Missouri Department of Higher Education

Building Missouri's future...by degrees

NEW PROGRAM PROPOSAL FORM

Sponsoring Institution(s): Lincoln University in Missouri

Program Title: Natural Sciences

Degree/Certificate: Master Degree - Master of Science

Options:

Delivery Site(s): Lincoln University in Missouri

CIP Classification: 301801 (Please provide a CIP code)

Implementation Date: Fall 2013

Cooperative Partners:

AUTHORIZATION:

Dr. Connie Hamacher, President	Dr. Connie Hamacher	11/25/13
Name/Title of Institutional Officer	Signature	Date

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1. **Need**
   - **A. Student Demand**
     - **i. Form SE – Student Enrollment Projections**

Year	1	2	3	4	5
Full Time	2	4	4	4	4
Part Time	4	8	12	12	12
Total	6	12	16	16	16

     - **ii. Will enrollment be capped in the future?**
       No

   - **B. Market Demand**
     - **i. National, state, regional, or local assessment of labor need for citizens with these skills**

The development of a Master of Science in Natural Sciences degree is based on a conviction that the unique combination of the integrated core plus a diversity of content foci and research opportunities will provide graduates the experiences, skills and academic training needed for success in constituent occupations. According to the Bureau of Labor Statistics, although scientists in the natural sciences usually require a Ph.D. to participate in highly competitive independent research projects, a master's degree is the threshold entry point for many jobs in applied research (shorter-term, mission-oriented projects), industrial product development, government agencies and preparation for further academic training. Further, completing advanced degrees, especially for work associated with the state and federal government, will often afford the worker opportunity to advance into a higher pay scale.

A sampling of local and regional employer representatives contacted seemed positive about Lincoln University in general, and appeared to want to find a way to cooperate with the currently-proposed degree efforts. Current negative economic conditions were most-often cited for employer's inability to associate direct promotion or economic value to an advanced degree in natural sciences; however, employees with master degrees are often more-likely to be employed or advanced when competing with others who have not completed advanced degrees.

In considering the need for the MS in Natural Sciences degree based on student perspectives, both current and former students surveyed look positively at the prospect of continuing their education and continuing their education at Lincoln University. Students see a need for advancing their educations, not only as current students, but as graduates who have been working in a variety of Science, Technology, Engineering and Math (STEM) related positions. This, too, is a testament to market demand, as former students currently working in STEM areas perceive an opportunity and individual advantage in obtaining an advanced degree in Natural Sciences.

Extrapolating student and former-student survey responses to bachelor degrees awarded, it appears that a sufficient number of potential students annually should be available to populate the program in order to arrive at the goal of at least five MS degrees awarded annually. This projection does not take into account the unknown of the potential additional market of non-Lincoln University students, who would add to the program's student base.

At the national scale, the need for graduate level training in the STEM areas (including biology, chemistry and physics) is well documented. The U.S. Department of Commerce observes that STEM workers drive our nation's innovation and competitiveness by generating new ideas, new companies and new industries. However, there are concerns over the supply and availability of STEM workers. Over the past 10 years, growth in STEM jobs was three times as fast as growth in non-STEM jobs. STEM workers are also less likely to experience joblessness than their non-STEM counterparts. Science, technology, engineering and mathematics workers play a key role in the sustained growth and stability of the U.S. economy, and are a critical component to helping the U.S. win the future. It is projected that STEM occupations will grow by 17.0 percent from 2008 to 2018, compared to 9.8 percent growth for non-STEM occupations.

In biology, the U.S. Bureau of Labor Statistics, reports that about 91,300 biologists worked in government offices, laboratories and pharmaceutical firms in the nation as of May 2008. The majority of biologists worked for local, state and federal governments. A 21% increase in the number of jobs for biologists is expected from 2008-2018 which is substantially above the national average for all industries due to society seeking better medical treatment and more ways to preserve the environment. Job growth is expected in a number of areas, biotechnology and molecular biology in particular. Business leaders have begun to address the issue of creating more science and technology jobs in the United States to prevent them from being exported. Also, the number of openings in federal government agencies charged with managing natural resources is expected to grow.

Biologists have many career paths. Research biologists study the natural world, using the latest scientific tools and techniques in both laboratory settings and the outdoors, to understand how living systems work. In health care industries, biologists may study and treat illnesses such as tuberculosis, AIDS, cancer, and heart disease or work as veterinarians with sick and injured animals. Biologists in management and conservation careers are interested in solving environmental problems and preserving the natural world for future generations. Naturalists help preserve natural resources and educate the general public. Educators encourage people to learn new things, whether in a classroom, a research lab, the field, or a museum, zoo or park. There are many newly developing areas in careers in biology. For example, in biotechnology biologists apply scientific principles to develop and enhance products, tools, and technological advances in fields such as agriculture, food science, and medicine. Forensic biologists work with police departments and other law enforcement agencies using scientific methods to discover and process evidence that can be used to solve crimes. Science advisors work with lawmakers to create new legislation on topics such as biomedical research and environmental protection. Their input is essential, ensuring that decisions are based upon solid science. Trained professionals work with the government and other organizations to study and address the economic impacts of biological issues, such as

species extinctions, forest protection, and environmental pollution. Journalists and writers with a science background inform the general public about relevant and emerging biological issues. Some biologists are talented artists and create illustrations in your biology textbook, as well as in newspaper and magazine science articles.

In chemistry, the American Chemical Society's "Survey of Master's Degree Programs in Chemistry", reports that master's degree programs continue to account for almost 50% of the graduate degrees awarded in chemistry. In NSF surveys, 49% of graduates are women with approximately 8% underrepresented minorities. A recent survey also suggested that, in general, the level of diversity rose as program size decreased.

According to projections data collected from the National Employment Matrix, there were 94,100 people employed as chemists or as materials scientists in 2008. In 2018, the projected employment figure is 97,300, which is a positive change of 3,300 people and a growth of 3 percent. Approximately 42 percent of all employed materials scientists and chemists worked in firms related to manufacturing; the most common of these was the chemical manufacturing industry. Firms in the chemical manufacturing industry are responsible for the production of synthetic materials, plastics, soaps, cleaners, drugs, pesticides, paint, fertilizers, industrial organic chemicals, toys, and additional chemical products. Slightly less than 20 percent of materials scientists and chemists worked in services related to scientific research or development. Approximately 9 percent worked in labs related to testing. Most materials scientists are employed by companies who produce products made of rubber, plastics, ceramics, and metals.

Chemists and materials scientists are likely to find employment in every part of the United States, but they are most often found in areas involving large industry, such as in large cities.

The rate of employment of both chemists and material scientists will grow by approximately 3 percent between 2008 and 2018, according to job projections from the Bureau of Labor Statistics. The growth in employment will be found in technical, professional, and scientific service firms because manufacturing corporations will continue their practice of outsourcing research, design, and testing procedures to firms that are smaller and more specialized. There will be a 2 percent growth in job opportunities for chemists due to increases in fields related to biotechnology. The rate of employment of materials scientists may grow by up to 12 percent due to increased demand for newer and higher quality products from manufacturers.

The primary demand for chemists in the United States is expected to be led by firms and corporations in the biotechnological industries. Biotechnological research encompasses a range of study of the integration of technological processes and biological mechanisms, and it includes the study of human genes. This field offers numerous possibilities for development in drug research and products that can fight diseases and illnesses that, until now, have not been responsive to treatments that originate from the traditional chemical and physiological processes.

In physics, master's level graduate degrees can qualify one for many different careers. Based on one's career and interests one can work in pure and applied research, policy development

(government), management (government and industry), and education processes for example. This when combined with business experience would provide a powerful educational background for an industrial career. Alternatively one can continue to pursue professional and medical careers such as earning a M.D. and be involved in patient care and/or research. One therefore sees a demand for physics graduates in all of these disciplines and industries.

Physics master's degree holders are employed by a variety of sectors. Half of them are employed in the private sector with the majority employed in a STEM discipline. They hold positions with a wide range of employers, including large hi-tech companies, defense contractors, utilities, and a diverse group of smaller companies. Ninety percent of the physics master's employed in the private sector were employed in STEM occupations. The largest fraction are employed in the field of engineering and the vast majority of these master's had the word engineering in their titles. The other half are employed in computer or information technology (19%), physics or astronomy (17%), or in other natural science, technology or mathematics (14%). Many of the master's working in the field of computer and information technology had titles such as software and systems engineer.

The most frequently cited skills and activities used by master's in the private sector were: teamwork, solving technical problems, technical writing, design and development, and programming. Many of the master's who indicted their employment was in a non-STEM field (10%) held management-level positions.

This data comes from surveys sent out by the American Institute of Physics (AIP) in 2006, 2007, and 2008. Because of the relatively small number of individuals receiving physics master's each year and the difficulty in obtaining accurate contact information, the AIP report combined three years of survey responses. The physics master's classes of 2006, 2007, and 2008 consisted of 799, 824, and 790 degree recipients, respectively. Post-degree information was received on 39% of these degree recipients, with 58% of the information coming directly from the degree recipients (Ref: AIP Focus On Physics and Astronomy Initial Employment, Patrick Mulvey and Brandon Shindel, April 2011).

The National Science Foundation has surveyed Doctoral Recipients who have worked in the private sector. It has remained consistent since 1971(Ref: Physics Careers in Industry and Government Workshop Forum on Industrial and Applied Physics (FIAP), APS March Meeting Sunday, March 21, 2011 Dallas, TX). On average 45% of all PhDs have been employed in the private sector and this demand is expected to continue into the future. The current percentage of master's in the private sector is near this number as discussed above. It is reasonable to therefore assume that the need for the master's degree holders will mirror that of the doctoral degree holder into the future.

C. Societal Need

Students surveyed, whether current students or graduates, are strongly drawn to furthering their educations and doing so in STEM areas. They state that they see a need for such education as a means to furthering and, in some cases, focusing their careers. Students responding to departmental surveys affirm the importance of education through an institution such as Lincoln University, with a diverse context being an important program characteristic for many of them. Students also seek support in connecting with likely employers.

Touching on broader societal needs, the role of the university as a center for learning for historically-underrepresented minorities resonates with a decision to expand academic degrees in the natural sciences area to the graduate level. In the pursuit of excellence in education, for the stakeholders upon whom the university continues to depend, it is not an insignificant step. Students have affirmed the importance of continuing their education within this educational community. The proposed program, therefore, is consistent with the university's mission and meets an expressed need of the institution in its intentions and plans. From this perspective, the master's degree in Natural Sciences would be the only program of its kind in Missouri combining a general science-focused curriculum devoted largely to career enhancement with a commitment to supporting the needs of minority students.

Several of the unique attributes of the proposed MS in Natural Sciences align well with the Department of Higher Education's current imperatives for change. With regard to increasing the percent of Missouri residents who possess a postsecondary credential, the graduate program will address this need, and likely do so by addressing the special needs of historically underserved and underrepresented citizens of Missouri in the process. Respondents among both current and former students from the bachelor programs, representing minority students nurtured through the university's founding mission, showed interest in participating in the graduate program because of the diversity of the school's student body. While these students are not and were not "non-traditional" in certain senses, they appear to feel that they are best served by the type of educational institution represented by Lincoln University, and that these needs, therefore, can be seen as atypical.

If successfully adopted and implemented, the program will extend the capacity of the department and university to meet the objective of continual improvement in student learning outcomes. The program course list demonstrates commitment to deepening and broadening the curriculum across content areas in a manner conducive both to improving student learning outcomes at a more advanced level, and meaningfully orienting students for careers in a variety of STEM-related careers.

STEM fields are critical state and national foci for present and future economic development. The MSNS degree will produce STEM graduates who will contribute to these fields. Further, the addition of the MSNS graduate degree program will expand the research capacity of the department by maturing assistantships into the graduate student level, a

crucial step. With enhanced research capacity the university is better situated to take advantage of corporate, federal, and foundation resources for continued STEM development.

D. Methodology

Methods applied in the needs assessment include a variety of collection, compilation, and analysis of extant and project-specific data. Extant data from a considerable variety of public sources have been used usually for the investigation and assessment of general characteristics, economic profiles, and educational contexts across domains of interest.

For student-specific needs assessment, a combination of surveys targeting current and former students were developed for on-line delivery, associated with a multiple-contact rubric to maximize response rates. For department and university needs assessment, semi-structured interviews, a de facto focus group meeting with department faculty, and compilation and analysis of data from Lincoln University, Missouri Department of Higher Education, other universities, other states' education agencies and research-based data were used. For employer/workforce needs assessment, telephone interviews based on a targeted set of employers of interest were conducted, augmented by extant employment, workforce and other economic data. For assessment of other societal factors, data from other domains filtered through a consideration of Lincoln University's unique role and perspective was considered appropriate.

A selection of representatives of local employers was interviewed in order to assess workplace and employer needs, and determine to what extent the proposed masters program aligned with them. A total of 10 companies and organizations were contacted with interviews resulting: Unilever HPC in Jefferson City; Tyson Foods; Missouri State Health Laboratory; Missouri Department of Natural Resources; Missouri Department of Health & Senior Services; Missouri Department of Conservation; Missouri Department of Agriculture; Diamond Pet Foods of Meta, Missouri, Manufacturing Branch; Boyce & Bynum Laboratories; and ABB (engineering and distribution of transformers). Two other companies did not respond to repeated requests for interviews.

Staff interviewed varied from Human Resource directors, analysts and managers (6) to an educational coordinator, a director, and a vice president of manufacturing. Interviewees therefore represented a cross-section of views and perspectives and all had positions of authority. Local sites of the businesses and organizations included 100-1,000 employees each. Proportions of employees devoted to production/manufacturing, clerical/administrative, scientific/technical and managerial positions varied considerably.

Simple descriptive quantitative measures were sufficient for much of the needs assessment analysis. However, owing to the complexity of concerns, the difficulty in such cases for any one data set to provide a definitive answer, issues related to sample sizes, and the need to apply specific value judgments, qualitative methods informed quantitative results.

Detailed information on items in the current-student survey appears as Table 1. Table 2 shows similar information for the former-student survey. Survey items were chosen based

on priority of importance for needs assessment, likelihood of reliable responses, and reasonableness for survey length and complexity.

Table 1. Current-Student Survey Items

Domain	Item
Present status	Current student
	Major
Post graduation plans	Current plans/current employment
	Considering continuing education
	Area of interest
	If not continuing education, why not

Domain	Item
Importance of characteristics of MSNS program	Course schedule (e.g. weekend, evening, late p.m.)
	Course mode (e.g. on-line, combination)
	Part-time/Full-time
	Thesis/Non-thesis
	Flexibility of content focus area
	Employer tuition support
	Concurrent teacher's certificate in sciences
	Concurrent MBA
	Training in instrumentation
	IT option
	Tuition support from teaching assistantships, university
	Diversity of school population
	Additional characteristics
Likelihood of considering	

Table 2. Former-Student Survey Items

Domain	Item
Education	College major
Employment since college	Work position/title
	Company
	Job description
Consideration of further	Area of interest
	If not, why not?
Characteristics of MSNS program	Course schedule (e.g. weekend, evening, late p.m.)
	Course mode (e.g. on-line, combination)
	Part-time/Full-time
	Thesis/Non-thesis
	Flexibility of content focus area
	Employer tuition support
	Concurrent teacher's certificate in sciences
	Concurrent M.B.A.
	Training in instrumentation
	IT option
	Tuition support from teaching assistantships, university
	Diversity of school population
	Additional characteristics
Likelihood of considering	

As noted, data were collected from employment contacts through a structured interview. Interview items appear in Table 3. As with student surveys, items were developed based on importance to the needs assessment process and a determination of the relevance and reasonableness of data requested from individual data providers.

Table 3. Business Interview Items

Domain	Item
Organization/Identification	Name of organization
	Name of respondent
	Job title
	Job description
	Organization description/science foci and job types
	Location(s)
	Number of employees (location nearest Lincoln U.,
Employment position needs	Skills needed by employees – STEM-focused
	Master degree requirement for management
Education support	Program for promotion or reward for employee education
	Tuition support/tuition reimbursement
	Time off/flex time for employees continuing education
Lincoln U. MSNS Program	Potential support in enhancing employees
	Program potential to enhance promotions or pay grade

2. Duplication and Collaboration:

A. Similar Programs:

i. Master of Natural and Applied Science Interdisciplinary Program
Missouri State University

Within Missouri, the only institution presently offering a superficially similar degree is Missouri State University, which offers a Master of Applied and Natural Science through an interdisciplinary program. This program is broader in scope and does not include an integrated core compared with the Master of Science in Natural Sciences as proposed by Lincoln University.

Although this program carries the same CIP code as that currently proposed, it has a very different structure from the currently-proposed program from Lincoln University. Our program is comprised of an integrated core group of courses that all students will be required to take, and allows for elective credits from multiple disciplines to complete the degree. The program at MSU does not have an integrated core but requires multiple concentration areas to be chosen from 6 different departments.

ii) Other Science Programs in Missouri

Although there are multiple degree programs in Missouri with emphasis areas including biology, chemistry, and physics, no programs were identified with the integrated core structure that has been proposed for the current degree.

B. Collaborative Efforts: No collaborative efforts with other institutions are proposed.

PROGRAM STRUCTURE

A. Total credits required for graduation: 30

B. Residency requirements, if any: Courses in this program will be offered on campus.

C. General education: Total credits: All students will have previously completed a baccalaureate degree.

Courses (specific courses OR distribution area and credits):

SCI 501 GRADUATE SEMINAR IN NATURAL SCIENCES 1 cr, repeat for 3 cr
SCI 502 INTRODUCTION TO PROFESSIONAL LABORATORY PRACTICE 3 cr
SCI 503 EXPERIMENTAL DESIGN AND ANALYSIS IN NATURAL SCIENCES 3 cr
SCI 504 INSTRUMENTATION IN RESEARCH 3 cr

D. Major requirements: Total credits:

_____ ___cr.	_____ ___cr.	_____ ___cr.
_____ ___cr.	_____ ___cr.	_____ ___cr.
_____ ___cr.	_____ ___cr.	_____ ___cr.
_____ ___cr.	_____ ___cr.	_____ ___cr.
_____ ___cr.	_____ ___cr.	_____ ___cr.

E. Free elective credits: In addition to the 12 credit hours of required core courses, students choosing the thesis option will complete 6-9 credit hours in SCI 515 Graduate Research. Students choosing the thesis option will complete 9-12 credit hours of elective credits. Non thesis students will complete 18 credit hours of elective credits. Elective credits will be available from this and related graduate programs at Lincoln Univeristy. (Sum of C, D, and E should equal A.)

F. Requirements for thesis, internship or other capstone experience:
Students choosing a thesis option will complete 6-9 credit hours in SCI 515 Graduate Research as part of their 30 credit hour requirement. Non-thesis students will complete 6-9 additional elective credit hours as part of their 30 credit hour requirement.

G. Any unique features such as interdepartmental cooperation:
N/A

Program Summary
Proposed M.S. in NATURAL SCIENCES
Department of Life and Physical Sciences
Lincoln University

The M.S. Degree in Natural Sciences is an integrated graduate program that draws upon the academic areas of Biology, Chemistry and Physics within the Department of Life and Physical Sciences as well as other academic areas at Lincoln University. All graduate students will participate in the required core courses as well as have the opportunity to take elective courses in academic areas that support their professional growth and development. Students with a thesis option will conduct research in relevant topics.

The goals of this program include:
-providing students with advanced academic and professional expertise in STEM areas
-providing students with advanced research training in STEM areas
-providing opportunities for matriculating undergraduates and degreed, working professionals
-providing enhanced financial support for students and research programs
-providing enhanced capacity for research programs and funding
-providing support as a partner in the growth and development of Lincoln University

Criteria for Admission:
In addition to the general criteria established by the Graduate Studies Program, applicants must also meet the following minimum criteria to be eligible for acceptance into the M.S. in Natural Sciences.
-GRE 800 combined
-GPA undergraduate average 2.75 or average 3.0 in major courses
-Baccalaureate degree in science or any Baccalaureate degree that includes a minimum of 12 credit hours in science at the junior level or higher
-Conditional admittance will only be considered if GRE and GPA requirements are met
-Students will only be admitted after a favorable review by department committee

M. S. in Natural Sciences Program Description
This program is designed to provide students with an integrated core in natural sciences drawing from the academic areas of biology, chemistry and physics. Students will choose elective hours in academic areas that support their professional interests. A minimum of 30 credit hours is required for thesis and non-thesis degree options.

Core Requirements
All students must complete the following core requirements with a total of 12 credit hours:
SCI 501 GRADUATE SEMINAR IN NATURAL SCIENCES (1 credit hour, repeat for a minimum of 3)
SCI 502 INTRODUCTION TO PROFESSIONAL LABORATORY PRACTICE (3 credit hours)
SCI 503 EXPERIMENTAL DESIGN AND ANALYSIS IN NATURAL SCIENCES (3 credit hours)
SCI 504 INSTRUMENTATION IN RESEARCH (3 credit hours)

Thesis option students must complete 6-9 credit hours in the following course:
SCI 515 GRADUATE RESEARCH

Elective Credits
Thesis option students need to complete a minimum of 9-12 credit hours of electives. Non-thesis option students need to complete a minimum of 18 credit hours of electives. Electives must be approved by the graduate advisor and may include courses from the following list, other graduate courses at LU, a maximum of 9 credit hours of graduate transfer credits from an accredited university and/or a maximum of 3 credit hours of graduate conference courses.

BIOLOGY
BIO 500 SPECIAL TOPICS IN BIOLOGY. (1-4 credit hours)
BIO 501 IMMUNOLOGY. (3 credit hours)
BIO 503 PARASITOLOGY. (4 credit hours)
BIO 506 EVOLUTION. (3 credit hours)
BIO 523 ECOLOGY. (4 credit hours)
BIO 524 ADVANCED ECOLOGY. (3 credit hours).

CHEMISTRY
CHM 501 PHYSICAL CHEMISTRY I. (3 credit hours)
CHM 502 PHYSICAL CHEMISTRY II. (3 credit hours)
CHM 503L PHYSICAL CHEMISTRY LABORATORY I. (1 credit hour)
CHM 504L PHYSICAL CHEMISTRY LABORATORY II. (1 credit hour)
CHM 505 INORGANIC CHEMISTRY. (4 credit hours).
CHM 505L INORGANIC CHEMESTRY LABORATORY. (0 credit hours)
CHM 506 ADVANCED BIOCHEMISTRY. (3 credit hours)
CHM 507 ADVANCED ORGANIC CHEMISTRY. (3 credit hours)
CHM 508 BIOINORGANIC CHEMISTRY. (3 credit hours)
CHM509 NANOCHEMISTRY. (3 credit hours)
CHM 541-542 SPECIAL TOPICS IN CHEMISTRY. (1-4 credit hours)

PHYSICS
PHY 501-502 SPECIAL TOPICS IN PHYSICS. (1-4 credit hours)
PHY 505 BIOPHYSICS. (3 credit hours)
PHY 506 ADVANCED MATHEMATICAL METHODS. (3 credit hours)
PHY 507 COMPUTATIONAL PHYSICS. (3 credit hours)
PHY 508 ANALOG ELECTRONICS. (3 credit hours)
PHY 509 DIGITAL ELECTRONICS. (3 credit hours)

COURSE DESCRIPTIONS

Courses marked with an ** are requested as new graduate courses in addition to the existing courses that are already available for graduate credit.

In addition to the courses listed below, three courses in Biology that are currently available at the 300 level (BIO 306, 308 and 311) will have requests for permanent change to the 400 level followed later by requests for graduate course credit.

The proposed new course numbers were provided by Wanda Harper.

BIOLOGY

BIO 500 SPECIAL TOPICS IN BIOLOGY. (1-4, LF may be required). Topic to be listed in course schedule; may or may not include laboratory; may re-enroll as topic changes. Prerequisites: BIO 103 and 104L or consent of instructor.

BIO 501 IMMUNOLOGY. (3). Basic concepts inherent to the field of immunology; antigens, antibodies, cells of the immune system, complement, immune reactions, host defense mechanisms, allergies, clinical implications. Prerequisites: BIO 103 and 104L; one semester of general chemistry (CHM 101 or equivalent). Three one-hour lectures.

BIO 503 PARASITOLOGY. (4, LF). A survey of parasitism in various animal phyla with emphasis on host-parasite relationship and vector associations. Prerequisites: BIO 103 and 104L and 105.

BIO 504 RESEARCH IN BIOLOGY. (1-3, LF, may re-enroll, maximum 6 credits towards major). Individual research involving use of biological literature, experimental design, collection, analysis and reporting of data. Prerequisite: biology majors, written consent of instructor, see department head for further information.

BIO 506 EVOLUTION. (3). Analysis of theories of the origin of living organisms and mechanisms of evolutionary change. Prerequisite: minimum of 12 hours credit in biology. Three one-hour lectures.

BIO 509 CRITICAL EXAMINATION OF SCIENTIFIC WRITING. (1). Critical reading and discussion of scientific literature. Prerequisite: at least 8 hours of 300-400 biology credits.

BIO 510 SEMINAR IN BIOLOGY. (1). Oral and written reports of selected topics in biology. Prerequisite: minimum of 12 hours credit in biology. Consent of instructor.

BIO 523 ECOLOGY. (4). This course will present dynamics of coexistence among species and their interactions with the physical environment. Prerequisites: BIO 103 and 104L. Four one-hour lectures.

****BIO 524 ADVANCED ECOLOGY. (3).** Discussion of advanced concepts in ecology and field biology. Prerequisite: one semester of ecology. Three one hour lectures.

CHEMISTRY

CHM 501 PHYSICAL CHEMISTRY I. (3). Laws and theories of chemistry, topics of interest in physics and chemistry. Includes thermodynamics, kinetic, quantum theory, spectroscopy, chemical bonding and molecular structure. Three one-hour lectures. Prerequisites: MAT 203; PHY 102 or 202; CHM 202.

CHM 502 PHYSICAL CHEMISTRY II. (3). A continuation of CHM 501 by which it must be preceded. Three one-hour lectures.

CHM 503L PHYSICAL CHEMISTRY LABORATORY I. (1, LF, EP). To accompany or follow CHM 501. Introduction to techniques of basic physiochemical measurements and illustration of physiochemical principles. One three-hour laboratory. Prerequisites: Same as for CHM 501.

CHM 504L PHYSICAL CHEMISTRY LABORATORY. (1, LF, EP). A continuation of CHM 503L. Prerequisite: CHM 502.

CHM 505 INORGANIC CHEMISTRY. (4). A survey of modern inorganic chemistry. The material to be covered will include inorganic structures and reactions, as well as applicable theories, coordination chemistry, bio-inorganic chemistry, and solid state. Three one-hour lectures and three hour laboratory. Prerequisite; CHM 501 or consent of instructor.

CHM 505L INORGANIC CHEMESTRY LABORATORY. Laboratory to accompany CHM 505. One three-hour laboratory.

****CHM 506 ADVANCED BIOCHEMISTRY.** (3). Structure, function, metabolism, and regulation of biological macromolecules (carbohydrates, lipids, proteins, and nucleic acids). Prerequisite: one semester of undergraduate biochemistry or consent of instructor. Three one hour lectures.

****CHM 507 ADVANCED ORGANIC CHEMISTRY.** (3). Fundamental concepts in organic chemistry applied to the study of advanced reactions and the structures and mechanisms involved. Prerequisite: one year of undergraduate organic chemistry. Three one hour lectures.
****CHM 508 BIOINORGANIC CHEMISTRY.** (3). Role of metal ions in biological processes and principles of coordination chemistry, spectroscopy methods to study metals in proteins and enzymes, structure of the metal centers in biological molecules. Prerequisite: two semesters of general chemistry with laboratory. Three one hour lectures.
****CHM509 NANOCHEMISTRY.** (3). Principles of nanochemistry, synthesis and structural characterization of nanomaterials, application of nanochemistry in science and current technology. Prerequisite: two semesters of general chemistry with laboratory. Three one hour lectures.
CHM 541-542 SPECIAL TOPICS IN CHEMISTRY. (1-4). Topic to be listed in course schedule; may or may not include laboratory; may re-enroll as topic changes. Prerequisite: consent of instructor.

PHYSICS
PHY 501-502 SPECIAL TOPICS IN PHYSICS. (1-4). Topic to be listed in course schedule; may or may not include laboratory; may re-enroll as topic changes. Prerequisites: PHY 101-102 or 201-202 and consent of instructor.
****PHY 505 BIOPHYSICS.** (3). Biophysics will allow students to understand statistical descriptions of biological systems and apply thermodynamic considerations to processes in cells. Students will also be able to estimate entropic forces acting in cellular environments. Three one hour lectures.
****PHY 506 ADVANCED MATHEMATICAL METHODS.** (3). Advanced Mathematical Methods is designed to provide students with the mathematical background for subsequent studies of biophysics, advanced mechanics, electrodynamics, and quantum theory. Three one hour lectures.
****PHY 507 COMPUTATIONAL PHYSICS.** (3). Computational Physics will allow students to apply algorithmic modeling to chaotic, stochastic, and multi-variate systems in the basic sciences. Students will learn the required programming alongside. Three one hour lectures.
****PHY 508 ANALOG ELECTRONICS.** (3). This course provides the student with the basic knowledge necessary to understand the operation and application of semiconductor devices in discrete electronic circuits. Three one hour lectures.
****PHY 509 DIGITAL ELECTRONICS.** (3). Digital Electronics will provide students with an introduction to digital system design using integrated circuits and field- programmable gate arrays. Three one hour lectures.

SCIENCE
****SCI 501 GRADUATE SEMINAR IN NATURAL SCIENCES.** (1). This course requires student presentations, completion of writing assignments and discussion of current topics in relevant natural science. Course content may vary by semester.
****SCI 502 INTRODUCTION TO PROFESSIONAL LABORATORY PRACTICE.** (3). Introduces new graduate students to common laboratory practices and procedures in natural sciences such as building professionalism, critical thinking, ethical reasoning, and organizational skills to help students become more informed and efficient in laboratory principles. Three one hour lectures.
****SCI 503 EXPERIMENTAL DESIGN AND ANALYSIS IN NATURAL SCIENCES.** (3). Fundamental concepts of experimental design, statistical analysis and application using examples which are representative of research in the natural sciences. Prerequisite: one semester of statistics. Three one hour lectures.
****SCI 504 INSTRUMENTATION IN RESEARCH.** (3). A summary of modern instruments currently used in scientific research. The emphasis is on broad coverage of the field in natural sciences rather than an in-depth study of selected topics or applications. Topics may vary by semester. Three one hour lectures.
****SCI 515 GRADUATE RESEARCH.** (1-9). Graduate research in natural sciences. Prerequisite: instructor consent.

Missouri Department of Higher Education

Building Missouri's future...by degrees

PROGRAM CHARACTERISTICS AND PERFORMANCE GOALS

Institution Name Lincoln University in Missouri
Program Name Master of Science Degree in Natural Sciences
Date 9-20-2012

(Although all of the following guidelines may not be applicable to the proposed program, please carefully consider the elements in each area and respond as completely as possible in the format below. Quantification of performance goals should be included wherever possible.)

Student Preparation

- Any special admissions procedures or student qualifications required for this program which exceed regular university admissions, standards, e.g., ACT score, completion of core curriculum, portfolio, personal interview, etc. Please note if no special preparation will be required.
  In addition to the general criteria established by the Lincoln University Graduate Studies Program, applicants must also meet the following minimum criteria to be eligible for acceptance into the M.S. in Natural Sciences: GRE 800 combined, GPA undergraduate average 2.75 or average 3.0 in major courses, completed Baccalaureate degree in science or any Baccalaureate degree that includes a minimum of 12 credits in science at the junior level or higher. Students will only be admitted after a favorable review by department committee.

- Characteristics of a specific population to be served, if applicable.
  N/A

Faculty Characteristics

- Any special requirements (degree status, training, etc.) for assignment of teaching for this degree/certificate.
  Faculty must be approved for teaching graduate courses by the Lincoln University Graduate Studies Program.

- Estimated percentage of credit hours that will be assigned to full time faculty. Please use the term "full time faculty" (and not FTE) in your descriptions here.
  100%

- Expectations for professional activities, special student contact, teaching/learning innovation.
  In addition to advanced academic concepts, faculty are expected to mentor students in research training and professional development.

Enrollment Projections

- Student FTE majoring in program by the end of five years.
  We project a total student enrollment of 10 full time equivelents by the end of five years.

- Percent of full time and part time enrollment by the end of five years.
  We project that 25% of students will be full time students. We project that 75% will be part time students.

Student and Program Outcomes

- Number of graduates per annum at three and five years after implementation.
  We project that 3 students will graduate per year at three years. We project that 6 students will graduate per year at five years.

- Special skills specific to the program.
  One of the unique characteristics of this program is the integrated academic core of courses which will ensure that all students gain experience in a common set special skills representing a broad range of sciences.

- Proportion of students who will achieve licensing, certification, or registration.
  N/A

- Performance on national and/or local assessments, e.g., percent of students scoring above the 50th percentile on normed tests; percent of students achieving minimal cut-scores on criterion-referenced tests. Include expected results on assessments of general education and on exit assessments in a particular discipline as well as the name of any nationally recognized assessments used.
  N/A

- Placement rates in related fields, in other fields, unemployed.
  While placement rates are partially dependent on market demand and other factors, we expect that 90% or more of our graduates will be successful in obtaining employment in related fields. We expect that 10% or fewer of our graduates will be unemployed.

- Transfer rates, continuous study.
  We expect that 90% or more of our graduates will remain in the program to graduation. We expect that 10% or fewer will transfer to other programs.

Program Accreditation

- Institutional plans for accreditation, if applicable, including accrediting agency and timeline. If there are no plans to seek specialized accreditation, please provide reasons.
  Lincoln University is accredited by the Higher Learning Commission of the North Central Association. We are not aware of any accrediting agency reviewing similar programs to the proposed program.

Alumni and Employer Survey

- Expected satisfaction rates for alumni, including timing and method of surveys.
  We expect that students that remain in the program through graduation (alumni) will express satisfaction with the program. The surveys will be conducted along with the existing alumni surveys that are conducted on an annual basis.

- Expected satisfaction rates for employers, including timing and method of surveys.
  We expect that employers of alumni from our program will be satisfied with their academic and professional preparation. The surveys will be conducted along with existing program surveys that are conducted on an annual basis.

7. Institutional Characteristics:

Lincoln University, Jefferson City, Missouri was founded in 1866 by the enlisted men and officers of the Civil War's 62nd and 65th Colored Infantries with a purpose to educate freed slaves. Lincoln University has led the way in providing quality education to all. While remaining committed to our historic roots, Lincoln University has expanded its mission to embrace the needs of a broader population reflecting varied social, economic, education and cultural backgrounds. Lincoln University enthusiastically accepts students wishing to pursue higher education. The university provides student-centered leaning in a nurturing environment, integrating teaching, research and service. We offer relevant, high quality graduate programs that prepare students for careers and lifelong learning.

The proposed master degree program is aligned with the university mission, and addresses the need for the university to remain current and progressive in maintaining equity in the educational programs it makes available to its historically underrepresented students.

The importance of being afforded an opportunity to pursue a master-level degree of the type being proposed in a diverse environment has been cited by current and former students as a positive characteristic. These responses confirm that, to these students, the choice of attending Lincoln University is not merely a matter of geographical or financial convenience. Our students see value in Lincoln University's unique characteristics.

8. Any Other Relevant Information:

N/A