FORMAT FOR PROPOSALS FOR NEW ACADEMIC PROGRAMS

ALL PROGRAM PROPOSALS MUST HAVE THE FOLLOWING ELEMENTS:

Cover page

The title page should include the name of the program; department; the proposed implementation date; the appropriate signatures; and, the date the proposal was submitted.

Table of contents *(optional)*

Body of the proposal

The body will include textual information, charts, tables, and other data displays as appropriate.

Executive Summary

The summary should address the seven criteria, **in brief**, of appropriateness to the mission, need, academic integrity, coordination, assessment and accreditation, resource sufficiency, and impact on educational opportunity. The document should be a Word.doc; and one space between sentences. The Executive Summary should not exceed three pages.

Five-year budget projection

The appropriate budget projection form is included on page 7 of this document.

REQUIRED COVER PAGE FOR PROGRAM PROPOSALS

Name of Degree: Minor in Bioinformatics

There is no form for a proposal of a new minor, so the form for new major is being submitted with modifications for a minor.

A New Program/Degree Proposal

School of Sciences

Department of Chemistry

Proposed Implementation Date: Spring/ 2020

Proposal Prepared by: _____
Name

_____
Signature

Proposal Submitted: _____
Date

School Approval: _____
Date

Dean's Approval: _____
Signature Date

Educational Policies Committee's (EPC) Approval _____
Date

Faculty Approval _____
Date

Provost's Approval: _____
Signature Date

President's Approval: _____
Signature Date

Board of Trustee's

Approval

____

Chairman’s Signature Date

Table of Contents for Program Proposals *(optional)*

BODY OF INFORMATION FOR PROGRAM PROPOSALS

Appropriateness to Mission

Description, scope, and purpose of the program.

Bioinformatics is the combination of computer science, mathematics, and information technology with the intent of collecting, organizing, and processing large volumes of biological and chemical data. Although the demand for bachelors, masters, and doctorate level bioinformaticists has significantly increased, very few undergraduate degree colleges have developed programs in bioinformatics, particularly Historically Black Colleges and Universities (HBCUs). The proposed bioinformatics minor at Lincoln University aims to address these needs by taking an innovative approach in bioinformatics education and research with the following objectives: 1) Prepare undergraduate students for interdisciplinary, computationally intensive, biomedical research by increasing research-oriented bioinformatics learning opportunities. 2) Increase the number of well-qualified underrepresented minority students for graduate programs in biomedical research by incorporating already established programs in STEM (biology, biochemistry, computer science) into the development of the Bioinformatics minor. 3) Generate a pipeline of minority students who are well prepared for the workforce and will choose to continue their education and training in STEM related disciplines with computational focus.

This proposal will advance knowledge in the field of bioinformatics, as the students will be trained in this growing field while working side-by-side with faculty. Therefore, it is necessary to instill a practical understanding of bioinformatics, incorporating its basic usage and critical understanding of the underlying principles. The minimum skill sets are key cross-disciplinary concepts, involving a combination of knowledge and proficiency from the fields of biology, chemistry, computer science, and mathematics, which will have implications in genomics, proteomics, and metabolomics research. Students will be trained to master a handful of scripting languages (ie. bash, Perl, or Python), and programming languages (ie. Java or C), serving as guidelines for bioinformatics curriculum development. Also, knowledge of the structure and content of basic primary databases such as those from NBCI is essential as well as the ability to manipulate and process large databases. This minor aims to not only address the issue of underrepresentation of minority students in bioinformatics, but create an innovative well-rounded education and research program well suited for faculty and student research for publication in peer-reviewed scientific manuscripts in bioinformatics and for presentation at national bioinformatics and educational meetings.

Alignment with University mission.

The mission of Lincoln University includes active and collaborative learning, which is also a feature of this minor. This minor will advance knowledge in the field of bioinformatics, as the students will be trained in this growing field while working side-by-side with faculty. Students will engage in coursework that is lab/lecture combined which will highlight active learning as they conduct research projects in the computer lab in tandem with the lectures. This is also very collaborative involving students and faculty across many established programs (including biology, chemistry, and computer science).

Appropriateness to university strategic direction and goals outlined in strategic plan.

The courses required of this minor emphasizes aims of the strategic plan including critical thinking and problem solving. Students will focus on analyzing real-world reseach problems by accessing data from national scientific databases to determine the best approach to solve a problem using skills pulled from multiple fields of

knowledge. It will prepare our students to succeed with STEM careers in this 21st century environment which involves many new computational and analytical skills.

Need

Need as substantiated by employment trends.

Bioinformatics is the combination of computer science, mathematics, and information technology with the intent of collecting, organizing, and processing large volumes of biological and chemical data. Although the demand for bachelors, masters, and doctorate level bioinformaticists has significantly increased, very few undergraduate degree colleges have developed programs in bioinformatics, particularly Historically Black Colleges and Universities (HBCUs). This minor will prepare our students to succeed with STEM careers in this 21st century environment which involves many new computational and analytical skills.

Demand for the program among current and prospective students.

Each year Lincoln University sends 8-10 students to summer internships in bioinformatic programs, this new minor would better prepare our students for these internships, as well as for careers post-graduation.

To establish more concretely the need for bioinformatics education at Lincoln, a bioinformatics interest survey was created using SurveyMonkey to get feedback from students on their interest in bioinformatics and their desire to have more bioinformatics course and research opportunities at Lincoln. Twenty-three students who have taken organic chemistry or biochemistry previously, responded to the survey (these courses were selected due to these being classes that have introduced some bioinformatics concepts). Later a survey will be conducted on a broader student population. 95% of students surveyed responded that they would like to see more bioinformatics course offerings at Lincoln, and that they would also like to have more opportunities to conduct bioinformatics research at Lincoln. 71% of students surveyed responded that a bioinformatics component to a research project would make them more likely to participate in that research project. 86% of students surveyed responded that they would be interested in pursuing a bioinformatics major or certificate program at Lincoln. 82% responded that they would be interested in pursuing a 4+1 BS/MS program in bioinformatics, and even 60% of students would be interested in a PhD program in bioinformatics at Lincoln. Despite all of this interest in bioinformatics at Lincoln, only 18% of students surveyed currently plan pursue bioinformatics in graduate school, but 86% of students surveyed would be interested in pursuing bioinformatics in graduate school if they received more bioinformatics education at Lincoln.

The last three pieces of data from that survey show us that although only 18% of the students surveyed currently plan to pursue bioinformatics in graduate school, up to 60% - 80% of students would consider pursing bioinformatics in graduate school if they received more bioinformatics during their undergraduate training. This indicates that this bioinformatics minor could result in a large increase in the number of minority students pursuing PhD programs in bioinformatics. If more bioinformatics were infused into the undergraduate experience at Lincoln, more students would want to pursue bioinformatics in graduate school.

Shown below are the results from the focus group of Lincoln students (who have completed the iBric bioinformatics internship at University of Pittsburgh). The focus group conducted was conducted by the external evaluator for the NSF TIP grant. These results further solidify the need and interest for a bioinformatics minor at Lincoln.

Student comments:

"It would be nice to have a bioinformatics minor program at Lincoln University."

"A bioinformatics minor could help me pursue a degree in Computational Biology and help me carry out more research in the field as an undergraduate student."

"I would be interested in Next Generation Sequencing or working with short and long non-coding RNAs."

"Although I am currently a graduating senior, I think that there are benefits to a bioinformatics minor at Lincoln. Were I not to be graduating, I certainly would be interested. I also feel that if given the exposure, there are other students who would opt to do that as well."

"As a Biology major, the study of bioinformatics would have helped clarify some concepts I learned in my genetics and biochemistry classes. It would also provide me with additional knowledge and skills which would make me a more marketable candidate for many jobs after graduation. Moreover, having bioinformatics knowledge would help broaden my research base and make me a more capable scientist."

"I think a bioinformatics minor would be a great help especially to science majors. Given the current rise in computer-based science, it would make us more prepared for work and life after graduation from Lincoln."

Uniqueness of the program.

Although the demand for bachelors, masters, and doctorate level bioinformaticists has significantly increased, very few undergraduate degree colleges have developed programs in bioinformatics, particularly Historically Black Colleges and Universities (HBCUs). This proposal is for a minor in bioinformatics to better prepare our students for current activities in the STEM field.

Enrollment projections.

8-10 minors per year

Academic Integrity

Program goals.

1) Prepare undergraduate students for interdisciplinary, computationally intensive, biomedical research by increasing research-oriented bioinformatics learning opportunities.

2) Increase the number of well-qualified underrepresented minority students for graduate programs in biomedical research by incorporating already established programs in STEM (biology, biochemistry, computer science) into the development of the Bioinformatics minor.

3) Generate a pipeline of minority students who are well prepared for the workforce and will choose to continue their education and training in STEM related disciplines with computational focus.

Curriculum overview. **See the below SAMPLE Curriculum Overview.*

Proposed Bioinformatics Minor:

General Biology 1 & 2 with lab (Bio 103, 104)	8 credits
Genetics with lab (Bio 208)	4 credits
2 Computer Science (CSC 151, 152, 158, 159)	6 credits
Introduction to Bioinformatics with lab (Che 255)	4 credits
1 upper level bioinformatics elective (Bio 305, Che 303, CSC 353, 354)	3-4 credits
TOTAL	25 credit minor

SAMPLE Curriculum Overview

General Education (Core Curriculum) courses	
First Year Experience	3 credits
Social Sciences	9 credits
Health & Wellness	2-3 credits
English	9 credits
Humanities	6 credits
Mathematics	3 credits
Natural Sciences	7-8 credits
Language OR Computer Science	6-8 credits
Writing Proficiency Requirement	
Total	**45-49 credits**
Major and major-related courses	
100/200 level prerequisites and requirements	16 credits
300/400 level requirements	30 credits
Specialization courses	8-10 credits
Electives	18 credits
Seminar	3 credits
Total	**75-71 credits**
Total	**120 credits**

Degree requirements.

7 courses (25 credits) required for minor

Course offerings.

(Catalog descriptions)

Describe how each course supports the program goals and student learning outcomes.

No new courses are proposed. These courses are part of established offerings in biology, chemistry, biochemistry, and computer science programs.

Learning experiences and instructional methods.

No new courses are proposed. These courses are part of established offerings in biology, chemistry, biochemistry, and computer science programs.

Program structure/administration.

The minor is housed within the chemistry department.

Leadership and faculty qualifications.

Briefly describe the expertise of the faculty members who will be teaching in the program.

(Use the format below for **each faculty member** associated with the new program.)

Name: Carla J. Gallagher **Years at University:** 4.5

Degree(s) Earned: Ph.D

Current Teaching Responsibilities (list course numbers and titles): Biochemistry 1 &2 (Che 303, 304), Bioinformatics (Che 255), Chemistry for Health Sciences (Che 120)

Teaching Responsibilities for Proposed Program (list course numbers and titles): Teaching responsibilities should not change for Dr. Gallagher, nor for anyone else due to the fact that these courses are already offered by the University as part as other established programs in biology, chemistry, biochemistry, and computer science.

Scholarship Related to the Proposed Program: Dr. Gallagher's teaching and research efforts have been using bioinformatics skills for the past ten years. Dr. Gallagher's current funding from the NSF which totals $579,846 (2 NSF grants over 4 years total) will build bioinformatics teaching and research opportunities at Lincoln University, and has already contributed to purchase of equipment for these purposes.

Additional Responsibilities Related to the Proposed Program: Coordinate bioinformatics internships

Other Information Relevant to the Proposed Program:

Student qualifications/support/advisement.

Coordination with Other Programs

With related programs at Lincoln University.

biology, chemistry, computer science

With other departments/units on campus.

With outside agencies, corporations, etc.

Assessment and Accreditation

Describe the assessment process that includes collecting and evaluating student-learning outcomes data and using the data to improve the program (the feedback loop).

The plan for the asssessment of this new minor is to use the procedures implemented for assessment of the biochemistry program (the major program which houses this minor). This proposal does not describe a new major, only a new minor, therefore the PSLOs (shown below) from the biochemistry program will be used to assess 1-2 courses per year. The courses highlight PSLOs 1, 2, and 5 (below), as well as ILOs 1, 5, and 7 (effective communication, critical thinking, and quantitative literacy). The percentage of students that meet the course objectives will be calculated, and then will be broken into subsets to determine if the percentage differs by student major. It is expected that many bioinformatics minors will be from programs in chemistry, biochemistry, biology, math, and computer science, and it will be beneficial to the program to know if the percentage of students meeting the objectives varies by major, so this assessment data will be used to improve the program in future years (ie. adding or replacing a biology or computer science course).

PSLOs

1. The student will be able to interpret and explain the concepts of biology and chemistry content chemistry covered in class.

2. The student will be able to use critical thinking skills to solve complex biochemical problems.

3. The student will apply quantitative skills to calculate numerical answers to biochemical problems, and interpret the relevance of those values.

4. The student will demonstrate proficiency in the collection, analysis, and report of data in the laboratory as described by the scientific method.

5. The student will be proficient in reading, critically understanding, and communicating the results of current published research journal articles.

6. The student will be able to design and formulate experiments to test or challenge hypotheses presented in class and in the laboratory.

7. The student will communicate biochemical concepts clearly through written and spoken means.

Describe the process to collect and evaluate program goals and to use program assessment to improve the program.

See above for description of how percentage of students that meet the course objectives, by major, will be used to improve the program by adding (or replacing) a course.

Describe the plan for achieving specialized accreditation (if available for the program).

Resource Sufficiency

Overview of resource sufficiency.

No new resources are required. Dr. Gallagher's teaching and research efforts have been using bioinformatics skills for the past ten years. Dr. Gallagher's current funding from the NSF which totals $579,846 (2 NSF grants over 4 years total) will build bioinformatics teaching and research opportunities at Lincoln University, and has already contributed to purchase of equipment for these purposes.

Teaching responsibilities should not change for Dr. Gallagher, nor for anyone else due to the fact that these courses are already offered by the University as part as other established programs in biology, chemistry, biochemistry, and computer science.

Courses for Proposed Bioinformatics Minor	Semester Currently Offered *	Current Instructor
General Biology 1 with lab (Bio 103)	fall and spring every year	Safford
General Biology 2 with lab (Bio 104)	fall and spring every year	McCarthy
Genetics with lab (Bio 208)	fall and spring every year	Hull
2 Computer Science (CSC 151, 152, 158, 159)	fall and spring every year	Monticchio, Smith, Jacks, Dedefa, Barimani
Introduction to Bioinformatics with lab (Che 255)	Spring Only	Gallagher

*The semester(s) that each course is currently offered is listed in the table. Some of these courses already offer multiple sections each semester, so over the next 5 years it is projected that all of these courses will be offered at least as frequently as indicated in the table.

Impact on Educational Opportunity

Effect on under-represented groups of students.

Although the demand for bachelors, masters, and doctorate level bioinformaticists has significantly increased, very few undergraduate degree colleges have developed programs in bioinformatics, particularly Historically Black Colleges and Universities (HBCUs). This minor will help to address that need.

Effect on faculty, advisors, etc.

This should not affect faculty or advisors since it is a minor only, students will still be advised in the major program.

Effect on employers.

This minor will better prepare our students to succeed with STEM careers in this 21st century environment which involves many new computational and analytical skills.

FIVE-YEAR BUDGET PROJECTION

SCHOOL: Sciences

PROPOSED PROGRAM:Minor in bioinformatics

There is no budget associated with this proposal since it is a minor. All courses that are part of this minor are already being taught as part of an established program (biology, chemistry, and computer science), so no funds are required. In addition, Dr. Gallagher's current funding from the NSF which totals $579,846 (2 NSF grants over 4 years total) will build bioinformatics teaching and research opportunities at Lincoln University, and has already contributed to purchase of equipment for these purposes. The equipment required has already been purchased, but if there is any additional equipment need, these grants could fund that need for 3 more years. There aren't any anticipated funding needs for this minor.

ESTIMATED REVENUES	Year 1		Year 2		Year 3		Year 4		Year 5	
	Existing	New	Existing	New	Existing	New	Existing	New	Existing	New
Tuition *or* University E&G										
External Grants and Contracts										
Other										
TOTAL REVENUE										
ESTIMATED EXPENSES	Year 1		Year 2		Year 3		Year 4		Year 5	
Salaries and/or benefits (Faculty and Staff)										
Learning resources										
Instructional equipment										
Facilities and/or modifications										
Other										
TOTAL EXPENSES										
DIFFERENCE (Rev.-Exp.)										

ESTIMATED IMPACT OF NEW PROGRAM	Year 1	Year 2	Year 3	Year 4	Year 5
FTE Enrollment					
Projected Annual Credits Generated					
Tuition Generated					

Budget Notes:

SAMPLE questions for possible discussion in each section of the proposal

Appropriateness to Mission

What kind of degree is being proposed?

What is the program title?

How does the degree/program fit with university goals, and Commonwealth and or regional workforce needs?

Why is this a program that Lincoln University should offer?

Is this program a good match for this university? Even if there is a need out there, why does it make sense for the university to respond to the need?

Need

What is the driving motivation behind creation of the program?

What evidence do you have that there is a need for this program? What are labor projections in this discipline in the U.S., in the Commonwealth, and in the region? Are the workforce needs expected to last for the next ten years or more? (Cite recent statistics on needs for programs such as this one.)

Was a market analysis conducted to determine level of demand? Surveys of prospective students? Surveys of prospective employers? What student population do you anticipate attracting? Are there new markets to tap?

To what extent is this program unique? Are there competitors? If so, who are the competitors? Is the program different in scope or content from existing programs?

Why is it more important for the university to invest in this program than in other programs it might offer?

How will the program be advertised and marketed?

How does this program respond to disciplinary changes/evolution? In what ways is this program forward-looking?

Academic Integrity

In which department(s) will the program be located?

What will students be able to do when they graduate from this program? What are the student learning outcomes? What is the program designed to teach?

What curricular models were used in designing this curriculum? Are the curricular elements dictated by accreditation criteria? Did you collaborate with the local community, discipline experts, and consultants as you designed the program?

What are the components of the curriculum? How are courses sequenced, e.g., with pre-requisites? How are the courses meant to fit together as a whole? How does each course relate to one or more learning outcome(s)? Have you provided proposed, catalog descriptions of the courses?

What relationship will the major courses have to general education, i.e., the balance of breadth and depth? What is the rationale for the balance selected?

How is this degree different from related degrees already offered?

To what degree will instructional technologies be used in major courses? How about team teaching or group projects? If appropriate, how do practical experiences (e.g., labs) fit in?

Are experiential elements such as internships and practica integrated into the program? If so, what is their purpose?

Is a final project required? If so, how will it be reviewed?

Are concentrations, options, specializations, or tracks being offered within the major program? If so, have they been delineated sufficiently and any differences among them (e.g., in terms of resources needed) been addressed throughout the proposal?

What are the qualifications of the program faculty? What are their academic credentials, their experience in developing and implementing new academic programs, and their prior experience in the specific field?

What evidence do you have of faculty and administration commitment to and interest in the success of the program?

What is the planned faculty/student ratio?

Will there be a program director, an oversight committee? How will continuity and oversight be ensured?

Are students expected to enter the program with specific competencies? If so, what are they? What grade point average will students be expected to maintain? What other factors related to student quality should you mention? How will students be advised and mentored? What certification tests will students need to pass? Have you anticipated curricular implications of these requirements?

Coordination with Other Programs

How have other departments been involved in the development of the proposal? What role will they play when the program is offered?

How will relationships with business, industry, public agencies, etc., strengthen this program?

Assessment and Accreditation

What are the intended learning outcomes of the program, and how will they be assessed?

What data will be collected in order to assess the success of the program?

Will you track graduates in some way, poll employers for feedback, or otherwise get information on how well the program succeeds in developing student knowledge, skills, attitudes, understandings, and values?

Did any external curriculum experts review this proposal or consult in developing the proposal?

If appropriate, which accrediting agencies would be involved in reviewing this program?

How does the program design reflect accrediting agency standards? How is the curriculum aligned with accreditation requirements? When might you expect to receive accreditation?

When the cycle of program review comes around, how do you expect to judge the success of the program?

Resource Sufficiency

Does the program require a significant investment of new university funds? How close is the university to having sufficient resources to initiate the program? What major funding must be found to start the program?

Have you worked contacted the University's Budget Manager to produce the five-year balance sheet of anticipated revenues and expenses? How many new courses and new sections of courses will the program generate?

Are any external funds going to be available or sought to help build the program? Have you indicated the source of these funds, the annual amount, and the duration of the funding?

Is the budget table consistent with the narrative provided here?

Have you accounted not only for initial start-up costs but also for annual continuation costs (such as library journals and supplies needed each year and equipment maintenance and replacement)?

Have you accounted for costs such as personnel (salary, benefits, professional development, travel, sabbatical replacements, etc.); equipment (office and instructional); clerical support; materials and supplies; library resources; evaluation; cooperating/supervising personnel; facilities; etc.?

Will there be new students or new faculty, or will each be shifted from somewhere else?

Impact on Educational Opportunity

How will this program provide opportunities to serve diverse student populations?

How will this program reach out to different employers and/or influence hiring patterns of historical employers?

How will the department recruit faculty who offer new role models?

How will the program utilize advisors with differing perspectives?

If the field of study is characterized by prior gender, racial, or ethnic biases, how will the program de-mystify the field?

General questions in writing the proposal

Have you convinced an educated readership (not people in the discipline) that this program is necessary and has every chance of success? Have you been persuasive on both a philosophical level as well as a factual level?

What objections are likely to be raised to the program, and have you addressed those potential concerns?

Have you asked others to read and react to a draft of this document to get an outside perspective?

Given the considerable cost to offer new programs, does the proposal demonstrate a likelihood of economic success?