

(NEW GRADUATE INITIATIVES)

PROPOSAL PROCEDURES CHECKLIST

Academic units should adhere to the following procedures when requesting new curricular initiatives (degrees, concentrations or certificates).

- Obtain the required approval from the Office of the Provost to move the initiative forward for internal ASU governance reviews/approvals. Please see the academic strategic plan website at: <https://provost.asu.edu/curriculum-development>.**
- Submit any new courses that will be required for the new curricular program to the Curriculum ChangeMaker online course approval system for review and approval.**
 - Additional information can be found at the Provost's Office Curriculum Development website: [Courses link](#)
 - For questions regarding proposing new courses, send an email to: courses@asu.edu
- Prepare the applicable proposal template and operational appendix for the proposed initiative.**
- Obtain letters or memos of support or collaboration (if applicable).**
 - when resources (faculty or courses) from another academic unit will be utilized
 - when other academic units or degree programs may be impacted by the proposed request
 - if the program will have an online campus option support will be required from the Provost's office and ASU Online. (*Please complete the ASU Online Offering form in [Curriculum ChangeMaker](#) to begin this request.*)
- Obtain the internal reviews/approvals of the academic unit.**
 - internal faculty governance review committee(s)
 - academic unit head (e.g. Department Chair or School Director)
 - academic unit Dean or their designee (will submit approved proposal to the curriculumplanning@asu.edu email account for further ASU internal governance reviews (as applicable, University Graduate Council, CAPC and Senate)
- Establish a Graduate Student Handbook for the new degree program** – Students need to know the specific requirements and milestones they must meet throughout their degree program. A Graduate Student Handbook, provided to students when they are admitted to the degree program and published on the website for the new degree, gives students this information. To be included in the handbook are the unit/college satisfactory academic progress policies, current degree program requirements (outlined in the approved proposal) and a link to the Graduate Policies and Procedures website: http://graduate.asu.edu/faculty_staff/policies.

Additional Recommendations

All new graduate programs require specific processes and procedures to maintain a successful degree program. Below are items that Graduate Education strongly recommends that academic units establish after the program is approved for implementation.

- Establish satisfactory academic progress policies, processes and guidelines** – Check within the proposing academic unit and/or college to see if there are existing academic progress policies and processes in place. If none have been established, please go to http://graduate.asu.edu/faculty_staff/policies and scroll down to the **academic progress review and remediation processes** (for faculty and staff) section to locate the reference tool and samples for establishing these procedures.

This template is to be used only by programs that have received specific written approval from the University Provost's Office to proceed with internal proposal development and review. A separate proposal must be submitted for each individual new degree program.

DEGREE PROGRAM

College/School: New College of Interdisciplinary Arts and Sciences

Note: Program ownership is coded at the College/School level first and may not be a center, department or division apart from it.

Department/Division/School: School of Mathematical and Natural Sciences

Proposing faculty group (if applicable): N/A

Name of proposed degree program: Master of Science (MS) in Biological Data Science

Proposed title of major: Biological Data Science

Master's degree type: MS - Master of Science

If Degree Type is "Other", provide degree type and proposed abbreviation: N/A

Is a program fee required? No, a program fee is not required.

Note: for more information about program fee requests, visit <https://provost.asu.edu/curriculum-development/changemaker/form-instructions#fees>

Is the unit willing and able to implement the program if the fee is denied? N/A

Requested effective term and year: Fall 2019

(The first semester and year for which students may begin applying to the program)

PROPOSAL CONTACT

Name: Stephen Wirkus **Title:** Professor, Associate Director


Phone number: 602-543-8236 **Email:** swirkus@asu.edu

DEAN APPROVAL(S)

This proposal has been approved by all necessary unit and college/school levels of review, and the college/school(s) has the resources to offer this degree program. I recommend implementation of the proposed degree program.

Note: An electronic signature, an email from the dean or dean's designee, or a PDF of the signed signature page is acceptable.

College/School/Division Dean name: Todd Sandrin

Signature: 

Date: 11/17/17

College/School/Division Dean name:
(if more than one college involved)

Signature:

Date:

This proposal template should be completed in full and submitted to the University Provost's Office [mail to: curriculumplanning@asu.edu]. It must undergo all internal university review and approval steps including those at the unit, college, and university levels. A program **may not** be implemented until the Provost's Office notifies the academic unit that the program may be offered.

1. PURPOSE AND NATURE OF PROGRAM

A. Provide a brief program description

The master of science in biological data science is constructed such that the traditional disciplinary pillars of biology, mathematics, statistics, and computing are accessible to students with backgrounds in any of those fields, as well as unrelated fields. The degree will provide students with training in the natural sciences as well as the mathematical sciences, including statistics and computing, but more importantly, will teach students to recognize the key intersections between and among these fields. Students will be prepared to work in emerging areas of interdisciplinary and transdisciplinary research, and be thought leaders in the development of these rapidly-developing areas of study. Biological data will be utilized throughout the degree and students will develop statistical and computational skillsets together with a knowledge of how to acquire and synthesize these biological datasets. Because of the interdisciplinary nature of the degree, applicants are eligible to apply to the program if they have earned a bachelor's or master's degree in a related field such as biology, mathematics, statistics, computing as well as unrelated fields from a regionally accredited institution.

B. Will concentrations be established under this degree program? Yes No

(Please provide additional concentration information in the curricular structure section – number 7.)

2. PROGRAM NEED

Explain why the university should offer this program (include data and discussion of the target audience and market).

The need for a knowledge of how to deal with data, biological data in particular, is becoming more and more prevalent. A search of six of the top job search websites shows a cumulative total of 178,000+ job listings with the keyword "data scientist" in the description (with the maximum of 139,000+ on Indeed.com). A December 2017 Forbes article "LinkedIn's Fastest-Growing Jobs Today Are in Data Science and Machine Learning" highlights areas such as big data that are experiencing large growth that will keep increasing according to the U.S. Bureau of Labor Statistics Monthly Labor Review due to the fact that jobs requiring skills in analyzing data are increasingly in shortage. Coupled together with the increase in professions relating to environmental science, ecology, and pharmacology/toxicology, this degree will target anyone with an interest in utilizing statistical and computational methods to analyze a wide range of datasets in the natural sciences. The target audience would be (a) bachelor's degree holders who have been in the workplace for a number of years that are seeking additional skill training in data science with a biological emphasis in order to allow them to move forward in their careers and (b) recent bachelor's degree recipients who are looking for additional training in order to set them apart from their peers (whether for job prospects, graduate schools, etc.).

3. IMPACT ON OTHER PROGRAMS

Attach any letters of collaboration or support from impacted programs (see checklist coversheet). Please submit as a separate document.

The master of science in biomedical informatics housed in the Department of Biomedical Informatics is the closest program to what we are proposing and will complement but not overlap with what we are proposing. Bioinformatics traditionally focuses on the large amounts of genome, clinical, health, and related data; however, data from ecological systems made possible by satellite and tracking systems or data from pharmacology and toxicology studies are two of many examples where the training in computational and statistical approaches in the natural science is increasingly important. The Department of Biomedical Informatics also received permission last year to plan for a new M.S. in *Biomedical Data Science*. While this name is similar to our proposed program, the focus of our proposed program on the three areas of ecological, environmental, and pharmacology/toxicology – all existing strengths within SMNS – make it unlikely that there will be overlap in terms of students that we expect to attract. However, we are keen to continue working collaboratively with Dr. Runger to make the most of our people-resources

and develop courses that will benefit both of our student bodies and grow our enrollments synergistically. Additionally, regarding the name similarity, doing an online search for Biomedical Data Science results in a number of degree programs at other universities; only one program with a minor comes up for Biological Data Science because the name doesn't seem nearly as popular. Moreover, the descriptions of each of those Biomedical Data Science programs clearly emphasize that improving human health is a main focal point of the degree and its training. We don't think that Biological Data Science will confuse the STEM student because of what we've chosen to emphasize. For the lay audience, the distinction between biomedical vs. biological can be thought of as "human health" vs. "non-human biology". A quick look at the homepage of the Department of Biomedical Informatics shows a strong emphasis on human health given their partnerships with "clinical practitioners" and "regional health care providers" whereas the School of Mathematical and Natural Sciences shows an interdisciplinary group with varied biological interests (and no mention of "human" or "health"). We believe a similar argument also holds for Colleges potentially objecting to the use of the words "data science" as we are not putting forward an "MS in Data Science". The strong component of big data and statistics within our proposal make "data science" part of the best choice of words and because all of the applications are biological (and nothing biomedical, business, or other emphasis), we don't think there will be a problem with name confusion. We believe the use of the word "biological" is most appropriate as it encompasses our strengths of environmental, ecological, and pharmacology/toxicology.

Per the request of Curriculum Planning, we have obtained additional impact statements from relevant units such as the College of Liberal Arts and Sciences, the College of Nursing and Health Innovation, Ira A. Fulton Schools of Engineering, the College of Health Solutions and the College of Integrative Sciences and Arts.

4. PROJECTED ENROLLMENT

How many new students do you anticipate enrolling in this program each year for the next five years?

Note: The Arizona Board of Regents (ABOR) requires that nine master's degrees be awarded every three years. Thus, the projected enrollment numbers must account for this ABOR requirement.

5-YEAR PROJECTED ANNUAL ENROLLMENT					
Please utilize the following tabular format	1st Year	2nd Year <small>(Yr. 1 continuing + new entering)</small>	3rd Year <small>(Yr. 1 & 2 continuing + new entering)</small>	4th Year <small>(Yrs. 1, 2, 3 continuing + new entering)</small>	5th Year <small>(Yrs. 1, 2, 3, 4 continuing + new entering)</small>
Number of Students Majoring (Headcount)	10	15-20	20	20-25	25

5. ACCREDITATION OR LICENSING REQUIREMENTS (if applicable)

Provide the names of the external agencies for accreditation, professional licensing, etc. that guide your curriculum for this program, if any. Describe any requirements for accreditation or licensing.

N/A

6. STUDENT LEARNING OUTCOMES AND ASSESMENT

Attach a PDF copy of the assessment plan printed from the University Office of Evaluation and Educational Effectiveness assessment portal demonstrating UOEEO's approval of your assessment plan for this program. Visit the assessment portal at <https://uoeee.asu.edu/assessment-portal> or contact uoeee@asu.edu with any questions.

See Appendix II for the Assessment Plan.

7. Curricular Structure

A. Curriculum Listing

Required Core Courses for the Degree			
Prefix and Number	Course Title	New Course?	Credit Hours
ACO 501	Database Systems and Problem Solving in Python	Yes	3
BIO 614	Biometry	No	3
STP 560	Experimental Statistics in Biology	Yes	3
LSC 519	Applied Learning Lab	Yes	1
LSC 547	Wet Laboratory Experience	Yes	1
<i>Section sub-total:</i>			11
Other Requirements			
<i>Other courses may be used with approval of the academic unit.)</i>			
Prefix and Number	Course Title	New Course?	Credit Hours
LSC 555	Integrative Biology I	Yes	3
LSC 556	Integrative Biology II	Yes	3
LSC 562	Applied Mathematics Techniques in Biology	Yes	3
<i>Section sub-total:</i>			9
Elective or Research Courses			
<i>(As deemed necessary by supervisory committee. Other courses may be used with approval of the academic unit.)</i>			
Prefix and Number	Course Title	New Course?	Credit Hours
ACO 598	Topic: Graduate Data Science	No	3
BIO 598	Topic: Ecosystem Ecology	No	3
BMI 555	Statistical Learning for Data Mining	No	3
BMI 601	Fundamentals of Health Informatics	No	3
LSC 598	Topic: Graduate Environmental & Human Toxicology	No	3
MAT 598	Topic: Graduate Mathematical Models in Biology	No	3
STC 510	Applied Social Technology	No	3
<i>Section sub-total:</i>			6
Culminating Experience(s)			Credit Hours
<i>Applied project, or thesis (must be 6 credit hours with oral defense). One of ACO, BIO, or MAT should be chosen depending on the emphasis of the project or thesis. – The nature of the proposed degree is such that a student will likely want to emphasize one aspect of biological data science, e.g., in terms of a particular job placement, and we believe specifying a thesis or project with ACO vs BIO vs MAT.</i>			
ACO 593 Applied Project, or BIO 593 Applied Project, or MAT 593 Applied Project			6
ACO 599 Thesis, or BIO 599 Thesis, or MAT 599 Thesis			6
<i>Section sub-total:</i>			6
Total required credit hours			32

- List all required core courses and total credit hours for the core (required courses other than internships, thesis, dissertation, capstone course, etc.).
- Omnibus numbered courses cannot be used as core courses.
- Permanent numbers must be requested by submitting a course proposal to Curriculum ChangeMaker for approval. Courses that are new, but do not yet have a new number can be designated with the prefix, level of the course and X's (e.g. ENG 5XX or ENG 6XX).

B. Will concentrations be established under this degree program? Yes No

8. COURSES

A. **Course Prefix(es):** Provide the following information for the proposed graduate program.

- i. Will a new course prefix(es) be required for this degree program?
Yes No
- ii. If yes, complete the [Course Prefixes / Subjects Form](#) for each new prefix and submit it as part of this proposal submission.

B. **New Courses Required for Proposed Degree Program:** Provide course prefix, number, title, credit hours and description for any new courses required for this degree program.

LSC 555 Integrative Biology I, 3 credit hours: This course provides a comprehensive understanding of the human genome, recent developments, next generation sequencing techniques including the preparation of DNA samples as well as principles of the new generation sequencing assay formats. Students will be able to describe, critically evaluate, and apply theoretical perspectives within genetic/genomic studies, develop and use computational and mathematical tools and of the invaluable lines of inquiry these biomedical investigations may portend.

LSC 556 Integrative Biology II, 3 credit hours: This course provides a survey of fundamental issues in organismal biology. Course material will cover biological diversity, relationships between form and function, processes of growth and development in individuals and populations, biomes and organism-environment relationships, populations and ecosystem function. Components of the Integrative Biology I class will be woven throughout this course where possible.

LSC 562 Applied Mathematics Techniques in Biology, 3 credit hours: Population dynamics, molecular interactions, population genetics, and other biological applications will motivate the discrete and continuous mathematics. Mathematical techniques and applications representative of a range of applied mathematics topics will be studied. Computer software will be incorporated to help with visualization and numerical solutions of some of the problems.

ACO 501 Database Systems and Problem Solving in Python, 3 credit hours: Design and implementation of databases for scientific applications. Defining and querying database systems using the SQL industry standard language. Data exchange using XML. Programming in Python to solve realistic problems using scientific data.

STP 560 Experimental Statistics in Biology, 3 credit hours: Introduction to the principles of experimental design, hypothesis testing and advanced data analysis in the biological sciences using statistical software (R and/or SAS). Statistical topics will be applied to biological data and the identification of the appropriate statistical methodology will be emphasized. Topics include exploratory data analysis with visualization, experimental design, categorical data analysis, generalized linear modelling, survival analysis, CART methods and power analysis.

LSC 519 Applied Learning Lab, 1 credit hour: Workshop-style course where students develop and peer review graduate-level project proposals. This may include topics such as integrative writing skills for an interdisciplinary thesis, presentation skills and topics tailored to the appropriate lay or technical audience, writing for a wide range of journals, etc.

LSC 547 Wet Laboratory Experience, 1 credit hour, repeatable for credit: The wet laboratory experience balances the need for bench work and in silico experience for students interested in pursuing a career with learning important statistical and computational tools to analyze biological data. Students receive instruction and perform all experiments as specified in the performance objectives for the course. Students will be under the direct supervision of the PI and/or Laboratory Manager.

9. FACULTY, STAFF, AND RESOURCE REQUIREMENTS

A. Faculty

i. **Current Faculty** – Complete the table below for all current faculty members who will teach in the program.

Name	Rank	Highest Degree	Area of Specialization/Expertise	Estimated Level of Involvement
Stephen Wirkus	Professor	PhD	Applied Mathematics	25%
Suzanne Dietrich	Professor	PhD	Applied Computing	25%
Sree Kanthaswamy	Associate Professor	PhD	Biology	25%
Jennifer Broatch	Assistant Professor	PhD	Statistics	25%
Erika Camacho	Associate Professor	PhD	Applied Mathematics	25%
Chad Johnson	Associate Professor	PhD	Biology	25%
Yasin Silva	Associate Professor	PhD	Applied Computing	25%
Michelle Mancenido	Assistant Professor	PhD	Statistics	25%
Pamela Marshall	Associate Professor	PhD	Biology	25%
Karen Watanabe	Associate Professor	PhD	Applied Mathematics/Biology	25%

ii. **New Faculty** - Describe the new faculty hiring needed during the next three years to sustain the program. List the anticipated hiring schedule and financial sources for supporting the addition of these faculty members.

Initially, no new tenure-track lines will be needed; we will hire Postdocs and FAs to "backfill" positions. We anticipate that three new tenure track lines will be needed once the program grows to capacity. These three new tenure track lines are needed in order to no longer "backfill" positions; a lack of such hires will simply mean that postdocs and FAs continue to teach the lower division courses. Because of this, there is no time frame for needing these lines – all three could be used immediately or left unfilled indefinitely and the MS program would continue. NCIAS leadership is aware and supportive of this eventuality since one of the hallmarks of the West campus is instruction of freshman and lower division courses by our tenure-track faculty. This is a fundamental mechanism through which we attract undergraduates into our research labs and ensure that they have a rich research experience lasting longer than only a semester or two during their senior year.

iii. **Administration of the program** - Explain how the program will be administered for the purposes of admissions, advising, course offerings, etc. Discuss the available staff support.

Advising will happen in the New College Advising Office. Select faculty from the School of Mathematical and Natural Sciences will meet with the graduate advising staff to discuss typical paths taken by students and answer questions they may have. Admissions to the program will be decided by a committee of three faculty that teach courses in the degree program. The School Director will discuss with the Program Leads to schedule the classes needed to implement the degree. Existing staff will help facilitate paperwork on admissions and other items related to the degree.

B. Resource requirements needed to launch and sustain the program: Describe any new resources required for this program's success such as new staff, new facilities, new library resources, new technology resources, etc.

Existing laboratory and classroom space together will be used to begin and sustain the new degree program.

**APPENDIX I
OPERATIONAL INFORMATION FOR GRADUATE PROGRAMS**

(This information is used to populate the [Graduate Programs Search](#)/catalog website.)

1. **Proposed title of major:** MS in Biological Data Science

2. **Marketing description** (*Optional - 50 words maximum. The marketing description should not repeat content found in the program description.*) N/A

3. **Provide a brief program description** (catalog type (i.e. will appear in Degree Search) – no more than 150 words):

The MS in Biological Data Science will provide students with real-world training at the interface of the natural and mathematical sciences. Students will learn to manipulate 'Big Data', including the generation and analysis of data using statistical and computational toolsets. Students will use their analytical skills in ecological, environmental, toxicological, and other biological applications. The program incorporates multiple levels of experiential learning, to ensure students gain critical thinking skills on top of core competencies. Students will be ready to enter one of the fastest-growing job markets, work with consulting firms, government agencies as well as non-governmental organizations, or go on to seek advanced professional or graduate degrees.

4. **Campus(es) where program will be offered:**

ASU Online curriculum consists of courses that have no face-to-face content. iCourses are online courses for students in on-campus programs. iCourses may be included in a program, but may not comprise the entirety of a program. On-campus programs must have some face-to-face content.

Note: Office of the Provost approval is needed for ASU Online campus options.

ASU Online only (all courses online and managed by ASU Online)

All other campus or location options (please select all that apply):

Downtown Phoenix Polytechnic Tempe West Other:

Both on-campus and ASU Online* - (check applicable campus(es) from options listed above)

**Note: Once students elect a campus or Online option, students will not be able to move back and forth between the on-campus and the ASU Online options. Approval from the Office of the University Provost and Philip Regier (Executive Vice Provost and Dean) is required to offer programs through ASU Online. Please complete the ASU Online Offering form in [Curriculum ChangeMaker](#) to begin this request.*

5. **Admission Requirements:**

An applicant must fulfill the requirements of both the Graduate College and the New College of Interdisciplinary Arts and Sciences .

Applicants are eligible to apply to the program if they have earned a bachelor's or master's degree in a related field such as biology, mathematics, statistics, computing as well as unrelated fields from a regionally accredited institution.

Applicants must have a minimum of a 3.00 cumulative GPA (scale is 4.00 = "A") in the last 60 hours of a student's first bachelor's degree program is required. A minimum of a 3.00 cumulative GPA (scale is 4.00 = "A") in an applicable master's degree program is required.

Applicants are required to submit:

1. graduate admission application and application fee
2. official transcripts
3. statement of purpose
4. two letters of recommendation
5. professional resume

6. proof of English proficiency

Additional Application Information

Applicants whose native language is not English (regardless of current residency) must provide proof of English proficiency.

It is preferred that letters of recommendation be from faculty members who know the applicant's work well; if these are not available, letters of recommendation from individuals in supervisory or professional roles will be accepted.

The statement of purpose should describe the educational background, scholarly interests, and academic and professional goals of the applicant.

Depending on student's educational background, deficiency courses may be required.

6. Application Review Terms (if applicable session):

Indicate the first term and year in which applications will be opened for admission. Applications will be accepted on a rolling basis after that time.

Note: It is the academic unit's responsibility to display program deadline dates on their website.

Terms	Years	University Late Fee Deadline
<input checked="" type="checkbox"/> Fall (regular) <input type="checkbox"/> Session B	(year): 2019 (year):	July 1st October 1st
<input type="checkbox"/> Spring (regular) <input type="checkbox"/> Session B	(year): (year):	December 1st February 8th
<input type="checkbox"/> Summer (regular) <input type="checkbox"/> Summer B	(year): (year):	May 14th May 14th
<p><i>Note: Session B is only available for approved online programs.</i></p>		

Program admission deadlines website address: <https://students.asu.edu/graduate/how-and-when-apply-graduate-admission>

7. Curricular Requirements:

Curricular Structure Breakdown for the Academic Catalog:

(To be completed by Graduate College)

Required Core (11 credit hours)

- ACO 501 Database Systems and Problem Solving in Python (3)
- BIO 614 Biometry (3)
- LSC 519 Applied Learning Lab (1)
- LSC 547 Wet Laboratory Experience (1)
- STP 560 Experimental Statistics in Biology (3)

Other Requirements (9 credit hours)

- LSC 555 Integrative Biology I (3)
- LSC 556 Integrative Biology II (3)
- LSC 562 Applied Mathematics Technique in Biology (3)

Electives or Research (6 credit hours)

Culminating Experience (6 credit hours)

ACO 593 Applied Project (6)
 BIO 593 Applied Project (6)
 MAT 593 Applied Project (6)
 ACO 599 Thesis (6)
 BIO 599 Thesis (6)
 MAT 599 Thesis (6)

Additional Curriculum Information

Other requirement, elective and research coursework may be substituted with approval of the academic unit.

For electives or research, please see the academic unit for the approved course list.

Students choose one culminating experience option based on their emphasis in biological data science.

8. Comprehensive Exams:

Master's Comprehensive Exam (when applicable), please select from the appropriate option.

N/A

9. Allow 400-level courses: **Yes** **No**

Note: No more than 6 credit hours of 400-level coursework may be included on a graduate student plan of study.

10. Committee:

Required number of thesis committee members (must be at least 3 including chair or co-chairs): 3

Required number of non-thesis option committee members (must be a minimum of one): 1

11. Keywords: List all keywords that could be used to search for this program. Keywords should be specific to the proposed program – limit 10 keywords.

data science, computation, biology datasets, applied math, statistics

12. Area(s) of Interest

A. Select one (1) primary area of interest from the list below that applies to this program.

- | | |
|--|---|
| <input type="checkbox"/> Architecture & Construction | <input type="checkbox"/> Interdisciplinary Studies |
| <input type="checkbox"/> Arts | <input type="checkbox"/> Law & Justice |
| <input type="checkbox"/> Business | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Communication & Media | <input type="checkbox"/> Psychology |
| <input type="checkbox"/> Education & Teaching | <input checked="" type="checkbox"/> STEM |
| <input type="checkbox"/> Engineering & Technology | <input type="checkbox"/> Science |
| <input type="checkbox"/> Entrepreneurship | <input type="checkbox"/> Social and Behavioral Sciences |
| <input type="checkbox"/> Health & Wellness | <input type="checkbox"/> Sustainability |
| <input type="checkbox"/> Humanities | |

B. Select one (1) secondary area of interest from the list below that applies to this program.

- | | |
|--|---|
| <input type="checkbox"/> Architecture & Construction | <input type="checkbox"/> Interdisciplinary Studies |
| <input type="checkbox"/> Arts | <input type="checkbox"/> Law & Justice |
| <input type="checkbox"/> Business | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Communications & Media | <input type="checkbox"/> Psychology |
| <input type="checkbox"/> Education & Teaching | <input type="checkbox"/> STEM |
| <input type="checkbox"/> Engineering & Technology | <input checked="" type="checkbox"/> Science |
| <input type="checkbox"/> Entrepreneurship | <input type="checkbox"/> Social and Behavioral Sciences |
| <input type="checkbox"/> Health & Wellness | <input type="checkbox"/> Sustainability |
| <input type="checkbox"/> Humanities | |

13. Contact and Support Information:

Office Location (Building Code & Room):	FAB N100
Campus Telephone Number: (may not be an individual's number)	(602) 543-3000
Program Email Address: (may not be an individual's email)	ncgradadvising@asu.edu
Program Website Address: (if one is not yet created, use unit website until one can be established)	https://newcollege.asu.edu/advising/graduate/
Program Director (Name):	Stephen Wirkus
Program Director (ASURITE):	swirkus
Program Support Staff (Name):	Tosha Ruggles
Program Support Staff (ASURITE):	tmsmith6
Admissions Contact (Name):	Arthur Morales
Admissions Contact (ASURITE):	aamroal2

14. Application and iPOS Recommendations: List the Faculty and Staff who will input admission/POS recommendations to Gportal **and** indicate their approval for Admissions and/or POS:

NAME	ASURITE	ADMSN	POS
Tosha Ruggles	tmsmith7	x	x
Robert Moody	rtmoody	x	x
Arthur Morales	aamoral2	x	

APPENDIX II

Assessment Plan



Academic Program Assessment Plan

Date: 4/6/2018	Program Name: MS in Biological Data Science	Status: UOEEE Provisional Approval
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Comment

Assessment Plan

Outcome 1:	Graduates of the MS in Biological Data Science will be able to generate data from wet lab experiments or describe how such data could be generated.
Measure 1.1	Successful completion of the wet laboratory experience reports.
Performance Criterion 1.1	75% or more of students will successfully complete the wet laboratory experience reports at a satisfactory level or higher.
Measure 1.2	Students will incorporate data into their thesis or project; data that the student generated in the lab or acquired elsewhere (e.g., online).
Performance Criterion 1.2	80% of students will satisfactorily explain the methodology or generation of data (as defined in Measure 1.2), as indicated by a score of "Satisfactory" or better on the data analysis portion of the thesis or project.
Measure 1.3	
Performance Criterion 1.3	
Outcome 2:	Graduates of the MS in Biological Data Science will be able to put datasets into an accessible form and read this data for computational purposes.
Measure 2.1	Students will be able to address datasets and the handling of them.
Performance Criterion 2.1	75% or more of students will receive a score of 70% or higher on a programming assignment (e.g., in Python) that addresses datasets and handling of them.
Measure 2.2	Students will use computational tools such as Python or other computer program taught in this degree, to manipulate datasets in their thesis or project.
Performance Criterion 2.2	80% or more of students will be able to describe how information resulting from computations tools contributes to the thesis or project, as indicated by a score of 'Satisfactory' or better on the results portion of the thesis or project.
Measure 2.3	
Performance Criterion 2.3	
Outcome 3:	Graduates of the MS in Biological Data Science will be able to use statistical methods to analyze large datasets.
Measure 3.1	Comprehensive final exam in Experimental Statistics.
Performance Criterion 3.1	75% or more of students will score 70% or higher on the final exam of Experimental Statistics.
Measure 3.2	Students will select and utilize appropriate statistical methods taught in this degree program to analyze the datasets in their thesis or project.

Performance Criterion 3.2

80% or more of students will satisfactorily explain why the particular statistical method employed is appropriate as indicated by a score of "Satisfactory" or better on the methods portion of the thesis or project.

APPENDIX III

Letters of Support

Note: Proposed program name changed from MS in Computational and Natural Sciences to MS in Biological Data Science during the proposal development process. Some of the letters reference the MS in Computational and Natural Sciences. Program is moving forward with MS in Biological Data Science.

New College of Interdisciplinary Arts and Sciences – Official Submission

From: Stacey Kimbell
Sent: Friday, May 18, 2018 2:09 PM
To: Amanda Morales-Calderon <AMANDA.MORALES-CALDERON@asu.edu>
Cc: Patricia Friedrich <Patricia.Friedrich@asu.edu>; Catherine Kerrey <Catherine.Kerrey@asu.edu>; Tosha Ruggles <tosha.ruggles@asu.edu>; Brian Mattson <Brian.Mattson@asu.edu>; Erin Froncek <Erin.Froncek@asu.edu>; Chasaty Smith <Chasaty.Smith@asu.edu>
Subject: RE: MS Biological Data Science - Graduate College Review

Good afternoon,

Attached please find our updated proposal to establish the MS in Biological Data Science. If you have any questions, please let me know at your earliest convenience.

Thanks,
Stacey

Stacey Kimbell

Executive Admin Support Specialist and Curriculum Coordinator
Academic Administration and Curriculum Planning
ASU New College of Interdisciplinary Arts and Sciences

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From: Amanda Morales-Calderon
Sent: Thursday, March 22, 2018 12:23 PM
To: Stacey Kimbell <kimbell@asu.edu>
Cc: Patricia Friedrich <Patricia.Friedrich@asu.edu>; Catherine Kerrey <Catherine.Kerrey@asu.edu>; Tosha Ruggles <tosha.ruggles@asu.edu>; Brian Mattson <Brian.Mattson@asu.edu>; Erin Froncek <Erin.Froncek@asu.edu>; Chasaty Smith <Chasaty.Smith@asu.edu>
Subject: MS Biological Data Science - Graduate College Review

Hi Stacy,

Hope you are doing well. New College recently received academic plan approval to change the name of their proposed MS in Computational and Natural Sciences graduate program to MS in Biological Data Science. Since the MS in Computational and Natural Sciences proposal is not yet approved, we have coordinated with the Provost's office to update the name in the establishment proposal rather than processing a name change proposal...meaning one proposal going through governance reviews rather than two.

Attached please find the updated MS Computational Natural Sciences proposal, now the MS in Biological Data Science proposal, which includes our suggested edits and comments.

Please let us know if you have any questions. With a proposed Fall 2019 effective term, we have some time to get this through governance reviews. We look forward to receiving a revised version.

Many thanks,

--Amanda

Amanda Morales-Calderon, M.Admin.
Manager, Graduate Catalog Coordinator
& Format Supervisor

Graduate Program Services
[Graduate College](#) | [Arizona State University](#)

Good afternoon,

Attached please find our proposal to change the name of the MS Computational and Natural Sciences to MS Biological Data Science. If you have any issues with the files, please don't hesitate to let me know at your earliest convenience.

Thank you,
Stacey

Stacey Kimbell

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College of Health Solutions, Department of Bioinformatics – Impact Statement

Additional comments from the proposal author: We have been in touch with Dr. Runger again. To repeat an earlier argument from this proposal: doing a search for Biomedical Data Science results in a number of degree programs at other universities. Only one program with a minor comes up for Biological Data Science because the name doesn't seem nearly as popular. We don't think that Biological Data Science will confuse the STEM student because of what we've chosen to emphasize. The strong component of big data and statistics within our proposal make "data science" part of the best choice of words and because all of the applications are biological (and nothing biomedical), we don't think there will be a problem with name confusion.

From: Lara Ferry <Lara.Ferry@asu.edu>
Date: Friday, April 27, 2018 at 4:41 PM
To: Maria Hanlin <Maria.Hanlin@asu.edu>
Cc: George Runger <George.Runger@asu.edu>, Patricia Friedrich <Patricia.Friedrich@asu.edu>
Subject: Re: Renewed Impact Statement for MS

Thanks Maria!

Sent from my iPhone, please excuse the brevity and typos.

On Apr 27, 2018, at 4:06 PM, Maria Hanlin <Maria.Hanlin@asu.edu> wrote:

Hello Dr. Ferry,

Regarding the program name, something like Environmental Data Science might be less confusing to students than Biological Data Science when compared to our title of Biomedical Data Science. However, we understand both our titles have been approved by the Provost.

We are happy to have student from your program register for our courses. We would suggest the following BMI courses as electives:

- BMI 601 Foundations of Health Informatics
- BMI 555 Statistical Learning for Data Mining

Please let us know if you need anything further.

Best regards,

Maria

Maria Hanlin, MA

Assistant Director, Academic Services

Biomedical Informatics

Biomedical Diagnostics

College of Health Solutions

Arizona State University

Mayo Clinic Johnson Research Building

13212 E Shea Blvd

Scottsdale, AZ 85259

From: Lara Ferry
Sent: Wednesday, April 25, 2018 12:01 PM
To: George Runger <George.Runger@asu.edu>
Cc: Patricia Friedrich <Patricia.Friedrich@asu.edu>; Stephen Wirkus

<Stephen.Wirkus@asu.edu>

Subject: FW: Renewed Impact Statement for MS

Hi George,

I had not heard back from you on the issue of our MS degree name (part of the message is appended below). I wonder if we might collaborate, as we just did on the Data Science UG Certificate, to help each other out? Our degree is highly focused in the natural sciences, mainly Environmental and Toxicological. I don't envision a lot of overlap in terms of student interest into the degrees. However, certainly some of our courses (yours and ours) might be relevant to both populations of students. If you had some courses that might be fitting, we could offer them as electives, which would help us to get the degree of the ground sooner with more courses available to students right away. We are always short on bodies to teach, as I am sure you also experience. I know you are in the planning stages of your degree, but if you have existing courses you would like us to consider, please don't hesitate to share them. We can add them to the course list at any of the stages of revision and beyond.

All the best,

Lara Ferry, PhD

Director and Professor, School of Mathematical & Natural Sciences

Honors Faculty, Barrett The Honors College

Sr. Sustainability Scholar, Julie Ann Wrigley Global Institute of Sustainability

Arizona State University

Mailing Address (letters): PO Box 37100, MC 2352 • Phoenix, AZ 85069-7100

Shipping Address (packages): 4701 W. Thunderbird Rd • Glendale, AZ 85306-4908

Research Website: <http://morphology.asu.edu>

From: Lara Ferry <Lara.Ferry@asu.edu>

Date: Wednesday, April 4, 2018 at 10:42 AM

To: George Runger <George.Runger@asu.edu>

Cc: Maria Hanlin <Maria.Hanlin@asu.edu>

Subject: Re: Renewed Impact Statement for MS

Hi George,

Thanks for getting back to me so quickly. I understand your concern. CLAS is organizing a massive effort using the name Data Science as well. Do you have any suggestions?

Lara

From: George Runger <George.Runger@asu.edu>

Date: Wednesday, April 4, 2018 at 10:26 AM

To: Lara Ferry <Lara.Ferry@asu.edu>

Cc: Maria Hanlin <Maria.Hanlin@asu.edu>

Subject: RE: Renewed Impact Statement for MS

Lara

I supported the plan for the program. However, we were approved by the Provost's office to plan a degree named Biomedical Data Science. The current name seems too similar to ours. It seems like an alternative would be better and clearer to potential students, George

From: Lara Ferry
Sent: Tuesday, April 03, 2018 1:11 PM
To: George Runger <George.Runger@asu.edu>
Subject: Renewed Impact Statement for MS
Hello George,

I hope you are well!

I am writing because we are in the final proposal revision stages of our new MS degree. You had provided us with a positive impact statement previously. We were advised to change the name of the MS to Biological Data Science (from Computational Natural Science). The provost has approved the name change, but would request that you are, justifiably, kept in the loop with the change. There have been no changes to the program's structure or course offerings, or our targeted audience, which we describe as students in toxicology, ecology, and environmental sciences.

I would appreciate if you let us know your thoughts on impact, and I hope that we might continue to collaborate on course offerings!

Thank you,
Lara Ferry, PhD
Director and Professor, School of Mathematical and Natural Sciences
Faculty, Barrett The Honors College
Senior Sustainability Scholar

Email from George Runger, Chair and Professor, Department of Bioinformatics to Dean Todd Sandrin

On Oct 31, 2017, at 1:39 PM, George Runger <George.Runger@asu.edu> wrote:

Todd

We requested comments from our faculty and I'll summarize as follows. In general, there is not a conflict when it is described as

...however, data from ecological systems made possible by satellite and tracking systems or data from pharmacology and toxicology studies are two of many examples where the training in computational and statistical approaches in the natural science is increasingly important and are examples of areas upon which we will focus.

But the other elements in the proposal are not as specific

Coupled together with the large increase in health related professions, this degree will target anyone with an interest in utilizing statistical and computational methods to analyze biological data.

and our comments are that the focus should be narrowed in the degree plan to the more targeted data sources.

Also, our current biomedical informatics degrees includes not only genomics, but also clinical, and other health data so that the following is not an complete characterization

The master of science in biomedical informatics housed in the Department of Biomedical Informatics is the closest program to what we are proposing and will complement but not overlap with what we are proposing. Bioinformatics traditionally focuses on the large amounts of genome and related data;

We also received permission last year to plan a new MS degree *Biomedical Data Science* that would focus on our data sources that were mentioned previously. If your degree plan specifies your target data domain clearly, there should not be an overlap. Thank you, George

College of Liberal Arts and Sciences – Impact Statement

From: Patrick Kenney
Sent: Wednesday, May 16, 2018 12:44 PM
To: Todd Sandrin <Todd.Sandrin@asu.edu>
Subject: RE: Proposal and documents to establish MS Biological Data Science - impact statement

Hi Todd, I talked to Ferran and this request is fine with CLAS.

Thanks, Pat

*Patrick J. Kenney
Dean, College of Liberal Arts and Sciences
Foundation Professor, School of Politics and Global Studies
Arizona State University*

From: Todd Sandrin
Sent: Wednesday, May 16, 2018 10:15 AM
To: Patrick Kenney <pkenny@asu.edu>
Subject: RE: Proposal and documents to establish MS Biological Data Science - impact statement

Pat,

Great to see you on the retreat! Per our brief conversation at Skysong, there appears to be one more impact statement request we haven't yet covered: MS in Biological Data Science.

Thanks!
Todd

From: Patrick Kenney
Sent: Saturday, April 28, 2018 4:30 PM
To: Todd Sandrin <Todd.Sandrin@asu.edu>
Subject: Re: Proposal and documents to establish MS Biological Data Science - impact statement

Hi Todd, ok, let me run it by Ferran and SOLS.

Thanks Pat

From: Todd Sandrin <todd.sandrin@asu.edu>

Sent: Friday, April 27, 2018 4:19 PM

Subject: Proposal and documents to establish MS Biological Data Science - impact statement

To: Patrick Kenney <pkenney@asu.edu>

Hi Pat,

It was great to see you at the Victoria Foundation event at the Biltmore today. What an inspiring set of leaders and stories!

I am writing to request an impact statement for a program we received permission to plan and are now seeking permission to establish (proposal attached). This is an MS degree. We received the Provost's approval for a name change to Biological Data Science. By focusing on biological data only, we are hoping to carve a niche, much smaller in scope than what other programs at ASU are seeking, one that does not conflict with other programs being proposed elsewhere at ASU.

Of course, don't hesitate to let me know if you need more information or would like to converse.

Have a great weekend!

Fulton Schools of Engineering - Impact Statement

From: Kyle Squires
Sent: Monday, May 28, 7:15 PM
Subject: RE: Proposal and documents to establish MS Biological Data Science - impact statement
To: Todd Sandrin

Hi Todd,

Looping back on this...thanks for contacting me about the proposal. Looks quite interesting.

The proposal does not seem to conflict (overlap) with existing FSE degrees and also likely not with those currently under discussion for development.

Thanks again and good luck!

-- Kyle

From: Todd Sandrin
Sent: Friday, April 27, 2018 4:21 PM
To: Kyle Squires <squires@asu.edu>
Subject: Proposal and documents to establish MS Biological Data Science - impact statement

Hi Kyle,

It was great to see you earlier this week at the Sun Devil 100 event (the University Council)! I look forward to our upcoming bus trip together.

I am writing to request an impact statement for a program we received permission to plan and are now seeking permission to establish (proposal attached). This is an MS degree. We received the Provost's approval for a name change to Biological Data Science. By focusing on biological data only, we are hoping to carve a niche, much smaller in scope than what other programs at ASU are seeking, one that does not conflict with other programs being proposed elsewhere at ASU.

Of course, don't hesitate to let me know if you need more information or would like to converse.

Have a great weekend!

Todd

Todd R. Sandrin, Ph.D.

[Dean, New College](#) of Interdisciplinary Arts and Sciences

Vice Provost, [West campus](#)

[Professor, School of Mathematical and Natural Sciences](#)

Senior Sustainability Scientist - [Julie Ann Wrigley Global Institute of Sustainability](#)

College of Nursing and Health Innovation – Impact Statement

Note: Proposed program name changed from MS in Computational and Natural Sciences to MS in Biological Data Science during the proposal development process.

From: Katherine Kenny

Sent: Thursday, May 17, 2018 1:13:51 PM

To: Patricia Friedrich

Subject: FW: Proposal and documents to establish MS Computational and Natural Sciences - impact statement

Dear Patricia – thank you for the opportunity to review your proposal to Establish MS Computational and Natural Sciences. There is no conflict with the courses or degree programs that we offer in the College of Nursing and Health Innovation (CONHI). On behalf of CONHI I support moving this degree forward. Good luck.

Best,

Kathy

Katherine (Kathy) Kenny, DNP, RN, ANP-BC, FAANP, FAAN
Associate Dean of Academic Affairs
College of Nursing and Health Innovation
Arizona State University

From: Patricia Friedrich <Patricia.Friedrich@asu.edu>

Date: Tuesday, April 24, 2018 at 3:37 PM

To: Craig Thatcher <Craig.Thatcher@asu.edu>

Subject: Proposal and documents to establish MS Computational and Natural Sciences - impact statement

Dear Craig:

How are you?

I am writing to request an impact statement for a program we received permission to plan and are now seeking permission to establish. This is an MS degree. Please note that while the documents above are under a previous name — MS in Computational and Natural Sciences, we received the Provost's approval for a name change to Biological Data Science. By focusing on biological data only, we are hoping to carve a niche, much smaller in scope than what other programs at ASU are seeking, one that does not conflict with other programs being proposed elsewhere at ASU.

Thank you,

Patty

College of Integrative Sciences and Arts – Impact Statement

From: Duane Roen <Duane.Roen@asu.edu>
Date: Wednesday, April 25, 2018 at 6:25 AM
To: Patricia Friedrich <Patricia.Friedrich@asu.edu>
Subject: RE: Proposal and documents to establish MS Computational and Natural Sciences - impact statement

Patty,

CISA enthusiastically supports the proposal from New College to establish an MS in Computational and Natural Sciences.

Please let us know if you need anything else.

Best,
Duane

Duane Roen
Vice Provost, Polytechnic campus
Dean, College of Integrative Sciences and Arts
Dean, University College
Arizona State University
Mail Code: 2780
7271 E Sonoran Arroyo Mall
Mesa, AZ 85212-6415
P: 480-727-6513

From: Patricia Friedrich
Sent: Tuesday, April 24, 2018 3:22 PM

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To: Duane Roen <Duane.Roen@asu.edu>
Subject: Proposal and documents to establish MS Computational and Natural Sciences - impact statement

Dear Duane:

How are you?

I am writing to request an impact statement for a program we received permission to plan and are now seeking permission to implement. This is an MS degree. Please note that while the documents above are under a previous name — MS in Computational and Natural Sciences, we received the Provost's approval for a name change to Biological Data Science. By focusing on biological data only, we are hoping to carve a niche, much smaller in scope than what other programs at ASU are seeking, one that does not conflict with other programs being proposed elsewhere at ASU.

Thank you,

Patty

Patricia Friedrich, PhD
Associate Dean for Academic Programs,
New College of Interdisciplinary Arts and Sciences
Professor of Linguistics/Rhetoric and Composition,
School of Humanities, Arts, and Cultural Studies
Arizona State University P. O. Box 37100
4701 W. Thunderbird Rd. Mail Code 3051
Phoenix, AZ, USA 85069-7100
voice 602 543-6046

National Center for Biotechnology Information (NCBI) – Letter of Support



Georgy P. Karev
PhD, Dr. in Sci.

National Center for Biotechnology Information (NCBI)
National Library of Medicine (NLM)
National Institutes of Health (NIH)
Bldg. 38A, 8600 Rockville Pike
Bethesda, MD 20894, USA
Phone: (301) 451-6722
Email: karev@ncbi.nlm.nih.gov

August 24, 2017

Dear Provost Mark Searle,

I am writing in support of the Master of Science in Computational and Natural Sciences that is being submitted from the School of Mathematical and Natural Sciences. From my vantage point at the National Institutes of Health, I have seen the increasing need for higher degree (B.S., M.S., and Ph.D.) recipients that have been well-trained in statistics and computing and adept at handling biological datasets. This is exactly what is proposed in this degree and I think it will be timely and impactful.

Yours

Georgy Karev

A handwritten signature in blue ink that reads 'Karev'.