or Co-PI. His primary area of research is in condensed matter theory with a specialization in surface excitations, multilayered structures, and magnetism. He has also collaborated with M. K. Newell in Bioenergetics. Prof. Camley is the Director of the Center for Magnetism and Magnetic Nanostructures and the Co-Director of the Institute for Bioenergetics. He is a winner of the campus-wide research award, the campus-wide teaching award and is a President's Teaching Scholar for the CU system.

Robert Carlson has been a UCCS faculty member since 1990. His current research interests include the spectral theory of differential operators on graphs, and network models in physiology. He worked at the Hughes Aircraft Company in Los Angeles from 1981-1990, rising to the position of senior scientist. Professor Carlson is the author of A Concrete Introduction to Real Analysis, coauthor of Linear Ordinary Differential Equations, and coeditor of Quantum Graphs and Their Applications. He received his B.S. in mathematics from MIT, and his Ph.D. in mathematics in 1977 from UCLA.

Radu Cascaval has been an Assistant Professor of Mathematics at UCCS since 2003. His primary research interests are in the area of mathematical modeling of physical and biological systems. Currently, his research focuses on developing mathematical models of the cardiovascular system, to include both analytical and computational components. Dr. Cascaval has supervised several undergraduate and graduate students working on research projects in the area of mathematical biology and physiology. He has also been

instrumental in incorporating modern computational tools in the mathematics instruction at UCCS.

Zbigniew Celinski's research interests are in the area of magnetism and magnetic materials. He has also collaborated with M. K. Newell in Bioenergetics. He has published 95 papers and has over 1500 citations in the scientific literature. He is a recipient of 13 awards, among them UCCS Research Award (2001), Postdoctoral Fellowship from National Science and Engineering Research Council of Canada (1992), and Junior Fulbright Scholarship (1986, USA). Dr. Celinski has been invited to present results of his research numerous times at scientific institutions and conferences in North America, Europe, Australia, and Asia.

James E. Daly has been a faculty member at UCCS since 1984 and a full professor since 1998 in the Mathematics Department. He has held numerous administrative positions (dept. chair, assoc. dean, Mathematics lab director) and chaired a number of important campus committees (e.g. EPUS, VCAA search comm., budget comm.-4 years). While being administratively active, he maintained an excellent teaching and research record. His area of research is harmonic analysis and he has published 25 papers in this area. In recent years, he developed a number of innovative courses in statistics for our students and local K-12 teachers.

Ronald E. Gill's research is focused on the complex, multicellular response of the bacterium Myxococcus xanthus to nutritional limitation. When populations of these "social" bacteria encounter conditions of carbon and energy limitation, they enter into an elaborate, developmental process that culminates in the formation of multicellular structures, each containing several hundred thousand cells, in which a portion of the population differentiates into environmentally-resilient, metabolically-inactive spores. This developmental process is coordinated and organized through several genetically-defined inter-cellular signaling steps. Dr. Gill uses genetic and biochemical techniques to understand the way in which these bacterial populations sense and respond to carbon and energy limitation. He is seeking to define the cellular genetic regulatory mechanisms that are utilized. He also studies biochemical and regulatory aspects of an essential inter-cellular signaling event that is critical for the population's immediate response to starvation.

Anatoliy Glushchenko is an Assistant Professor of Physics at the University of Colorado at Colorado Springs. His area of expertise is in soft condensed matter physics and more particularly in liquid crystals, applied optics, and material science. Dr. Glushchenko received his Ph.D. at the Institute of Physics (Kyiv, Ukraine); he worked at LG-Phillips (Seoul, South Korea), at Martin-Luther University (Halle, Germany), and at the Liquid Crystal Institute (Kent, OH). He is a recipient of the Inventor Recognition Award and Inventor of the year Award from Kent State and from UCCS, respectively. Dr. Glushchenko is the driving force behind the new Liquid Crystal Research Lab at UCCS.

Marek Grabowski has been in Physics faculty since 1985. His research interests include Theoretical Condensed Matter Physics (superconductivity, correlated fermions, low

dimensional and artificially structured systems), Nonlinear Physics and Dynamical Systems (solitons, deterministic chaos, nonlinear optics, complex systems in mathematical biology), and Foundational Problems in Physics (nonlinear vector spaces in quantum theory, causal sets theory of quantum gravity). He has taught a large variety of graduate level courses both here, at UCCS, as well as at a number of other institutions in the U.S. and Europe. He is also a recipient of College and Campus Outstanding Teacher Awards.

Robert Melamede's lab researches the impact of free radicals on living systems. He examines biochemical relationships that produce or suppress free radical production and how they impact on the whether cells live or die. Specifically, the impact of turning on or off the components of the endocannabinoids system, the effects of drugs that modulate cellular metabolism, and the expression of base excision DNA repair enzymes are examined in drug sensitive and drug resistant cells.

Gregory J. Morrow has been a Mathematics faculty member since 1986. His research is in Probability Theory. This research is influenced and inspired in part by collaborations with the probability group at UCCS. His research focus on percolation models includes connections to the field of critical phenomena in mathematical physics. Morrow has co-organized several conferences in probability in collaboration with his colleagues at UCCS as well as with probabilists from other Front Range institutions. His courses on Chaos and Fractal Geometry have helped shape graduate studies in mathematics since 1990. Morrow has served as an Associate Chair of Mathematics at UCCS.

Karen Newell earned a doctoral degree in microbiology and immunology from the University of Colorado Health Sciences Center in 1987 and did postdoctoral work at McGill University in Montreal and the National Jewish Center for Immunology and Respiratory Medicine in Denver. Newell taught and began her research at Dartmouth University and the University of Vermont before coming to the University of Colorado at Colorado Springs in 1999. Newell is an associate professor in the biology department and is the director and chief scientist at the CU Institute for Bioenergetics on the UCCS campus. She has collaborated actively with faculty in Physics and Mathematics. She is president and scientific director for Newellink, Inc. which has licensed her patented technology for manipulating metabolism to fight disease. Dr. Newell holds over 75 pending and issued patents and 56 publications and published her first textbook in January 2007.

Jerry L. Phillips research has focused on the biological effects of physical agents, particularly electric and magnetic fields at cellular telephone frequencies and at 60 Hz. Data has been obtained on changes in the expression of the oncogenes, *c-fos* and *c-jun*, as well as the gene encoding the transcriptional regulator, ICER. Recent studies found changes in DNA damage to exposed cells that were dependent on the period of exposure, the frequency and modulation of the field, and the intensity of the field. Future studies will be in two areas: effects of exposure on cellular metabolism, and effects of exposure on DNA repair mechanisms.

Rinaldo B. Schinazi has been at UCCS since 1991 except for 2001-2003 where he was a Professor at the University Aix-Marseille. His research focuses on probability models for population biology. He has written over 30 research articles and was awarded several grants by NSF and NSA. He is also the author of two books Classical and spatial stochastic processes and Probability with Statistical Applications (both published by Birkhauser). He received his Ph.D. at the University of Sao Paulo and his undergraduate studies were done at Paris VI.

Seung Son has been a faculty member of the mathematics department for five years. His area of expertise is Ramaujan's theory in Number Theory. Applied areas are coding, cryptography, numerical analysis, relational database design, system administration, and software engineering. With various programming skills and computational techniques, he helps students design programs for complex tasks and projects in various areas. In one word, he is the "tech" person of the department.

Yu Zhang received his Ph.D. in Mathematics from Cornell University in1990.
He is currently a Professor in the Mathematics department at UCCS. His research interests include General Probability Theory, Mathematical Physics Models including Percolation Theory, Infinite Particle Systems, Matching sequences and Random Graphs.

4. Institutional Factors

a. Diversity Goals

The disciplines and campus support a goal to increase the diversity of staff, faculty and students. The program will work with campus resources to recruit and retain people who contribute to the diversity of the program and the campus as a whole. This program will advance the campus diversity goal - “We will aggressively seek the development of a multicultural campus environment in which each person contributes unique talents to make the University of Colorado at Colorado Springs a better place and in turn is fully valued and supported. We will reaffirm the tradition of shared governance and encourage all members of our campus community to join together in creating a positive working environment where all enjoy respect, fair treatment and a voice in campus decisions.”

b. Effect on Instruction, Research and Service and other Campuses

It is anticipated that this program will enhance instruction, research and service on the campus. The existing undergraduate and graduate programs in the disciplines represented in this proposal will be significantly strengthened due to a number of factors:

1) The Ph.D. will enhance current undergraduate and graduate programs by creating a group of graduate students who could be qualified TA's and/or instructors for lab courses and lower division introductory courses. Having a group of Ph.D. students would also strengthen the MS programs by allowing MS students to "see" a possible next stage of their career.

2) The Ph.D. will allow students who are interested in an advanced degree to continue their work at UCCS. This is important for students who are tied to this region for family or employment reasons, for example.

3) The Ph.D. in Applied Science will enhance current graduate enrollments. Most students entering graduate programs look for institutions which have Ph.D. programs. For example in 2003:

> 93.7 % of all students in graduate biology were in schools with Ph.D.s;
> 97.2% of all students in graduate physical sciences were in schools with Ph.D.s;
> 89.3% of all students in graduate mathematics were in schools with Ph.D.s.

These statistics show that the graduate student population overwhelmingly prefers universities with Ph.D. programs. Thus, we are significantly limiting our graduate enrollment by not having a Ph.D. program and we expect the Ph.D. program to substantially aid the Masters Degree programs as well.

4) The Ph.D. in Applied Science will enhance the learning experience of undergraduate and graduate students by bringing in state-of-the-art equipment that would otherwise not be funded by the State of Colorado. This equipment will be used in research and will also be available for coursework. For example, undergraduate students in Biology become familiar with the flow cytometry method of characterizing cells. Undergraduate students in Physics become familiar with a variety of deposition techniques including RF sputtering and molecular beam epitaxy. None of this equipment would be available without grant funding.

The effect on research will also be significant and positive:

1) The Ph.D. program would allow faculty members who are interested in mentoring Ph.D. students to do so. This will help support research on this campus because many research projects require significant training and experience to carry out. Currently our students are limited to MS programs and their graduate work is strongly focused on coursework rather than research. Thus, our students do not have the time to develop the expertise to contribute substantially to a research program. This significantly limits the number and type of grants that we can obtain on this campus.

2) External reviewers often downgrade grant proposals from UCCS because of the lack of Ph.D. programs. A Ph.D. program in Applied Science should eliminate this problem.

High-level research work is often funded by national agencies such as the NIH or NSF. Reviewers from these agencies expect that proposals will come from Ph.D. level universities. It is an unfortunate, but very common, experience for the faculty in the sciences to have proposals, which are considered interesting and appropriate, turned down simply because the reviewer does not expect that such a proposal can be successfully carried out at a non-Ph.D. granting institution. This is clearly a substantial

problem for the faculty and for the university as a whole, and could be eliminated by the creation of the Ph.D. program in Applied Science.

Because this program does not duplicate any other programs in the state, and because the program is expected to be attractive regionally, other campuses will not be impacted by this program.

c. Effect on Existing Resources

The existing space resources (classrooms, laboratories and common areas) allotted to the College are adequate for the proposed program. The new Science and Engineering Building, scheduled to open in Fall of 2009 significantly enhances classroom, office and laboratory space. Small enhancements to the library and departmental budgets have been incorporated into the budget. The primary impact on resources is due to the request for new faculty. We believe that tuition and new research monies will eventually offset the cost of the new faculty. Furthermore, we note that the new faculty will not solely support the graduate program, but will also support undergraduate programs and existing graduate programs. Therefore the cost of the new faculty can not be solely attributed to the Ph.D. program.

We point out that the PhD program will not require substantial increases in library expenditures. The reason for this is that the library journal collection (in electronic form) has expanded greatly in the past few years. For a research-based PhD program, it is the current journals which are most important and these are now quite extensive. From the library web pages we see that there is access to at least 250 Mathematics journals, 240 Physics journals, and 300 Biological and Health Science journals.

d. Formal and Informal Relationships with Other Parties:

There are no formal relationships associated with this program at this time. The Air Force Academy has indicated it will financially support at least two students per year if those students participate in investigations with researchers at the Academy. The Dean of the College of Letters, Arts and Sciences has also discussed with an Air Force Academy representative the possibility of undergraduate AFA students taking graduate classes at UCCS. In return, students from UCCS would also be able to use research equipment and facilities at the Academy. We note there are many research labs at the Air Force Academy including two in physics, one in computer science, one in chemistry and one in biology.

5. Physical Capacity and Needs

a. Space Estimates

Because of the new Science and Engineering Building opening in Fall, 2009, the additional space needs of the three disciplines are fairly minimal. Mathematics is

requesting two additional offices over the next four years for graduate students teaching in the department. Neither Physics nor Bioenergetics is requesting any space in addition to the space already being built in the new Engineering expansion and the space presently held by the two departments.

Table 2, in Appendix A, gives the space estimates for program space requirements based on existing and five-year space planning assumptions and program size data (from curriculum and student load projections and projected use of special or dedicated facilities).

b. Program Delivery

The program is designed to be delivered on campus and will use a teaching schedule that accommodates working professionals, e.g. most courses will be offered after 4:30 in the afternoon.

c. Additional Facilities or Renovation Required

There are no additional facilities or renovation required for this program.

6. Cost Description and Source of Funds

a. Summary of Costs Associated with the new Ph.D. in Applied Science

The costs associated with the program are discussed below and are displayed in detail in Table 3 in Appendix A. The primary costs are for new faculty lines which are necessary to strengthen each of the three disciplines involved, e.g. the additional faculty will allow an increased range of graduate courses and an increased range of research topics. We note that the program can begin with the current faculty and we have suggested a six year phase-in of the new faculty. In addition to the faculty positions, we are requesting some support for graduate students and small increases in the travel budgets associated with the participating faculty members.

We note that Table 3 overestimates the costs of the Ph.D. program. Although the new faculty are requested in order to support the Ph.D., all of their effort and time will not be devoted solely to the Ph.D. program. Indeed it is expected that they will also teach in the current undergraduate programs and perform service as expected from faculty members. We note that the UCCS 7 Year Growth Plan currently calls for an addition of 42 faculty members by 2012. Given the present rate of growth it is likely that each of the three disciplines would obtain additional positions over this period. We are requesting that these positions be allocated now to support the Ph.D. program. Again, to minimize the impact on other programs, we have suggested the six tenure track and instructor positions could be phased in over time.

The key requests for each department are outlined below.

Mathematics

New faculty:	One new position - $58,000 per year plus benefits
Instructor:	One half-time position - $17,870 per year plus benefits
Student Support:	Eight stipends of $ 5,500 per year for advanced students in the Ph.D. program, for a total of $44,000 annual cost once all eight students are in place. This will be phased in as the number of students increases. Students will also teach as lecturers (paid by the department).
Travel:	An additional $ 6,000 per year, over and beyond the current $7,000 per year.
Space:	Two additional offices over the next 4 years.

Mathematics: Justification for New Resources

The adoption of the Applied Science Ph.D. program would increase instructional demand on the Mathematics faculty in two ways. First, the addition of approximately four advanced graduate courses per year requires the addition of more than one new faculty position. Because the Mathematics Department already makes heavy use of nontenure track lecturers, this increased demand cannot be met without the addition of at least one new tenure track faculty member. Second, once Ph.D. students begin individualized study and research, regular consultation with faculty members will effectively add a load of approximately one course per semester for each four students. Unlike laboratory sciences, supervision of Ph.D. students in mathematics does not normally provide direct support to the advisor's research program. At the beginning of the program the development of new courses or the revival of rarely taught courses will also add to the instructional load of the department. Some of this burden will be offset by the addition of a half-time instructor.

Physics

New faculty:	One new position $59,000 plus benefits
Instructor:	One half-time position $17,870 plus benefits
Student Support:	Approximately $ 27,000 total per year for 1.5 RA's The rest of the students' support will come from grants from individual faculty (RA's) and teaching (TA's serving as lecturers).
Travel:	An additional $ 4,200 per year, starting year one. This will be used to augment the current $600/year travel stipend for faculty involved in the new Ph.D. program who do not have travel grants.
Space:	No new space required. We do need to keep the space we currently have assigned, however, including the space in the campus services building, Engineering Building and new Science and Engineering Building..

Physics: Justification for New Resources

The Physics Department is proposing to add two to three courses per semester to create the Ph.D. graduate program. As mentioned earlier, some of these classes have been taught before - occasionally as an unpaid overload - so all the classes do not need to be developed, but they need to be funded properly. The department has requested one new faculty position. Because the normal teaching load is two courses per semester, this one new faculty position would allow all the graduate courses above to be taught on a regular basis. It is anticipated that the entire department would share in teaching the graduate courses, as is currently the case.

We also point out that the dissertation research must be advised and guided by graduate faculty and that the new position will help significantly in supporting this function.
.
The Physics Department is also proposing to add one half-time instructor to help strengthen the undergraduate program so that it is not adversely influenced by the new Ph.D. program. In fact the research program in Physics has been significantly supporting the teaching mission of the department for the past three to four years. A large grant has allowed a total of four off-loaded courses per year. The grant paid for these off-loads and the money has been used to hire a full-time instructor who teaches a total of 8 courses per year. When this grant expires, the department will need some additional resources to cover the current courses. Furthermore, the development of new courses or the revival of rarely taught courses will also add to the instructional load of the department at the beginning of the program. Some of this burden will be offset by the addition of a half-time instructor.

Applied Bioscience

Instructors:	1.5 new instructors - $53,610 per year plus benefits
Travel:	Enhanced travel for participating faculty – total $3,000 per year
Student Support:	Most of the student support will come from new and existing grants. A request is made for partial support for two RA's, at $7,000 each for a total of $14,000 per year.
Space:	No new space required.

Applied Bioscience: Justification for New Resources

The largest request for new resources is associated with the new courses to be developed and offered on a regular basis. It is proposed that approximately 4 courses per semester be added to the Applied Bioscience schedule to create the Ph.D. graduate program. As discussed earlier, we have already identified highly qualified instructors for these courses. However the courses need to be funded, and this will be accomplished by the additional funding for 1.5 instructors. Part of the 1.5 instructor positions will be used to offset additional administrative and advising responsibilities associated with the Ph.D. program.

Summary of Costs for the Ph.D. in Applied Science

This proposal would establish the track in Applied Bioscience and would provide instructor support to allow interested Biology faculty to participate in the Ph.D. without negative impact on the other degree programs. Implementation in Mathematics and Physics is sufficient to allow the program to begin.

- Faculty:
  - Mathematics:
    - TT: Develop stand-alone core graduate classes (6 classes per year)
    - TT: Assist with advising of Ph.D. students
    - TT + Instructor: Provide replacement instruction at undergraduate level
      - One tenure track position $58,000 + benefits
      - 0.5 instructor $17,870 + benefits
  - Physics
    - TT: Develop specialized elective graduate classes (4 classes per year)
    - TT: Assist with advising of Ph.D. students
    - TT + Instructor: Provide replacement instruction at undergraduate level
      - One tenure track position $59,000 + benefits
      - 0.5 instructor $17,870 + benefits
  - Biology (partial implementation)
    - Instructor: Provide replacement instruction at undergraduate level
      - 1.5 instructor $53,610 + benefits
- graduate student support
  - Mathematics
    - 8 stipends @ $5500 $44,000 + benefits
  - Physics
    - 1.5 research assistants @ $18,000 $27,000 + benefits
  - Biology (partial implementation)
    - 2 partial research assistants @ $7000 $14,000 + benefits
- travel
  - Mathematics
    - $600 x 10 faculty $6000
  - Physics
    - $600 x 7 faculty $4200
  - Biology
    - $600 x 5 faculty $3000

b. Summary of Sources of Funds with the new Ph.D. in Applied Science

The program will be funded through student tuition, general funds and research grants and contracts. In addition some external support for the program may be available as indicated by the desire (discussed above) of the Air Force Academy to fund two students per year. Below we estimate the income the established program will generate based both on tuition and research.

- **Estimated Tuition** is determined by assuming an average enrollment of 20 students a year:

  20 students @ 16 credit hours/year and $370 tuition/ credit hour = **$118,400**

- **Increase in Grant Funding – Current Faculty**

  We anticipate a 20% increase in grants for faculty in the program. Current funding for faculty participating is $ 1.2 million/year. Therefore, the estimated increase 20% of $1.2 million would be = **$240,000**

- **Increase in Grant Funding – New Faculty**

The new faculty hired into the program must be research-centered in order to support the Ph.D. program. Recently hired faculty in Physics have been bringing in about $100,000/year in grant funding. So, we estimate $50,000 on average for the future new faculty in the program.

2 new faculty at $50,000/year = **$100,000**

- **Total income from new program = $458,400 / year**

The $458,400/year represents an estimate of the total income this program will generate. Although not all of this money is available to support the program, it is all of benefit to the University of Colorado at Colorado Springs because it represents new equipment, student support and indirect cost recovery (F&A). Some general funds will be required.

Statement from the Dean

A written statement from Dean Tom Christensen verifying the adequacy of resources to support the new program can be found in Appendix A, right after Table 3.

Appendix A

CCHE Tables

Appendix A

TABLE 1: ENROLLMENT PROJECTIONS

Name of Program: Ph.D. in Applied Science

Name of Institution: University of Colorado at Colorado Springs

		Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Full Implementation
1-a	In-state Headcount	6	9	12	14	16	18
1-b	Out-of-State Headcount	1	1	1	2	2	2
2	Program Headcount	7	10	13	16	18	20
3-a	In-state FTE	3.2	4.8	5.3	7.5	8.5	9.6
3-b	Out-of-state FTE	.5	.5	.5	1.1	1.1	1.1
4	Program FTE	3.7	5.3	5.8	8.6	9.6	10.7
5	Program Graduates				1	2	3

(Attach a brief description explaining the specific source data for projecting the program headcount (e.g., actual enrollment in a similar program at a comparable college).

We have created the required table above on headcounts and FTE for the program using the estimates from the table in section B-1. We have assumed that each student will take an average of 16 credit hours per year. To calculate FTE, we have multiplied the number of students times the projected number of credit hours students will be typically enrolled in per year and divide by 30. The assumptions for enrollments are discussed in section B-1.

_____ _____

Signature of Person who completed the Enrollment Table Title Date

TABLE 2: PHYSICAL CAPACITY ESTIMATES

Name of Program: Ph.D. in Applied Science

Name of Institution: University of Colorado at Colorado Springs

Purpose: This table documents the physical capacity of the institution to offer the program and/or the plan for achieving the capacity. Complete A or B.

Part A

I certify that this proposed degree program can be fully implemented and accommodate the enrollment projections provided in this proposal without requiring additional space or renovating existing space during the first five years.

_____ _____

Campus Capital Construction Officer Date

Part B

	Column 1	Column 2	Column 3		Column 4		Column 5	Column 6
ASSIGNABLE SQUARE FEET	TOTAL NEEDED	AVAIL-ABLE	RENOVATION		NEW CONSTRUCTION		LEASE/ RENT	REVENUE SOURCE*
TYPE OF SPACE			Immed.	Future	Immed.	Future		
Classroom								
Instructional Lab								
Offices								
Study								
Special/General Use								
Other:								
TOTAL								

* Capital Construction Fund (CCF), Research Building Revolving Fund (RBRF), Gift (GIFT), Grant (GR), Auxiliary Fund (AUX)

Attach a narrative describing the institutional contingency plan that addresses the space requirements of the proposed program or alternative delivery options, in the event that the request for capital construction or renovation is not approved.

_____ _____

Signature of Person who completed the Institutional Physical Capacity Table Title Date

TABLE 3: PROJECTED NEW EXPENSES FOR NEW PROGRAM

(Do not include an inflation factor when projecting over 5 years)

I. Expenses

Below, list all new expenses that will be incurred over the first five years (by year) of the new program, broken into the categories provided. Following the table, provide a narrative that, for each category of expense, identifies the source of funds that will cover these expenses: tuition, COF or fee-for-service funds, clinical income, and endowment, gift, grant or contract funds.

If expenses are to be covered by reallocation of existing resources, specify what activities and costs will be discontinued and how existing resources/responsibilities will be reallocated. Be quite specific.

		ESTIMATED AMOUNT in DOLLARS				
		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Operating Expenses						
1	Faculty + Instructors	111,688	184,188	257,938	257,938	257,938
2	Financial Aid specific to program- Grad students	53,125	85,000	85,000	85,000	85,000
3	Instructional Materials					
4	Program Administration	2,800	2,800	2,800	2,800	2,800
5	Rent/Lease					
6	Laboratory & Other Operating Costs- travel	6,000	10,000	13,200	13,200	13,200
7	Total Operating Expenses	173,613	281,988	358,938	358,938	358,938
Program Start-Up Expenses						
8	Capital construction					
9	Equipment Acquisitions	2,000				
10	Library Acquisitions	2,000	2,000	2,000	2,000	2,000
11	Total Program Start-Up Exp.	4,000	2,000	2,000	2,000	2,000
TOTAL PROGRAM EXPENSES		177,613	283,988	360,938	360,938	360,938

Line 1: Faculty and instructor salaries plus benefits. All years have 2.5 instructors. One faculty member is added in the 2nd and 3rd years.

Line 2: Graduate student support – Estimated at $91,800 for the established program, the costs are phased in over 4 years as the number of students grows.

Line 4: Supplies and postage, marketing

Line 6: Travel – Estimated at $13,200 for the established program, the costs are phased in over 4 years.

Line 10: Enhanced funding for Library

II. Narrative Explaining How Costs are to be Covered

Will any new cash revenue be generated by this new program? How much and from what sources?

As indicated in Section 6b we estimate that this program will generate about $658,400 in new revenue, once the program is fully established. This revenue will come from tuition and research grants and contracts. Furthermore, there may be additional tuition revenues due to increases in existing undergraduate and graduate programs. As this is difficult to measure, we have not included it in the estimate above.

III. Dean's Statement.

I support this proposal for a new Ph.D. in Applied Science. In terms of the academic development of the campus, it represents a logical next step. The Science and Math departments all have strong Master's Degree programs and good records of grant activity. The research level of the departments is appropriate to begin a Ph.D. program. The departments have faculty who are committed to excellence in teaching and learning as well as research.

Given the existence of Master's degrees, some coursework is already available supported by current resources. Additional resources are requested from the campus in this proposal. The request for resources appears to be reasonable in order to get the Ph.D. program started at a modest, but sustainable level.

Appendix B

One Page Resumes of Faculty

APPENDIX B: One Page Resumes of Faculty

Gene Abrams
Professor, Department of Mathematics, University of Colorado at Colorado Springs
abrams@math.uccs.edu

Education: Ph.D. in Mathematics, University of Oregon, Eugene, August 1981
Appointments: 1. Assistant / Associate / Full Professor, Department of Mathematics, University of Colorado at Colorado Springs, 9/83 - Present (Department chair: 8/95 – 6/98)
2. Instructor, Department of Mathematics, Colorado College, 9/81 – 6/83
3. Graduate Teaching Fellow, Dept of Mathematics, University of Oregon, 9/76 – 6/81
Professional Societies: 1. American Mathematical Society (AMS), 1977 – present
2. Mathematical Association of America (MAA), 1996 – present
3. Colorado Council of Teachers of Mathematics (CCTM), 1999 - present
Mathematics Research Publications in Refereed Journals: More than thirty solely authored or co-authored articles since 1982, including six articles produced since fall 2004. Area of specialty: algebra, more specifically noncommutative rings and categories of modules.
Mathematics Pedagogy Publications in Refereed Journals: Eight articles on various aspects of mathematics pedagogy. Topics include the UCCS *MathOnline* program, and the Sky Sox Math Youth Days program for K-8 students.
Various Awards / Recognition: 1. "2002 Teacher of the Year", UCCS College of Engineering and Applied Science. (One award given per year.)
2. "2002 Annual Award for Distinguished Teaching", Rocky Mountain Section of the American Mathematical Society. ("Burton W. Jones Award"; one award given per year.)
3. "President's Teaching Scholar," University of Colorado system wide award, May 1996. Highest recognition of teaching and research in the CU system. (Less than 3% of faculty achieve this lifetime designation.)
4. "1988 Outstanding Teaching Award", UCCS campus wide award. (One award per year.)
Presentations on Mathematics Research: More than three dozen invited hour-long research colloquium talks given at various universities throughout the world, including six since January 2006. More than two dozen 20-30 minute talks at professional meetings.
Various grants awarded: 1. "Evaluating the Benefits of Providing Online Video Lectures to In-Class Students Enrolled in Math Courses at UCCS" (with R. Cascaval), Spring 2007, $2800.
2. "Leavitt path algebras", awarded by the Ministerio Educación y Ciencia de España and Universidad de Málaga. Travel grant and salary to visit the Universidad de Málaga to work with G. Aranda Pino and M. Siles Molina, 2 May – 25 July 2006. Total award: $15,951.
3. "SPECTRUM 2000: SPearheading Education, Consultation, and TRaining in the Usefulness of Mathematics" (with 4 co-PIs), awarded through the Colorado Institute of Technology, to deliver a workshop to K-8 teachers, June 2000. Total award: $32,080.

James F Burkhart

University of Colorado, Colorado Springs
Colorado Springs, CO 80933-7150
Feb 2006

Education History

B.S. in Physics and Mathematics, University of Wisconsin-La Crosse, 1968 (Cum Laude)
M.S. in Physics, University of Wisconsin-Milwaukee, 1970
Ph.D. in Theoretical Physics, University of Wisconsin-Milwaukee, 1973

Honors and Fellowships

Graduated with Honors, University of Wisconsin, La Crosse, 1968
University Fellowship, University of Wisconsin, Milwaukee, 1968
N.D.E.A. Fellowship, University of Wisconsin, Milwaukee, 1970
N.D.E.A. Fellowship, University of Wisconsin, Milwaukee, 1972
Outstanding Teacher Award, University of Colorado, Colorado Springs (campus-wide award), 1982
Outstanding Teaching Award, College of Letters, Arts and Sciences, UCCS, 1986
Presidential Teaching Scholar, University of Colorado, 1991.
Chancellor's Award, University of Colorado, Colorado Springs, 1995.
2004 Pi Beta Phi, Outstanding Professor of the Year, UCCS Engineering Sorority, 2004

Selected Publications

"The Correlation of Indoor Radon Concentration to Commonly Available Geologic Data", J.F. Burkhart and T.P. Huber, Journal of Environmental Management, Vol. 17, No. 2 pp. 249-256, 1993.

"A Survey of Public Drinking Water Systems on Wells in Colorado", J.F. Burkhart, L.A. Martin, S.L. Kladder, D.L. Kladder, 1999 International Radon Symposium, pp. 17.0-17.7, 1999.

"Lung Cell Immune System Response Due to Irradiation by Alpha Particles", J.F. Burkhart, R. E. Camley, Proceedings of the 2002 International Radon Symposium, Vol. 1, pp. 51-62, 2002.

"Corrections for overdispersion due to correlated Counts in radon measurements using grab scintillation cells, activated charcoal devices and Liquid scintillation charcoal devices" by Jenkins, Burkhart, and Kershner. (Accepted chapter in the ACS/Oxford UP book, January 2006).

"Using a Pressure Chamber to Determine Cell Counting Efficiencies as a Function of Elevation", James F. Burkhart, Phil Jenkins and Eric Morland, American Association of Radon Scientists and Technologists, Proceedings of the 2006 International Radon Symposium. Kansas City, KS, September, 2006. Volume 1, Pages 67-75

Robert E. Camley

Department of Physics and Energy Science, University of Colorado at Colorado Springs,
719-262-3512 Office, 719-262-3013 Fax
E-mail address: rcamley@uccs.edu

Education

1979	Ph. D.	Physics, University of California, Irvine
1977	M. A.	Physics, University of California, Irvine
1973	B. A.	Physics and Mathematics, University of California, Irvine

Professional Experience

1991 - present	Professor of Physics University of Colorado, Colorado Springs
1982 - 1991	Assistant Professor (82-85) and Associate Professor of Physics University of Colorado, Colorado Springs

Publications and Grants

Number of publications in peer-reviewed journals: 168
Grants received (as PI or co-PI) - over $5 million

Awards

Research Award – College of Letters, Arts, and Sciences, University of Colorado at Colorado Springs, 2000
President's Teaching-Scholar – System Wide – University of Colorado, 1999
Research Award - Campus Wide, University of Colorado at Colorado Springs, 1997
Outstanding Teacher of the Year Award - Campus Wide - University of Colorado at Colorado Springs 1986

Recent Administrative and Visiting Positions

2001 - present	Director – Center for Magnetism and Magnetic Nanostructures
2003 - present	Co-Director – CU Institute for Bioenergetics
2005 May-June	Theory Institute – Argonne National Laboratory
2001 July	Theory Institute – Argonne National Laboratory
1995 July - July 1996	Research Fellow, University of Essex, Colchester England
1994 June - July	University of Essex, Colchester, England

Robert Carlson
Department of Mathematics
University of Colorado at Colorado Springs
Colorado Springs, CO 80918

Education

1973-77 Ph.D. Mathematics, University of California at Los Angeles
1969-73 B.S. Mathematics, Massachusetts Institute of Technology

Current Research Interests - Spectral theory of differential operators on graphs, network models in physiology

Employment

1990-present University of Colorado at Colorado Springs, Professor (2001), Chairman (2002-2004)
1981-1990 Hughes Aircraft Company, Los Angeles, CA, Senior Scientist
1977-1980 University of Utah, Instructor of Mathematics

Patent

(with R. Rosen) Efficient Multi-target Tracking Method,
U.S. Patent 5,379,044, 1995

Books
1. Quantum Graphs and Their Applications, American Mathematical Society, 2006 (editor, with G. Berkolaiko, S. Fulling, and P. Kuchment)
2. A Concrete Introduction to Real Analysis, Chapman-Hall/CRC Press, 2006
3. Linear Ordinary Differential Equations, SIAM, 1997 (with E. Coddington)

Recent Papers
1. Linear network models related to blood flow, in Quantum Graphs and Their Applications, AMS (2006)
2. A note on analyticity and Floquet isospectrality, Proceedings of the American Mathematical Society (2005)
3. Spectral theory and spectral gaps for periodic Schrodinger operators on product graphs, Waves in Random Media 14(1) (2004).
4. A spectral transform for the matrix Hill's equation, The Rocky Mountain Journal of Mathematics 34(3) (2004)
5. An inverse problem for the matrix Schrodinger equation, J. Mathematical Analysis and Applications, 267 (2002)

Current Grant: CRDF: Direct and Inverse Problems for Differential Systems on Graphs (2006-08) (with V. Pyvovarchyk and others)

Radu C. Cascaval

Department of Mathematics rcascava@uccs.edu
University of Colorado (719) 262–3759
Colorado Springs, CO 80933 www.uccs.edu/rcascava

Education:
• May 2000 Ph.D. in Mathematics, University of Memphis, Memphis, TN
• 1996–2000 Research and Teaching Assistant, University of Memphis
• 1995–1996 Graduate Assistant, Department of Mathematics, Louisiana State University, Baton Rouge, Louisiana.
• 1990–1995 B.S., Department of Mathematics, "Al. I. Cuza" University, Iasi, Romania. Diploma with Honors.

Professional Experience
• 2003 – present Assistant Professor, Department of Mathematics, University of Colorado - Colorado Springs
• 2000 – 2003 Postdoctoral Fellow, Department of Mathematics, University of Missouri - Columbia

Awards, Grants and Contracts
• 2005 & 2007 CRCW Awards, Graduate School, UCCS ($5,000)
• 2006 Presidential Teaching and Learning Collaborative Project, CU System (with Gene Abrams)
• 2006 Service and Technology Development Award, EAS College, UCCS
• 2005 NSF Grant Award (Co-PI), International Conference on Nonlinear Waves, Integrable Systems and Their Applications, June 4-8, UCCS and Boulder ($25,025)
• 2005 Colorado Institute of Technology Contract (with Dr. Robert Carlson) ($5,000)
• 2002 AMS Travel Award, ICM 2002, Beijing, China ($2,250)
• 2001 AMS Summer Research Grant, Mt. Holyoke College ($500)
• 2000 NSF Travel Award, Mathematical Challenges of the 21st Century, UCLA ($1,000)
• 1999 AMS Travel Award, NAS Colloquium on Nonlinear PDEs, Irvine, CA ($700)
• 1997 & 1998 Van Vleet Memorial Doctoral Research Fellowship, University of Memphis
• 1995 Diploma with Honors, "Al. I. Cuza" University, Iasi, Romania

Research Interests
• mathematical biology and physiology
• fluid mechanics, dispersive equations, optical communications
• nonlinear PDEs and semigroups
• spectral theory and integrable systems

James E. Daly

Education: 1974 Ph.D., Mathematics, New Mexico State University, Las Cruces, NM
Thesis: Algebras of Singular Integrals Over Local Fields

Professional Experience: 2001 to 2002 Chair, Department of Mathematics
University of Colorado at Colorado Springs

1998 to present Professor, Department of Mathematics
University of Colorado at Colorado Springs

1997 to 2/99 Assoc. Dean of Eng. and Applied Science
University of Colorado at Colorado Springs

Publications:

A Marcinkiewicz condition for dyadic H^1, in preparation.

Two dimensional Walsh multipliers, accepted – under revision. (w/ S. Fridli).

Trigonometric multipliers on H^1(T), Canad. Math Bulletin 48-3 (2005) 370-381.(with S. Fridli)

H^p multipliers on the dyadic field, Ann. U. Sci. Budapest, Sect. Comp 24 (2004), 275-284. (w/S. Fridli).
Translation invariant operators on Hardy spaces for Vilenkin groups, Acta. Math. Acad. P. N. 20 (2004), 131-140. (w/ S. Fridli).

Walsh multipliers for dyadic Hardy spaces, Journal of Applicable Analysis 82 (2003), #7, 689-700. (with S. Fridli).

Plus 20 additional publications.

Awards:

1989 Outstanding Teacher – College of Engineering/Applied Science
1990 Nominated as President's Teaching Fellow

1999 Chancellor Award as Outstanding Faculty Member

Numerous grants for educational initiatives for K-12 educations

Ronald E. Gill

Associate Professor of Microbiology
University of Colorado Health Science Center

Education

Whitman College	BA	1974	Biology
Univ of Washington, Seattle WA	MS, Ph.D.	1977,1980	Microbiology
Stanford University, Stanford CA	Postdoctoral	1980-81	Biochem/Mol Bio

Positions and Honors

University of Colorado Health Sciences Center,
Department of Microbiology
1982-1989 Assistant Professor
1989 - present Associate Professor, tenured
Program in Molecular Biology
1989 to 2000
Biomedical Sciences Graduate Program
1999 to present
University of Colorado at Colorado Springs, Department of Biology
2000-present Adjunct Associate Professor
CU- Institute of Bioenergetics
2006- Member and Associate Director, HSC Campus

Recent Peer-reviewed publications

Tse, H. and RE Gill. (2002) Bypass of A- and B-signaling requirements for *Myxococcus xanthus* development by mutations in *spdR*. J. Bacteriol. **184:** 1455-1457**.**

Cusick, J., E. Hager, and R. E. Gill. (2002) Characterization of *bcsA* mutations that bypass two distinct signaling requirements for *Myxococcus xanthus* development. J. Bacteriol. **184**: 5141-5150.

McCollister BD, Bourret TJ, Gill R, Jones-Carson J, Vazquez-Torres A. (2005) Repression of SPI2 transcription by nitric oxide-producing, IFNgamma-activated macrophages promotes maturation of Salmonella phagosomes. J Exp Med. **202**:625-635.

Cusick, J. K. and R.E. Gill. (2005) The *bcsA* gene influences multiple aspects of development in *Myxococcus xanthus*. Curr Microbiol. **51**:336-343

Invited Book Chapter (revised manuscript submitted to editors 6/06)
Gill, RE (2006) Regulation of early developmental gene expression in *Myxococcus xanthus*. Submitted. To appear in *Myxobacteria III.*

Pending Patent:*Universal Detection of Binding.* USPTO Patent Application Number 10/888,959. [This patent application is based on Dr. Gill's concept and initial studies.]

Provisional Patent Application: Chemiluminescent proximity nucleic acid assay

Anatoliy V. Glushchenko

Department of Physics, University of Colorado at Colorado Springs

1420 Austin Bluffs Parkway, Colorado Springs, CO 80933-7150

Phone: (719) 262-3130, Fax (330) 262-3013, E-mail: anatoliy.glushchenko@uccs.edu

Education

Post-doctoral training: Liquid Crystals Institute, Kent State University, Kent, OH.

Ph.D. Physics and Mathematics, Institute of Physics, Ukrainian Academy of Sciences, Kyiv, 1997;

M.Sc. Physics and Mathematics, "Red Diploma" with honor and with distinction, Zhytomyr State Pedagogical University, Zhytomyr, Ukraine, 1993

Professional work history

2005-present	Assistant Professor, Department of Physics & Energy Science, UCCS
2003-2005	Adjunct Faculty, Kent State University, Chem.-Physics
2002-2005	Lab Manager, WestLab, Liquid Crystal Institute, Kent State
2001-2002	Research Associate, Liquid Crystal Institute, Kent State
2000-2001	Postdoctoral Fellow, Liquid Crystal Institute, Kent State
1999-2000	Research Fellow, Department of Physics of Crystals, Institute of Physics, National Academy of Sciences, Kyiv
1998-1999	Visiting Scientist, Martin-Luther University, Institute for Physical Chemistry, Halle, Germany
1997-1998	Visiting Scientist, LG Electronics Inc., LCD Division, 533 Hogae-dong, Donguan-gu, Anyang-shi, Kyong ki-do, 431-080, South Korea
1993-1996	Research Assistant and a Ph.D. student, Institute of Physics, National Academy of Sciences, Kyiv, Ukraine

Honors & Awards

Inventor of the Year: University of Colorado, 2007
Inventor Recognition Award: Kent State University, 2004
Award of the President of Ukraine for young scientists: "…for many contributions to the science and technology of liquid crystal displays including high speed and bistable devices", 2000
Special honor stipend of Zhytomyr Pedagogical University: 1988, 1989, 1990, 1991, 1992, 1993

Marek Grabowski

Department of Physics and Energy Science, University of Colorado at Colorado Springs
Colorado Springs, Colorado 80933-7150; phone: (719) 262-3189; fax: (719) 262-3013
e-mail: mgrabows@uccs.edu

Education
M.S. in Physics, Technical University of Wroclaw, Wroclaw, Poland, 1978.
Thesis: "Formal Solutions for Electromagnetic Response of a Superconducting Fermi Liquid"
Ph.D. in Physics, University of Kentucky, Lexington, Kentucky, 1981.
Thesis: "Solitons and Commensurate-Incommensurate Transitions in Quasi-One-Dimensional Conductors"

Academic Honors
Graduated Cum Laude, Technical University of Wroclaw (1978)
Polish Academy of Science Fellowship (1977, 1978)
Rector's Special Award, Technical University of Wroclaw (1976-1978)
Graduate Fellowship, University of Kentucky (1979-1980)
Teacher of the Year Award at UCCS (1989)
Outstanding Teaching Award, College of LAS, UCCS (1989)
Best Practice in Teaching and Learning Award, UCCS (2000)

Academic Experience
Research and Teaching Assistant, University of Kentucky, Lexington (1978-1980)
Postdoctoral Research Associate, University of Southern California, Los Angeles (1981)
Postgraduate Research Physicist, University of California, San Diego (1982-1983)
Postgraduate Research Physicist, University of California, Santa Barbara (1983-5)
Assistant Professor, University of Colorado, Colorado Springs (1985-1990)
Associate Professor, University of Colorado, Colorado Springs (1990-present)

Selected Papers
– *Wave Propagation in a Nonlinear Periodic Medium,* with P. Hawrylak, Phys. Rev. B41, 5783 (1990).
– *Nonlinear Polariton Excitations in Quantum Dot Arrays,* with P. Hawrylak, and J. Tuszynski, Phys. Lett. A165, 148 (1992).
– *Bichromatic Wave Propagation in Periodically Poled Media*, Phys. Rev. B48, 2370 (1993).
– *Emergent spatial correlations in stochastically evolving populations*, with R.E. Camley, Phys. Rev. E56, 3421 (1997).
-*Stochastic model for nonequilibrium polymerization*, Europ. Biophys. J. 5, 918 (1999)
-*Stochastic Models for Growth and Spreading Phenomena*, Marek Grabowski, Proc, Int. Conf. on New Directions in Dynamical Systems, (2000).

Zbigniew Jan Celinski

Department of Physics and Energy Science, University of Colorado at Colorado Springs,
1420 Austin Bluffs Parkway, Colorado Springs, CO 80918
719-528-8238 Residence, 719-262-3583 Office, 719-262-3013 Fax
E-mail address: zcelinsk@uccs.edu

Education

Ph.D., Physics, Simon Fraser University, Burnaby, Canada, January 1992
Thesis topic: "Molecular Beam Epitaxy Growth and Magnetic Studies of Ultrathin Fe Structures"
M.A., Physics, Temple University, Philadelphia, USA, May 1988
M.Sc., Physics, Silesian University, Katowice, Poland, September 1982
Thesis topic: "The Magnetic Properties of $KMn_xNi_{1-x}F_3$ Compounds

Work Experience

May 2003 –to present:	Professor, Department of Physics and Energy Science, UCCS, Colorado Springs, CO 80933-7150
May 2000 – May 2003:	Associate professor, UCCS
Aug. 1995 – May 2000:	Assistant Professor, UCCS
Nov. 1993 - June 1995:	Research Associate, University of Arizona, Tucson, AZ
Jan. 1992- Nov.1993:	Post Doctoral Fellow, Simon Fraser University, Burnaby, Canada
July 1993 - Aug. 1993:	Visiting Scientist, BESSY Berlin and KFA Jülich, Germany
Jan. 1989 - Dec. 1991:	Research Assistant, Simon Fraser University, Burnaby, Canada
Sep. 1988 - Dec.1988:	Teaching Assistant, Physics Department,
and Jan. 1990 - April 1990:	Simon Fraser University, Burnaby, B.C.
Sep. 1986 - May 1987	Teaching Assistant, Temple University, Philadelphia, PA
June 1987 - Dec. 1987:	Research Assistant, Temple University, Philadelphia, PA
Sep. 1982 - June 1986:	Research Assistant, Institute of Solid State Physics of the Polish Academy of Sciences, Zabrze, Poland
Jan. 1981 - Aug.1982:	M.Sc. student, Silesian University, Katowice, Poland

Achievements

- Recipient of 132 awards, among them, UCCS Inventor of the Year (2007) UCCS Research Award (2001), Postdoctoral Fellowship from National Science and Engineering Research Council of Canada (1992), and Junior Fulbright Scholarship (1986, USA)
- Author of 17 and co-author of 78 scientific papers
- Over 1500 citations in the scientific literature

- Numerous invited talks, among them one in Philips Research Laboratories (Eindhoven, The Netherlands) and one at the International Magnetic Conference, INTERMAG 95,and 2005 (San Antonio, Texas and Nagoya, Japan)

Robert Melamede

Education:

Herbert H. Lehman College,	NYC	B.A.	1969	Anat/Phys.
Herbert H. Lehman College,	NYC	M.S.	1972	Molec/Biochem.
City University of New York,	NYC	Ph.D	1980	Molec/Biochem

Research and Professional Experience:

Part-time Lecturer	Bronx Comm. College	1970Chairman
Adjunct Lecturer	Lehman College	1970-1975
Graduate Fellow	Lehman College	1975-1978
Research Associate	N.Y. Medical College	1978-1981
Assistant Professor	N.Y. Medical College	1985-8/88
Assistant Professor	Univ. of Vermont	8/88-2001
Director	LCCRO Monoclonal Facility	1/93-2001
Associate Prof.	University of Colorado CS	9/01-present

Patents and Disclosures

1. Automatable Process For Sequencing Nucleotides, Robert Melamede. (1989) USA Patent #4,863,849 (sold to PyroSequencing 1998)
2. Fluorometric Quantitation of Broth Cultured Mycoplasmas Using Alkaline Ethidium Bromide
3. A means of preserving organs and tissue for transplant, and for improving the success of transplantation (Disclosed 6/02)

Principal Investigator

Automated Process for Sequencing Nucleotides and Site-specific Mutagenesis,
Whitehead Associates: Venture Capital Support $90,000 11/84-86
Development Grant to establish *in vitro* antibody technology at UVM.
Vermont Cancer Center, $75,000, 12/92-12/93; $45,000, 1/94/-12-94
Development Grant A Novel Method for Determining Antigens that bind T-cells.
Immune Response Corporation, $30,000, 1/94-12/94

Recent Publications

1. Melamede, R. J. (2006). Endocannabinoids: Multi-scaled, Global Homeostatic Regulators of Cells and Society. Abstract_Paper #70. Proceedings of the Sixth International Conference on Complex Systems
2. Melamede, R. J. (2005). Harm reduction-the cannabis paradox. Harm Reduct *J*, 2(1), 17.
3. Melamede, R. (2005). Cannabis and tobacco smoke are not equally carcinogenic. Harm Reduct *J*, 2, 21.
4. Nakae Y, Stoward PJ, Bespalov IA, Melamede RJ, Wallace SS. (2005) A new technique for the quantitative assessment of 8-oxoguanine in nuclear DNA as a marker of oxidative stress. Application to dystrophin-deficient DMD skeletal muscles. Histochem Cell Biol. 2005 Aug 10; 1-11.

Gregory J. Morrow

Education:
B.A. Mathematics, University of Illinois, Urbana, IL, 1974
M.A. Mathematics, University of Illinois, Urbana, IL, 1976
M.S. Statistics, University of Illinois, Urbana, IL, 1979
Ph.D. Mathematics, University of Illinois, Urbana, IL, 1979
M.A. Counseling Psychology, Regis University, Denver, CO, 1998

Academic History:
2006-Present: Professor, Mathematics, University of Colorado, Colorado Springs, CO
1986-2006: Associate Professor, Mathematics, University of Colorado, Colorado Springs, CO
Summer, 1988: Visiting Scholar, University of Utah, Salt Lake City, UT
1983-1984: Visiting Assistant Professor, Texas A&M University, College Station, TX
1979-1986: Assistant Professor, Mathematics, Washington University, St. Louis, MO

Recent Conference Talks:
IMS-CSPS Meeting on Probability and Mathematical Statistics, Beijing, China, July, 2005.
AMS-IMS-SIAM Summer Research Conf., Mount Holyoke College, June, 2001.

Recent Conference Participation:
6th World Congress, Bernoulli Soc. for Math. Stat. and Probability, Barcelona, Spain, July, 2004.
Front Range Probability Day, Boulder, Colorado, May, 2006.
31st Conference on Stochastic Processes and their Applications, Paris, France, July, 2006.

Grants:
1994, 1999 (With R. Schinazi (PI) and Y. Zhang) NSF Stat/Prob Conference
1990 (With Wei-Shih Yang (co-PI)) NSF Special Projects Grant
1989, 90 NSF Grant, DMS 89-03435; REU Supplement (1991)
1989 William Grigsby Sencenbaugh Award, CU-Colorado Springs
1988 ROA under NSF Grant MCS 87-04369 (Salt Lake City)
1982, 83 NSF Grant, MCS 82-02192
1980, 81 NSF Grant, MCS 80-02874

Selected Creative Work:
(With Y. Zhang) The sizes of the pioneering, lowest crossing, and pivotal sites in critical percolation on the triangular lattice, *Ann. Appl. Probab*. **15**, no. 3, 1832-1886 (2005).

Large deviation results for a class of Markov chains with application to an infinite alleles model of population genetics, *Ann. Appl. Probab.* **2**, 857-905 (1992).

M. Karen Newell

Professional Preparation

B.S. 1972, University of Texas at Austin; Microbiology,
Ph.D. 1987, University of Colorado Health Sciences Center, Denver, Colorado; Microbiology
1987 - 1991 McGill University, Montreal, Quebec, Canada; Immunology
1991 - 1992, National Jewish Center for Immunology and Respiratory Medicine, Denver, CO; Immunology

Appointments

2005 – 2006	President, Board of Directors, Newellink Inc. Colorado Springs, CO
2005 – Present	President and Scientific Director, Newellink, Inc. Colorado Springs, CO
2004 – Present	Co-Chairman Board of Advisors, CU Institute of Bioenergetics (University of Colorado system-wide Institute)
2003 – Present	Chief Executive Scientific Director, CU Institute of Bioenergetics
2003 – Present	Clement and Margaret Markert Endowed Professor of Biology, UCCS
2002 – Present	Associate Professor, Department of Biology, UCCS
2002 – Present	Associate Director, Center for Computational Biology, UCCS
1999 – Present	Adjunct Member, Webb Waring Institute, University of Colorado Health Sciences Center, Denver, Colorado
1999 – Present	Adjunct Asst. Professor, Dartmouth Medical College, Hanover, New Hampshire
Jun 1999 – 2002	Assistant Professor, UCCS
1996 – May 1999	Assistant Professor, Division of Rheumatology and Immunobiology Department of Medicine, University of Vermont, College of Medicine Burlington, Vermont
1994 – 1996	Assistant Member, Division of Basic Immunology, Department of Medicine, National Jewish Center for Immunology and Respiratory Medicine, Denver, Colorado
1994 – 1996	Assistant Professor, Department of Immunology University of Colorado Health Sciences Center, Denver, Colorado
1992 – 1994	Instructor, Department of Microbiology and Immunology University of Colorado Health Sciences Center, Denver, Colorado
1992 – 1994	Research Associate/Instructor with John H. Freed, Ph.D. Division of Basic Immunology, Department of Medicine National Jewish Center for Immunology and Respiratory Medicine, Denver, Colorado

Over 75 pending and issued patents and 56 publications
Mentors numerous graduate and undergraduate students as thesis advisor and committee member. Thesis advisor to 12 past graduates and 7 current masters students.

Jerry L. Phillips

Education

B. A., Chemistry (1967), The University of Colorado, Boulder, CO
Ph. D., Biochemistry (1970), Colorado State University, Fort Collins, CO
Postdoctoral Fellowship (Supported by the American Cancer Society), McArdle Cancer Research Laboratory, University of Wisconsin, Madison, WI

Employment

Director, Science Learning Center, UCCS 2006 – present
Project Director/Educator, Biological Sciences Curriculum Study, Colorado Springs, CO 1999 – 2006
Visiting Scholar, Department of Biology, California State University, San Bernardino, CA 1998 –1999
Research Scientist, Pettis Veterans Administration Medical Center, Loma Linda, CA 1990 – 1998
Professor, Department of Physiology & Pharmacology, Loma Linda University, Loma Linda CA 1993-1998
Visiting Research Fellow, The University of Texas Health Science Center, San Antonio, TX 1989 – 1990
Director, Phase I Drug Development Laboratory/Senior Scientist, Cancer Therapy and Research Center, San Antonio, TX 1982 – 1989
Associate Professor, Department of Medicine, University of Texas Health Sciences Center, San Antonio, TX 1982-89
Associate Professor/Assistant Professor, The University Of Texas, San Antonio, TX 1975 – 1982

Grants

Awarded contracts and grants from NIH, Morrison Trust, Robert A. Welch Foundation, Nutrition Foundation, Southern California Edison, Motorola Corporation, and the Department of Energy.

Relevant Professional Activities

Reviewed manuscripts for Cancer Research, International Journal of Radiation Biology, Environmental and Molecular Mutagenesis, Bioelectromagnetics, FASEB Journal, Radiation Research, Life Sciences, FEBS Letters, Journal of Biological Physics, Molecular and Cellular Biochemistry, and IEEE Spectrum Magazine.

Invited speaker and workshop leader or participant at meetings and universities in the US, Europe, and Australia, in addition to 72 research presentations at national and international meetings.

Fifty six peer-reviewed scientific publications and four book chapters or conference proceedings.

Rinaldo Schinazi

Education
1988: Ph.D. Probability under P. Ferrari, University of Sao Paulo (Brazil).
1982: Maitrise de mathematiques pures, Paris VI (France).

Appointments
Since 2000: Professor, Department of Mathematics,
University of Colorado, Colorado Springs.

2001-2003: Professeur, Universite de Provence, Marseille.

1995-2000: Associate Professor, Department of Mathematics,
University of Colorado, Colorado Springs.

1991-1995: Assistant Professor, Department of Mathematics,
University of Colorado, Colorado Springs.

1990-1991: Post-Doctoral Fellow at York University, Toronto.

1989-1990: Visiting Assistant Professor at Syracuse University, Syracuse.

Recent Publications
R.B.Schinazi (2003). On the role of reinfection in the transmission of infectious diseases. Journal of Theoretical Biology, 225, 59-63.

R.B. Schinazi (2005). Mass extinctions: an alternative to the Allee effect. Annals of Applied Probability 15, 984-991

R.B. Schinazi (2006). The probability of drug induced resistance. Acta Biotheoretica 54, 13-19.

R.B. Schinazi (2006). A stochastic model for cancer risk. To appear in Genetics.

R.B. Schinazi and J. Schweinsberg (2006). Spatial and non-spatial stochastic models for immune response. To appear in Markov Processes and Related Fields.

and an additional 30 research articles. I have also published two books on Stochastic processes and Probability and Statistics.

Grants
2004-2006 and 1996-1998, research grants from NSF and NSA.
May 1999 and May 1994, NSF grants to organize conferences

Seung H. Son

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EDUCATION

- Ph.D. University of Illinois at Urbana-Champaign, 1991-1998
- M.S. Korea Advanced Institute of Science and Technology, 1985-1988
- B.S. Seoul National University, 1981-1985

PROFESSIONAL EXPERIENCE

- Assistant Professor University of Colorado, Colorado Springs, 2002-present
- Assistant Professor Kansas Wesleyan University, Salina, 2001-2002
- Software Engineer Lucent Technologies, Cambridge, MA, 2000-2001
- Software Engineer Parametric Technology, Waltham, MA, 1999-2000
- Post Doctoral Fellow University of Missouri-Columbia, 1998

PUBLICATIONS

- Number of publications in peer-reviewed journals: 12
- Number of papers in various places: 4

AREAS OF INTEREST

- Undergraduate, graduate, and online education
- Education of scientific and computational programming
- Database and website development
- Ramanujan's work
- Cryptography
- Numerical Analysis
- Software engineering

SOFTWARE DEVELOPMENT

- **Pro/Engineer**: With full CAD/CAM/CAE capabilities, it is the world's most commercially adopted 3D product design solution.
- **Arbor BP**: Billing software used by telecommunication companies such as Cingular, AT&T, Verizon, etc.

Yu Zhang

Professor of Mathematics
University of Colorado at Colorado Springs
Tel: (719)593-3336, E-mail yzhang3@uccs.edu

Education:
Ph.D. in Mathematics, Cornell University, 1990
M.S. in Mathematics, Cornell University, 1987

Research Interests:
1. General Probability Theory
2. Mathematical Physics Models including Percolation Theory, Infinite Particle Systems, Matching sequences and Random Graphs

Employment:
1990 - 1995 - 2001-present Assistant - Associate - Professor
Department of Mathematics
University of Colorado at Colorado Springs

Award from NSF:
1994 - 1997 DMS 9400467
1997 - 2000 DMS 9618128
2000 - 2003 DMS 0071635
2004 - 2006 DMS 0405150

Recent Publications:
1. On the infinite differentiability of the right edge in the supercritical oriented percolation (2004), to appear in Stoch. Proc. Appl. 114, 279-286
2. (With G. Morrow) The sizes of the pioneering, lowest crossing, and pivotal sites in critical percolation on the triangular lattice (2005), Ann. Appl. Probab. 15, 1832-1886
3. (With J. Yukich) Singularity points for first passage percolation (2006) Ann. of Probab. 34577-592.
4. The divergence of fluctuations for shape in first passage percolation (2006), Probab. Theory and Relat. Fields. 136298-320
5. Shape fluctuations are different in different directions. (2007) (To appear in Ann. of Probab.)
6. (With Y. Wu) A geometrical structure for an infinite oriented cluster and its uniqueness. (2007) (To appear in Ann of Probab.)