THE UNIVERSITY OF ARIZONA®

New Academic Program Workflow Form

General

Proposed Name: Ecosystem Genomics GIDP

Transaction Nbr: 00000000000098

Plan Type: Minor

Academic Career: Graduate

Degree Offered:

Do you want to offer a minor? Y

Anticipated 1st Admission Term: Fall 2021

Details

Department(s):

AGSC

DEPTMNT ID	DEPARTMENT NAME	HOST
1230	Biosystems Engineering	N
1232	Agricultural Education	N
1238	School of Plant Science	N
1239	School of Natural Resources and the Environment	N

GRDC

DEPTMNT ID	DEPARTMENT NAME	HOST
2501	Graduate Interdisciplinary Programs	Y

SBSC

DEPTMNT ID	DEPARTMENT NAME	HOST
0481	School of Information	N
3008	School of Geography and Development	N

SCNC

DEPTMNT ID	DEPARTMENT NAME	HOST
0420	Ecology & Evolutionary Biology	N
0469	Hydrology and Atmospheric Sciences	N

Campus(es):

MAIN

LOCATION	DESCRIPTION
TUCSON	Tucson

Admission application terms for this plan: Spring: N Summer: N Fall: Y

Plan admission types:

Freshman: N Transfer: N Readmit: N Graduate: Y

Non Degree Certificate (UCRT only): Y

Other (For Community Campus specifics): N

Plan Taxonomy: 26.1201, Biotechnology.

Program Length Type: Program Length Value: 0.00

Report as NSC Program:

SULA Special Program:

Print Option:

Diploma: Y Ecosystem Genomics Graduate Interdisciplinary Program PhD Minor

Transcript: Y Ecosystem Genomics Graduate Interdisciplinary Program PhD Minor

Conditions for Admission/Declaration for this Major:

We welcome active doctoral students who are enrolled full time at the University of Arizona, with background and training in ecology, evolutionary biology, entomology, plant sciences, biosystems engineering, hydrology, atmospheric science, environmental science, and/or natural resource management. While students from diverse programs will be considered, we anticipate that students generally will be enrolled in a graduate program aligned conceptually with ecosystem genomics (e.g., but not limited to, Ecology and Evolutionary Biology (EEB), Entomology and Insect Sciences (EIS), School of Plant Sciences (SPLS), Biosystems Engineering (BE), Hydrology and Atmospheric Sciences (HAS), Environmental Sciences (ENVS), School of Natural Resources and the Environment (SNRE), School of Information (INFO), and School of Geography, Development, and Environment (GEOG). Students who previously completed the Graduate Certificate in Ecosystem Genomics are not eligible to earn the minor.

Requirements for Accreditation:

We will not seek accreditation.

Program Comparisons

University Appropriateness

The proposed Ecosystem Genomics GIDP fits under two pillars of the University of Arizona's strategic plan: Grand Challenges 2.2A--Preeminence in environmental research and education, by striving to "excel in research on the natural and built environment..."; and Arizona Advantage 3.1A--Strengthen commitment to equity and support of diverse communities by "creat[ing] engaging and empowered campus environments that inspire creativity, enhance our ability to think critically, and challenge us to approach some of societys most complex problems without hesitation, and enriched by diverse perspectives... leading the way toward a society that taps into the talents, wisdom, and strengths that all individuals and communities possess to solve our greatest problems."

The GIDP Co-Chairs, participating faculty, and University leaders such as Dean Carnie and Dr. Folks have a shared commitment to fostering the long-term sustainability and growth of ecosystem genomics as an emerging critical science at University of Arizona, with attention to continued recruitment of faculty; supporting research, teaching, curriculum development, outreach, and mentorship through the ecosystem genomics initiative; and enhancing and formalizing graduate student training through the proposed GIDP.

The University of Arizona is the most appropriate location within the Arizona University System for this GIDP because of our sustained and growing excellence in Ecosystem Genomics, as reflected in our Ecosystem Genomics Initiative, the highly successful Ecosystem Genomics cluster hire, and the thriving focus on ecosystem genomics that connects multiple colleges and units on campus in a new, emergent, convergent science. Moreover, the University of Arizona, as Arizona's land-grant institution, is uniquely positioned to serve stakeholders statewide and regionally with problem-solving that, by working across scales from genomics to ecosystems, can solve grant challenges in human sustainability. Finally, as a Hispanic Serving Institution the University of Arizona has the opportunity to increase the recruitment, inclusion, retention, and visibility of diverse students in graduate programs in STEM. This GIDP aims to enhance graduate recruitment to partner programs with an infusion of support from the National Science Foundation Research Trainee grant (BRIDGES), which supports the initiation and first strategic phase of this GIDP.

Arizona University System

NBR	PROGRAM	DEGREE	#STDNTS	LOCATION	ACCRDT
1	Ecol. & Environ. Informatics	PHD	11	NAU (Main-Flagstaff Mountain)	N

Peer Comparison

The proposed program is globally unique and complements existing programs in the integrative life sciences by centering on a newly emergent and convergent scientific field, the interdisciplinary science of ecosystem genomics. While many programs exist with major/minor emphases in genomics, ecosystem science, and related disciplines, we did not identify any existing minor (or major) program that focuses on integrating from genes to ecosystems in a manner that reaches from molecules to landscapes, from soils to the atmosphere, from microbes to plants and insects, and from wild lands to agriculture. The closest matches are presented in the comparison table: the T3 option in the INF (Informatics) PhD program at Northern Arizona University; and the Environmental Life Sciences PhD at Arizona State University. Both are oriented toward sustainability and addressing grand challenges in sustainability, the former through informatics and the latter through traditional environmental science. Both are outstanding and successful programs that differ from, and are complementary to, the proposed UArizona GIDP PhD Minor in Ecosystem Genomics: the proposed GIDP brings students in diverse areas together on a convergent training program in an emergent field of ecosystem genomics, rather than drawing only from informatics students or only from students studying environmental science: our partner programs on campus include EEB, BE, EIS, SNRE, HAS, SPLS, ENVS, GEOG, and INFO. The proposed GIDP has a novel core course that spans the emergent discipline and is distinct in its dual foci in ecosystem sciences and genomics. The role of informatics for the proposed GIDP is to advance the synthesis of ecosystem sciences and genomic sciences, advancing the emergent discipline as a tool rather than a focus. Coupled with our outstanding faculty hires in Ecosystem Genomics, our active faculty research programs, and our initial funding through the National Science Foundation, the GIDP in Ecosystem Genomics is conceptualized as a novel and innovative program that will fill an open niche at the leading edge of interdisciplinary science.

Faculty & Resources

Faculty

Current Faculty:

INSTR ID	NAME	DEPT	RANK	DEGREE	FCLTY/%
01868877	Luciano Matzkin	1235	Assoc. Prof	Doctor of Philosophy	.05
01875717	Jana Uren	1230	Assit. Prof	Doctor of Philosophy	.01
02565087	Bonnie Hurwitz	1230	Assoc. Prof	Doctor of Philosophy	.05
06902489	Andrew Comrie	3008	Professor	Doctor of Philosophy	.01
08609517	Jennifer Croissant	0433	Assoc. Prof	Doctor of Philosophy	.01
11403676	Anne Arnold	1238	Professor	Doctor of	.05

INSTR ID	NAME	DEPT	RANK	DEGREE	FCLTY/%
				Philosophy	
13205326	Rod Wing	1238	Professor	Doctor of Philosophy	.01
13509167	Erin Leahey	0418	Professor	Doctor of Philosophy	.01
14903023	Scott Saleska	0420	Professor	Doctor of Philosophy	.05
22052456	Katrina Dlugosch	0420	Assoc. Prof	Doctor of Philosophy	.01
22052954	Rachel Gallery	1239	Assoc. Prof	Doctor of Philosophy	.01
22067228	Laura Meredith	1239	Assit. Prof	Doctor of Philosophy	.05
22074294	Albert Barberan	1240	Assit. Prof	Doctor of Philosophy	.01
22075561	William Pauli	1238	Assit. Prof	Doctor of Philosophy	.01
22080295	Malak Tfaily	1240	Assit. Prof	Doctor of Philosophy	.01
22085060	Winslow Burleson	0481	Professor	Doctor of Philosophy	.01
22086244	Yang Song	0469	Assit. Prof	Doctor of Philosophy	.01

Additional Faculty:

No additional faculty needed.

Current Student & Faculty FTE

DEPARTMENT	UGRD HEAD COUNT	GRAD HEAD COUNT	FACULTY FTE
2501	0	24	.37

Projected Student & Faculty FTE

	UGRD HEAD COUNT			GRAD HEAD COUNT			FACULTY FTE		
DEPT	YR 1	YR 2	YR 3	YR 1	YR 2	YR 3	YR 1	YR 2	YR 3
2501	0	0	0	8	16	24	.37	.37	.37

Library

Acquisitions Needed:

None.

Physical Facilities & Equipment

Existing Physical Facilities:

The GIDP will use existing physical facilities already in use by our partner

graduate programs. Dr. Jennifer Barton, Director of The BIO5 Institute has agreed to provide office space for the Program Coordinator. No special facilities are required.

Additional Facilities Required & Anticipated:

None.

Other Support

Other Support Currently Available:

Directors/Coordinators/Chairs of Graduate Studies in partner programs have agreed to assist in student recruitment to the GIDP minor. Funds from the National Science Foundation, College of Science, and College of Agriculture and Life Sciences will support the Program Coordinator for the first five years of the GIDP, with plans currently underway to seek private, donor, and institutional support thereafter. Funding for personnel for the GIDP will be non-Graduate College/GIDP resources.

The BIO5 Institute will provide support the Ecosystem Genomics Seminar Series to bring 2-3 domestic and international speakers per year to UA for the first five years of the GIDP. The Co-Chairs of the GIDP are tenured faculty members contributing their leadership as service aligned with the University of Arizona's strategic aims.

Other Support Needed over the Next Three Years:

None.

Comments During Approval Process

12/2/2021 2:21 PM

BCOLOMBI

Comments
Approved.

NEW ACADEMIC PROGRAM- STANDALONE GRADUATE MINOR ADDITIONAL INFORMATION FORM

I. **MINOR DESCRIPTION** - *provide a marketing/promotional description for the proposed minor. Include the purpose, nature, and highlights of the curriculum, faculty expertise, etc. The description should match departmental and college websites, handouts, promotional materials, etc.*

The Ecosystem Genomics Graduate Interdisciplinary Program (GIDP) PhD Minor will support and train diverse, outstanding doctoral students in **ecosystem genomics**, an emergent discipline that integrates across biotic systems from genes to ecosystems to solve grand challenges in sustainability and innovation in a rapidly changing world. As an innovative, interdisciplinary area of study, ecosystem genomics represents the synthesis of ecosystem- and genomic sciences via the tools of computational biology, modeling, data science, experiments, theory, applications, and the approaches and power of 'big data' in a collaborative and convergent framework.

The **ultimate aim** of the Ecosystem Genomics GIDP is to foster a new generation of diverse transdisciplinary scientists to address the challenges of sustaining natural and managed ecosystems on which humans depend, including wildlands, agricultural systems, forests, arid lands, and marine environments. The coursework supported by this minor will help students think across scales from 'genes to ecosystems' as they develop skills in interdisciplinarity, scientific communication, and collaboration. At is core the minor will foster and extend students' excellence in areas such as data science, microbiology, plant sciences, insect science, environmental science, atmospheric science, biosystems engineering, ecology and evolutionary biology, geography and information science, and it is intended to attract students majoring in these UArizona programs. Ultimately the minor will help students translate ideas into meaningful scientific advances while cultivating deep and broad skill sets and promises to prepare students for important roles in solving grand challenges relevant to regional, national, and international issues in sustainability and innovation.

II. **NEED FOR THE MINOR/JUSTIFICATION** - *provide market analysis data or other tangible evidence of the need for and interest in the proposed minor. This might include results from surveys of current students, alumni, and/or employers or reference to student enrollments in similar programs in the state or region. Curricular Affairs can provide a job posting/demand report by skills obtained/outcomes of the proposed minor. Please contact the Office of Curricular Affairs to request the report for your proposal.*

Ecosystem genomics is both a new scientific discipline and a nexus for coalescing UArizona's existing and emergent strengths in environmental science, microbial ecology, plant science, insect science, hydrology and atmospheric science, biosystems engineering, natural resources, ecology, evolutionary biology, genome-enabled science, and "big data" cyberinfrastructure to address the grand challenge of scaling biological information from genes to ecosystems. This GIDP is motivated by a group of faculty with shared and resonant interests who already have come together as collaborators, co-mentors, and instructors to fill a clear need in the job market, from industry to academia to government and non-governmental organizations. As evidenced by our letters of support from industry, as but one example of the excitement among prospective employers, there is considerable enthusiasm for the program.

This minor will simultaneously advance theory and practical solutions to problems ranging from global climate change to human health. As a science, ecosystem genomics integrates the theory and tools of *ecosystem ecology* with *meta-omics* approaches to open a new window on mechanisms that regulate scaling of micro- to macro-scale processes in natural and human-built environments. This minor seeks to advance predictive understandings of how biological information networks regulate natural and human ecosystem responses to change.

The University of Arizona already has supported the development of the Ecosystem Genomics focus area through a faculty cluster hire that resulted in 6 new faculty at the Assistant/Associate Professor level in 5 departments. The foundation for the cluster hire in Ecosystem Genomics emerged from the iBiosphere Working Group that was convened in 2012 at the request of then-Associate VPR Andrew Comrie, and Deans Shane Burgess (CALS) and Joaquin Ruiz (COS). In creating the iBiosphere concept, a group of nine faculty members from six colleges developed a strategic plan for enhancing interfaces among the natural sciences, information sciences and social sciences, with a primary nexus being 'big-data' and 'big-computing'.

Since then, the team of faculty has grown to 15 faculty in nine units. This effort resulted in a successful 5-year NSF Research Training (NRT) grant in Ecosystem Genomics that started in Fall 2020. During the first recruitment cycle more than 45 incoming students applied, suggesting interest and sustainability for a long-term program in this area. Moreover, employers such as Bayer Crop Sciences and Indigo Agriculture have expressed their support for graduate training in Ecosystem Genomics, indicating opportunities for future jobs for students from our program. We anticipate that the training provided by the minor will expand and complement the expertise gained by doctoral students in majors in partner programs (EEB, EIS, BE, SPLS, ENVS, HAS, SNRE, GEOG, INFO) and foster additional hard- and soft-skill training that will propel them as they move on to careers in academia, governmental agencies, non-profits, industry, agriculture, data science, and more.

III. MINOR REQUIREMENTS - *complete the table below to list the minor requirements, including minimum number of credit hours, required core, electives, and any special requirements. Note: information in this section must be consistent throughout the proposal documents (comparison charts, curricular/assessment map, etc.).*

Total transfer units that may apply to minor	Three (3), but these may not replace the Ecosystem Genomics Seminar
Pre-admissions expectations (i.e., academic training to be completed prior to admission)	We welcome active doctoral students who are enrolled full time at the University of Arizona, with background and training in ecology, evolutionary biology, entomology, plant sciences, biosystems engineering, hydrology, atmospheric science, environmental science, and/or natural resource management. While students from diverse programs will be considered, we anticipate that students generally will be enrolled in a graduate program aligned conceptually with ecosystem genomics (e.g., but not limited to, Ecology and Evolutionary Biology (EEB), Entomology and Insect Sciences (EIS), School of Plant Sciences (SPLS), Biosystems Engineering (BE), Hydrology and Atmospheric Sciences (HAS), Environmental Sciences (ENVS), School of Natural Resources and the Environment (SNRE), School of Information (INFO), and School of Geography, Development, and Environment (GEOG). To apply, an interested student should contact the Program Coordinator or co-chairs. There are no additional GPA requirements beyond a 3.0.
Minor requirements. List all minor requirements including core and electives. Courses listed must include course prefix, number, units, and title. Mark new coursework (New). Include any limits/restrictions needed (house number limit, etc.). Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department.	All courses already exist and are taught regularly in person on the UArizona main campus. We have reached out to instructors and unit/department heads to confirm that the GIDP minor would not create enrollment challenges. Letters of support are included. 11 units required (3 core + 8 or more elective units) **Complete 3 units of core coursework:** -RNR 696A (2) Ecosystems Genomics Seminar, fall -EIS 596A (1) Ecosystem Genomics Seminar, spring

	Complete 3 courses, choosing at least <u>one</u> course from each of three of the following four areas (to be chosen in conjunction with major and minor advisor/doctoral advising committee) for a minimum of 8 units. All courses already exist and are taught regularly in person on the UArizona main campus. We have reached out to instructors and unit/department heads to confirm that the graduate certificate would not create enrollment challenges. Letters of support are included. 11 units required (3 core + 8 or more elective units) 1. *Communication & Dissemination* -ENVS 508 (3) Scientific Writing for Env., Ag., & Life Sciences -ENVS 515 (3) Translating Environmental Science -WSM/GEOS 595E (currently 1, will become 3 after fall 2021) Scientific Writing (Topics in Dendrochronology) -INFO 520 (3) Ethical Issues in Information -INFO 536 (3) Data Science and Public Interests 2. *Theory & Concepts: Ecosystem & Earth Science* -ENVS 511 (3) Environmental Metabolomics -ENVS510 (3) Microbial Biogeochemistry and Global Change -RNR 558 (3) Ecosystem Ecology and a Sustainable Future -ENVS 525 (3) Environmental Microbiology -ECOL 578 (3) Global Change -ATMO 536A (3) Fundamentals of Atmospheric Sciences -GC 530 (3) The Climate System -GC 597A (3) Global Change Research, Application, and Decision Making 3. *Theory & Concepts: Genomic Biology* -ECOL 553 (4) Functional and Evolutionary Genomics -ECOL 596A (1) Evolutionary Ecology -ECOL 600A (3) Fundamentals of Evolution -ECOL 565 (3) Phylogenetic Biology -EIS 544 (3) Insect Ecology -PLP 550 (4) Principles of Plant Microbiology 4. *Tools & Data: Data Analytics* -BE 534 (3) Biosystem Analytics -BE 587 (3) Metagenomics: From Genes to Ecosystems -ECOL 580 (3) Mathematical Models in Biology -ENVS 567 (3) Introductory Statistics & Multivariate Statistics with R (undergoing course name change to Statistical analysis of ecological and environmental data with R) -INFO 533 (3) Medical On-Line Searching -INFO 544 (3) Informatics in Biology -INFO 597 (1-6) Biodiversity Informatics
Research methods, data analysis, and methodology requirements (Yes/No). If yes, provide description.	Yes, integrated into the required Ecosystem Genomics seminar and delivered through training for their majors.
Internship, practicum, applied course requirements (Yes/No). If yes, provide description.	No
Additional requirements (provide description)	No

IV. CURRENT COURSES - *using the table below, list all existing courses included in the proposed minor. You can find information to complete the table using the UA course catalog or UAnalytics (Catalog and Schedule Dashboard> "Printable Course Descriptions by Department" On Demand Report; right side of screen). If the courses listed belong to a department that is not a signed party to this implementation request, upload the department head's permission to include the courses in the proposed minor and information regarding accessibility to and frequency of offerings for the course(s). Upload letters of support/emails from department heads to the "Letter(s) of Support" field on the UAccess workflow form. Add rows to the table, as needed.*

Course prefix and number (include cross-listings)	Units	Title	Course Description	Pre-requisites	Modes of delivery (online, in-person, hybrid)	Typically offered (F, W, Sp, Su)	Dept. signed party to proposal?
ATMO 536A	3	Fundamentals of Atmospheric Sciences	Broadly covers fundamental topics in the atmospheric sciences. Topics include composition of the atmosphere, atmospheric thermodynamics, atmospheric chemistry, cloud physics, radiative transfer, atmospheric dynamics, and climate. Graduate-level requirements include additional questions on homework and exams plus a term paper on a specialized research topic.	none listed	in person	Sp	Yes
BE 534	3	Biosystem Analytics	This course provides a comprehensive introduction to Python for data analytics focused on the interpretation of biological data. The course is structured as a series of short lectures covering key concepts and analytical strategies using Python and cutting-edge open source packages for data analytics. The majority of the course focuses on hands-on exercises both in- and out- of class to develop practical coding skills for interpreting and analyzing high-dimensional biological data. Students work in a collaborative learning classroom to gain skills in (1) basic Unix and Python, (2) Python data structures functions, and files, and (3) data wrangling and visualization using IPython, NumPy, and pandas, and (4) analytics using machine-learning methods available in Scikit-Learn.	Online introduction to Linux. Code academy's Intro to Unix or Command line bootcamp. Apple or Linux computer or Windows machine with Putty. An introductory programming class in python is useful but not required.	in person	F	Yes

			These skills are taught by implementing real-world coding examples to manipulate and process biological data in Python, and effectively use data-oriented Python libraries to analyze and interpret data from biological systems.				
BE 587	3	Metagenomics: From Genes to Ecosystems	Environmental genomics is revolutionizing our understanding of microbes from the environment to human health, towards a holistic view of ecosystems or "One-Health". At its core are new molecular methods called metagenomics to sequence DNA directly from an environmental sample, thus capturing the whole microbial community and bypassing culture. Modern (Next-Gen) sequencing technologies offer vast new datasets of short sequence reads representing these microbial communities, however many hurdles exist in interpreting data with high species complexity and given specialized software for microbial metagenomic analyses. This course focuses on the science of metagenomics towards understanding (1) questions that metagenomics can address, (2) possible approaches for metagenomic sequencing and analysis, and (3) how genes, pathways, and environmental context are translated into ecosystem-level knowledge. This course alternates between traditional lectures and hands-on experience with programming, bioinformatics tools, and metagenomic analysis. The course concludes with several weeks of seminar-format discussions on current research in metagenomic data analysis and a final project of your choice analyzing real-world experimental data.	none listed	in person	F (not in Fall 2021, offered Spring 2022)	Yes
ECOL 578	3	Global Change	Analysis of the Earth system through an examination of its	none listed	in person	F	Yes

			component parts (particularly climate and biogeochemistry) and their interactions with human activities, emphasizing information needed to understand modern and future environmental changes. Graduate-level requirements include an in-depth written exercise and additional activities as described in the syllabus.				
ECOL 553	4	Functional and Evolutionary Genomics	Computational, functional, and evolutionary approaches to genomics, including bioinformatics and laboratory methods relevant to many modern research approaches in biology. Graduate-level requirements include students completing independently designed lab exercises and relate these to the primary literature in a paper. Undergraduate students will only complete defined lab exercises.	Concurrent registration, ECOL 553L for 1st yr. IGERT fellows. While stated in the catalog, this requisite no longer applies.	in person	F	Yes
ECOL 600A	3	Fundamentals of Evolution	The fundamentals of modern Evolutionary Biology, including molecular evolution, phylogenetics, macroevolution, and population/quantitative genetics. Graduate-level review of evolution focusing on (i) phenotypic evolution of complex traits, and (ii) molecular evolution.	Graduate status in EEB or related department.	in person	Sp	Yes
ECOL 565	3	Phylogenetic Biology	Concepts in phylogenetic biology, focusing on the phylogenetic (evolutionary) tree of species. The form of the tree, character evolution, speciation, and gene trees. Graduate-level requirements include a more in-depth term paper.	none listed	in person	Sp, even years	Yes
ECOL 580	3	Mathematical Models in Biology	For advanced undergraduates and graduate students in biological and ecological sciences, and math students: learn how to apply basic tools of mathematical tools (from simple back-of-the-envelope estimates to formal stability analysis using difference and differential equations) to biological problems including population	MATH 129	in person	Sp	Yes

			dynamics, species coexistence, population genetics, links between ecosystems ecology and Global biogeochemistry, and biological scaling.				
ECOL 596A	2	Evolutionary Ecology	This seminar-style graduate-level course will explore standing questions at the interface of ecology and evolution, with an emphasis on how evolutionary processes affect the ecology that we observe in natural populations. Underlying concepts will be reviewed briefly in lectures by the instructor, but the majority of class time will be spent discussing current literature and major questions in the field.	none listed	in person	F, even years	Yes
EIS 544	3	Insect Ecology	The study of how variation in the environment, interactions with other species and the special features of insect "design," have determined the evolution of diverse insect life histories, the dynamics of insect population and the roles of insects in communities.	none listed	in person	F, odd years	Yes
ENVS 508	3	Scientific Writing for Env., Ag., & Life Sciences	Effective writing is a valuable tool for any student aspiring for a career in the Environmental, Agricultural, and Life Sciences. This course will cover in-depth technical writing skills needed for scientific writing success, ranging from how to perform comprehensive reviews of the scientific literature, to performing peer reviews of the writing of fellow students. Ultimately, completion of this course will improve students' ability to write technical reports, theses and dissertations, and journal articles. Graduate-level requirements include work on theses, dissertations or journal articles.	none listed	in person	Sp	Yes
ENVS 515	3	Translating Environmental Science	Scientists speak a different language, a dialect filled with abstract symbolism, hypotheses and references to Latin and Greek. In this course, students learn	none listed	in person	Sp	Yes

			journalism techniques to translate environmental science topics into language a layperson could appreciate. The writing concepts will apply to any field of science, as well as grant proposals, public reports and media including web-based publishing. Students also learn techniques for converting numbers into relevant statistics. Students will "workshop" in groups and work closely with the instructor to produce publication-quality articles on assigned or agreed-upon topics. The best of these could be posted on university-affiliated websites, with credit given to the author. Graduate-level requirements include an additional final project writing a grant proposal or writing a feature article for a specified magazine or newspaper worth 50 points and a higher level of expectation regarding writing and reviews of their peers' work.				
ENVS 511	3	Environmental Metabolomics	This is a 3 credit hours course aimed to provide an introduction to metabolomics, describes the tools and techniques we use to study the metabolome and explains why we want to study it.	CHEM 142/144 or CHEM 152 or CHEM 162/164 and MCB 181R; or equivalent or instructor consent	in person	Sp	Yes
ENVS 510	3	Microbial Biogeochemistry and Global Change	Microbes are the drivers of planetary biogeochemistry. They produce half the oxygen on the planet, and fix half the carbon. They introduce bioavailable forms of nitrogen into the biosphere. If human life ceased to exist, the central biogeochemical cycles would continue turning. However, while the planet's biogeochemistry can persist readily in the absence of human life, that does not mean that humankind's presence lacks impact. The Anthropocene (era of human impact) has seen significant changes to planetary stocks and fluxes	Background in biology or biogeo-chemistry, and openness to inter-disciplinary learning.	in person	F	Yes

			of C, N, S, etc. Many of these changes involve or impact microbes, and have significant impacts on biogeochemical cycles. To understand microbial biogeochemistry in today's world, one must include the context of global change. And, conversely, one cannot understand the trajectory of global change without understanding microbial feedbacks via biogeochemical cycles. In this interdisciplinary undergraduate and graduate class we will cover major microbial biogeochemical cycles, and how these cycles are impacted by, and feedback to, global change. To understand the research in this area, we will discuss current methods in both microbial ecology and biogeochemistry, ranging from molecular meta-omics to the use of isotopes as biogeochemical tracers, with a particular emphasis on the challenges and opportunities of integrating these two disciplines. Lectures will be mixed with journal club-style readings and discussions, so active participation is essential. This course is designed for graduate students from diverse backgrounds and advanced undergraduates.				
ENVS 525	3	Environmental Microbiology	Current concepts in water quality, aerobiology and microbial biogeochemistry. Graduate-level requirements include extra journal readings and more comprehensive exams.	none listed	online	F	Yes
ENVS 567	3	Introductory Statistics & Multivariate Statistics with R	The course (3-unit class) will teach the fundamentals of coding and programming using the R language (https://www.r-project.org/). The students will use code examples and practice problems to understand the statistical as well as the scientific viewpoint. Using R, students will explore and visualize real-world data and derive meaningful interpretations. The course will cover introductory statistics (descriptive	ENVS 275 or MATH 263, an introductory college-level, statistics course, or instructor consent	in person	Sp	Yes

			statistics, hypothesis testing, t-test, ANOVA, correlation, regression) and multivariate statistics with a focus on ecological analyses (diversity, cluster analysis, unconstrained ordination, constrained ordination).				
GC 530	3	The Climate System	Systematic examination of processes and circulations comprising Earth's climate. Emphasis on circulations influencing geographic processes using examples of atmospheric environmental issues. Graduate-level requirements include the completion of a term paper.	none listed	in person	Sp	Yes
GC 597A	3	Global Change Research, Application, and Decision-Making	Integrative experience for natural and social science students with focus on local and regional consequences of global change.	none listed	online	Sp, every other year	Yes
INFO 520	3	Ethical Issues in Information	This course presents an overview and understanding of the intractable and pressing ethical issues as well as related policies in the information fields. Emerging technological developments in relation to public interests and individual well-being are highlighted throughout the course. Special emphasis is placed on case studies and outcomes as well as frameworks for ethical decision-making.	none listed	in person		Yes
INFO 533	3	Medical On-Line Searching	This course will focus on the online retrieval and evaluation of medical literature and the issues surrounding provision of timely, relevant, peer-reviewed medical information. Emphasis will be on the development of the intellectual acuity required to provide physicians, nurses, pharmacists, allied health professionals, medical researchers and consumers with targeted responses to medical queries. Current search modalities such as Evidence-Based Medicine will be covered both in readings and in class discussions.	none listed	in person	Sp	Yes

INFO 536	3	Data Science and Public Interests	This course focuses on the use of modern data science methods to help learners make socially responsible decisions and mitigate harm that arises from issues like bias, discrimination, and threats to one's personal privacy. More and more individuals are needing to make data-driven decisions in a wide variety of contexts including non-governmental organizations, not-for-profit industries, human services, environmental organizations, refugee camps, and more. Students in this class will thus learn about data science and how it can be utilized in contexts where socially-good decisions are desired and emphasized. This active learning class is designed for students who have an interest in the topic but who may have little to no previous experience with data science or programming.	none listed	in person	F	Yes
INFO 544	3	Informatics in Biology	Analyze genomic sequences through understanding and using a variety of bioinformatics algorithms and software tools. Interdisciplinary approach integrating informatics, statistics, and biology. Graduate-level requirements include leading a discussion on a current paper or give a tutorial on a bioinformatics tool as part of the Major Concept Exercises category.	none listed	in person	F	Yes
INFO 597	1-6	Biodiversity Informatics	Modern science has always been data driven but advances in data gathering tools from ground sensors to aerial-based remote sensing increase the researchers' opportunities and responsibility for the professional management of data to support the reproducibility and validity of science. In this course, biology, engineering, and information science	none listed	in person	Su	Yes

			students will learn to design and implement research methodologies for field research that effectively combine 1) the discovery and use of existing data with 2) the collection, organization, analysis, dissemination, and preservation of field generated research data. These research methodologies will be implemented/studied within the motivating context of behavioral wildlife observation research. Working in teams, students will build, program and deploy microcontroller-based field sensors to gather animal behavioral information in challenging field conditions. Students will use tools such as R and Jupyter Notebooks to add metadata, document data for publication and deposit the data in a trusted data repository.				
PLP 550	4	Principles of Plant Microbiology	This course deals with the mechanisms that plants and associated microorganisms use to establish detrimental or beneficial relationships from the molecular level to the population level. Classical and contemporary research are used extensively to evaluate contemporary and emerging theories.	PLP 305 or consent of instructor	in person	Sp, odd years	Yes
RNR 558	3	Ecosystem Ecology and a Sustainable Future	Rapid changes to Earth's biosphere will influence how natural and managed ecosystems function and alter the services they provide. Issues from conservation biology to sustainability and global climate change rely on a comprehensive understanding of ecosystem processes. In this class, students will learn the principles of terrestrial ecosystem ecology, examining the influence of biological, ecological, and physical processes on energy and material flows and water and elemental (carbon, nitrogen, phosphorous) cycling in ecosystems.	none listed	in person	Sp	Yes

			Graduate level requirements include an additional project and leading class discussions.				
RNR 621	3	Applied Statistics	Statistical methods relevant to the applied sciences, with emphasis on applications in ecology and biology. Fundamentals of inference, estimation, hypothesis testing, and model selection, with a focus on linear models.	An introductory statistics course such as MATH 263 or equivalent	in person	F	Yes
RNR 696A	2	Ecosystem Genomics	The development and exchange of scholarly information, in a small group setting, on selected topics in Natural Resources science and management. Course registrants exchange results of research through discussions, reports, and/or papers.	none listed	in person	F	Yes
TBD	1	"Ecosystem Genomics"	This is a companion course to RNR 696A. Students will practice the outcomes introduced in the fall course.	RNR696A	in person	Sp	Yes
WSM 595E	1 (3 in and after F'21)	Scientific Writing (Topics in Dendro-chronology)	The exchange of scholarly information and/or secondary research, usually in a small group setting. Instruction often includes lectures by several different persons. Research projects may or may not be required of course registrants.	none listed	in person	F	Yes

V. NEW COURSES NEEDED - *using the table below, list any new courses that must be created for the proposed program. If the specific course number is undetermined, please provide level (i.e., CHEM 6**). Add rows as needed. Is a new prefix needed? If so, provide the subject description so Curricular Affairs can generate proposed prefix options.*

No new courses are required. We expect that our spring companion course to RNR 696A will use an existing prefix and course number.

VI. FACULTY INFORMATION - *complete the table below. If UA Vitae link is not provided/available, attach a short CV (2-3 pages) to the end of the proposal or upload to the workflow form. UA Vitae profiles can be found in the UA directory/phonebook. Add rows as needed.* ***NOTE: full proposals are distributed campus-wide, posted on committee agendas and should be considered "publicly visible". Contact the Office of Curricular Affairs you have concerns about CV information being "publicly visible".***

Faculty Member	Involvement	UA Vitae link or "CV attached"
A. Elizabeth Arnold (Betsy)	Teach PLP 550, Faculty advisor, Instructor; **Co-chair, GIDP**	https://profiles.arizona.edu/person/fungi

Bonnie Hurwitz	Teach BE 534, BE 587 (Co-taught), Faculty advisor, Instructor; **Co-Chair, GIDP**	https://profiles.arizona.edu/person/bhurwitz
Laura Meredith	Teach RNR 696A-F (Req), RNR 558, Faculty advisor, Instructor	https://profiles.arizona.edu/person/laurameredith
Scott Saleska	Teach ECOL 580, ECOL 578 (Co-taught), Faculty advisor, Instructor	https://profiles.arizona.edu/person/saleska
Jana U'Ren	Teach BE 587 (Co-taught), Faculty advisor, Instructor	https://profiles.arizona.edu/person/juren
Malak Tfaily	Teach ENVS 510, ENVS 511, Faculty advisor, Instructor	https://profiles.arizona.edu/person/tfaily
Albert Barberán	Teach ENVS 567, Faculty advisor, Instructor	https://profiles.arizona.edu/person/barberan
Luciano Matzkin	Teach EIS 596A-Sp (Req: spring Ecosystem Genomics seminar), ECOL 553 (Co-taught), Faculty advisor, Instructor	https://profiles.arizona.edu/person/lmatzkin
Katrina Dlugosch	Teach ECOL 596A, Faculty advisor, Instructor	https://profiles.arizona.edu/person/kdlugosch
Rachel Gallery	Faculty Advisor, Instructor	https://profiles.arizona.edu/person/rgallery
Regis Ferriere	Faculty Advisor, Instructor	https://profiles.arizona.edu/person/regisf
Rod Wing	Faculty Advisor, Instructor	https://profiles.arizona.edu/person/rwing
W. Duke Pauli	Faculty Advisor, Instructor	https://profiles.arizona.edu/person/dukepauli
Yang Song	Faculty Advisor, Instructor	https://profiles.arizona.edu/person/chopinsong
Winslow Burleson	Faculty	https://profiles.arizona.edu/person/win
Andrew Comrie	Faculty	https://profiles.arizona.edu/person/comrie
Jennifer Croissant	Faculty Co-Advisor, Faculty Co-Advisor, Contribute to RNR696A and EIS 596A	https://profiles.arizona.edu/person/jlc
Erin Leahey	Faculty Co-Advisor, Faculty Co-Advisor, Contribute to RNR696A and EIS 596A	https://profiles.arizona.edu/person/leahey

VII. STUDENT LEARNING OUTCOMES AND CURRICULUM MAP - *describe what students should know, understand, and/or be able to do at the conclusion of this minor. Work with the Office of Instruction and Assessment to create a curricular map using Taskstream. Include your curricular map in this section.*

Upon concluding the minor in Ecosystem Genomics, doctoral students will:

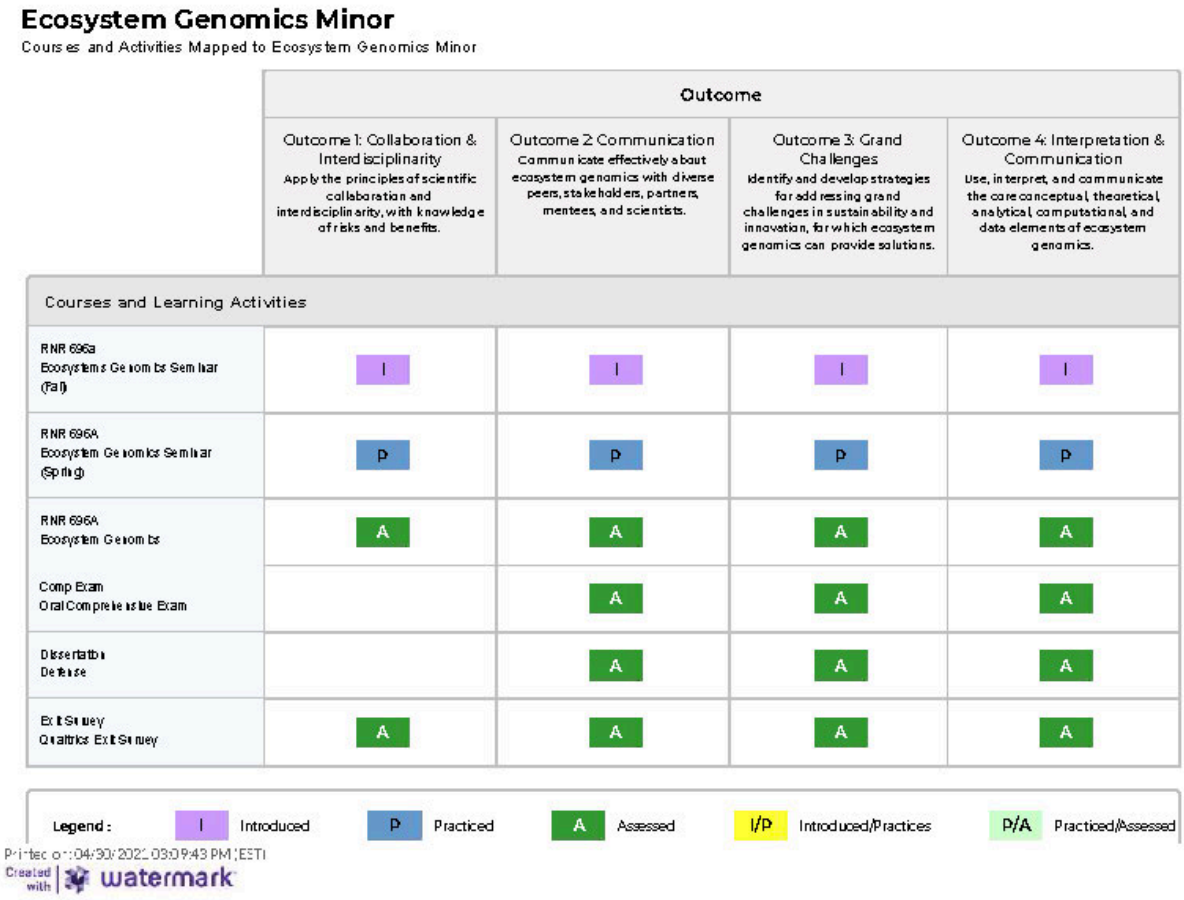
1. Apply the principles of **scientific collaboration and interdisciplinarity,** with knowledge of risks and benefits
2. **Communicate effectively about ecosystem genomics** with diverse peers, stakeholders, partners, mentees, and scientists
3. Identify and develop **strategies for addressing grand challenges in sustainability and innovation**, for which ecosystem genomics can provide solutions
4. Use, interpret, and communicate the core **conceptual, theoretical, analytical, computational, and data elements** of ecosystem genomics

These will be achieved via the curriculum, as mapped below. Students will take two successive semesters of the **Ecosystem Genomics seminar course (RNR 696A, 2 credits)** in fall semester and the companion Ecosystem Genomics (**EIS 596A, 1 credit)** in spring, with most topics introduced or introduced and practiced in the first semester and practiced and assessed in the second semester. Concurrently or thereafter, they will take electives, choosing one course from three of four core areas at the discretion/direction of their major and minor advisors.

The comprehensive exam for the Ecosystem Genomics GIDP minor may take the form of a written question or a portion of a question with a focus on ecosystem genomics, and/or having

elements of ecosystem genomics in the research proposal, at the discretion of the minor representative and the committee. It also is expected that ecosystem genomics will be represented as a theme in the oral exam, at the discretion of the faculty representing the GIDP minor. This may take the form of a series of questions or discussion points between the student and minor representative with respect to ecosystem genomics.

Courses and outcomes are mapped below for the minor. RNR 696A as the Ecosystem Genomics seminar is listed for both fall and spring, but the spring course is now listed as EIS 596A.



Ecosystem Genomics Minor

Courses and Activities Mapped to Ecosystem Genomics Minor

Courses and Learning Activities	Outcome 1: Collaboration & Interdisciplinarity Apply the principles of scientific collaboration and interdisciplinarity, with knowledge of risks and benefits.	Outcome 2: Communication Communicate effectively about ecosystem genomics with diverse peers, stakeholders, partners, mentees, and scientists.	Outcome 3: Grand Challenges Identify and develop strategies for addressing grand challenges in sustainability and innovation, for which ecosystem genomics can provide solutions.	Outcome 4: Interpretation & Communication Use, interpret, and communicate the core conceptual, theoretical, analytical, computational, and data elements of ecosystem genomics.
RNR 696a Ecosystems Genomics Seminar (Fall)	I	I	I	I
RNR 696A Ecosystem Genomics Seminar (Spring)	P	P	P	P
RNR 696A Ecosystem Genomics	A	A	A	A
Comp Exam Oral Comprehensive Exam		A	A	A
Dissertation Defense		A	A	A
Exit Survey Qualtrics Exit Survey	A	A	A	A

Legend: I Introduced; P Practiced; A Assessed; I/P Introduced/Practices; P/A Practiced/Assessed

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VIII. ASSESSMENT PLAN FOR STUDENT LEARNING - *using the table below, provide a schedule for program assessment of intended student learning outcomes 1) while students are in the program and 2) after completion of the minor. Add rows as needed.*

Learning Outcomes	Sources(s) of Evidence	Assessment Measures	Data Collection Points
Outcome 1: Apply the principles of **scientific collaboration and interdisciplinarity,** with knowledge of risks and benefits	- Course-embedded assessments in the core course, Ecosystem Genomics Seminar (RNR 696A and EIS 596A) - Student: Pre- and post questionnaires	- Formative and summative assessments including discussions, discourse, and presentations in the core course	- Upon declaration and completion of the minor - In core course

		- Self-evaluation of interdisciplinarity and collaboration skills	
Outcome 2: **Communicate effectively about ecosystem genomics** with diverse peers, stakeholders, partners, mentees, and scientists	- Course-embedded assessments in the core course, Ecosystem Genomics Seminar (RNR 696A and EIS 596A) - Student: Pre- and post questionnaires - Minor advisor: evaluation during oral comprehensive exam	- Formative and summative assessments including discussions, discourse, and presentations in the core course - Self-reflection and ranking of communication - Successful passing of the oral exam	- Upon declaration and completion of the minor - In core course - Oral comprehensive exam
Outcome 3: Identify and develop **strategies for addressing grand challenges in sustainability and innovation**, for which ecosystem genomics can provide solutions	- Course-embedded assessments in the core course, Ecosystem Genomics Seminar (RNR 696A and EIS 596A) - Student: Pre- and post questionnaires - Minor advisor: evaluation during oral comprehensive exam	- Formative and summative assessments including discussions, discourse, and presentations in the core course - Self-reflection and questionnaire responses - Successful passing of the oral exam	- Upon declaration and completion of the minor - In core course - Oral comprehensive exam
Outcome 4: Use, interpret, and communicate the core **conceptual, theoretical, analytical, computational, and data elements** of ecosystem genomics	- Course-embedded assessments in the core course, Ecosystem Genomics Seminar (RNR 696A and EIS 596A) - Student: Pre- and post questionnaires - Minor advisor: evaluation during oral comprehensive exam	- Formative and summative assessments including discussions, discourse, and presentations in the core course - Self-reflection and questionnaire responses - Successful passing of the oral exam	- Upon declaration and completion of the minor - In core course - Oral comprehensive exam

IX. ANTICIPATED STUDENT ENROLLMENT - *complete the table below. What concrete evidence/data was used to arrive at the numbers?*

5-YEAR PROJECTED ANNUAL ENROLLMENT: DOCTORAL STUDENTS					
	1st Year	2nd Year	3rd Year	4th Year	5th Year
Number of Students	6-8	12-16	18-24	24-32	34-40

Data/evidence used to determine projected enrollment numbers: The Ecosystem Genomics PhD Minor is motivated by a 5-year NSF training grant, which will fund approximately 3-4 doctoral fellows and engage approximately 3-4 additional doctoral participants per year.

X. ANTICIPATED MINORS AWARDED - *complete the table below, beginning with the first year in which the minor will be awarded. How did you arrive at these numbers? Take into consideration departmental retention rates.*

PROJECTED MINORS AWARDED ANNUALLY: DOCTORAL STUDENTS					
	1st Year	2nd Year	3rd Year	4th Year	5th Year
Number of Minors	0	0	2	4	8

Data/evidence used to determine number of anticipated minors awarded annually: We anticipate that currently enrolled graduate students spanning at least nine units on the UArizona campus (EEB, EIS, SPLS, BE, HAS, ENVS, SNRE, INFO, and GEOG) may wish to adopt the new program as their doctoral minor. These will be first-year doctoral students, entering their second semester, such that their graduation dates will be in y5+ of the existence of this program.

XI. PROGRAM DEVELOPMENT TIMELINE - *plans and timelines for 1) marketing the minor and 2) student recruitment activities.*

The Ecosystem Genomics GIDP recruitment team will contact colleagues at the University of Arizona and other universities; ask GIDP faculty to recruit for the program; request REU program coordinators to share information with their students; and advertise the minor on organizational listservs such as the Ecological Society of America, American Society for Microbiology, and Out in STEM to enhance recruitment of students to existing UArizona graduate majors relevant to ecosystem genomics, with the added opportunity to then minor in the GIDP.

The program will send a representative to recruit at the Annual Biomedical Research Conference for Minority Students (ABRCMS), the Society for Advancement of Chicanos/Hispanics, Native Americans in Science (SACNAS), and/or the American Indian Science and Engineering Society (AISES) as funds permit through fall 2025. The marketing and recruitment process is motivated initially by a five-year training grant. Doctoral fellows and participants accepted into this training grant will automatically be enrolled into the Ecosystem Genomics GIDP PhD minor and will make up most of the students accepted through 2025.

Sample Marketing and Recruitment Timeline

<u>Summer 2021</u>
Update website ahead of recruitment season
Confirm and activate GIDP leadership team

Fall 2021 (pending approval)
Enroll current PhD students in the fall core course, RNR 696A (Ecosystem Genomics Seminar, 2 credits)
Share flyer/brochure and announcements with Directors of Graduate Studies
Confirm GIDP faculty commitment and host organizational meeting for GIDP faculty
Present GIDP as an exciting opportunity for prospective students SACNAS, AISES, peer institutions that are minority-serving, etc.
Communicate with graduate programs admission committees, directors of graduate studies, and graduate program coordinators about sharing GIDP information with PhD applicants to their programs
Remind GIDP faculty and graduate program coordinators to direct PhD applicants to GIDP website
Advise active PhD students in the minor to enroll in elective(s) for spring

Spring 2022
Host online informational meeting for interested applicants to the GIDP who are applying to partner PhD majors at UArizona
Host online informational meeting for faculty who may wish to join the GIDP; vote in January and at annual intervals thereafter
Enroll current PhD students who have chosen the minor in the spring core course, EIS 596A (Ecosystem Genomics Seminar, 1 credit); host social event
Convene GIDP advisory/assessment teams and evaluate program recruitment and marketing
Offer informational and social opportunity via Zoom for PhD applicants; offer tours and social activities to interested students
Finalize fall cohort for fall 2023

Summer 2022
Assess recruitment and marketing success; evaluate diversity and revise strategies as needed
Update recruitment and marketing approaches.
Host all-GIDP meeting with presentations, social activities, and professional training for all GIDP faculty and students. Repeat all above.

XII. DIVERSITY AND INCLUSION - *describe how you will recruit diverse students and faculty to this program. In addition, describe retention efforts in place or being developed in order to retain students.*

Achieving a diverse GIDP requires focused efforts to find and recruit students. All participating departments/doctoral majors have room to improve diversity, inclusion, equity, and representation among their graduate students, a process that will be aided by this GIDP as a recruitment tool. Such improvements are critical to our vision of successfully implementing this program.

Our GIDP Co-chairs are mindful of this goal and already have established partnerships with Michelle Higgins, UArizona Office of Societal Impact, and Frans Tax, UArizona Graduate College. Their insight and guidance will enhance our efforts to develop recruitment strategies that grow the diversity of the GIDP and its affiliated majors.

We will work closely with the UArizona Graduate College to engage underrepresented-in-STEM students, with four main strategies: reaching out directly to diversity-serving conferences and institutions; presenting the GIDP program to STEM students in UArizona's cultural centers and at regional peer institutions that are minority serving; working closely with the UArizona Graduate College to develop and leverage complementary funds for underrepresented minority students; and providing student support in the form of a trained program manager/program coordinator with a strong background in inclusion initiatives in STEM.

ARIZONA PEER COMPARISON FORM

Graduate Minor Peer Comparison Chart- *select two peers for completing the comparison chart from (in order of priority) ABOR-approved institutions, AAU members, and/or other relevant institutions recognized in the field. The comparison chart will be used to identify typically required coursework, themes, and experiences for minor programs within the discipline. The comparison programs are not required to have the same minor name as the proposed UA program. Information for the proposed UA program must be consistent throughout the proposal documents.*

Minor name, institution	Proposed UA Program: Ecosystem Genomics PhD GIDP Minor	Peer 1: Northern Arizona University Ecological and Environmental Informatics (EEI) T3 Option for PhD students in Informatics	Peer 2: Environmental Life Sciences PhD program at Arizona State University
Current # of enrolled students	[redacted]	11	29
Minor program description	**The Ecosystem Genomics GIDP PhD Minor** will support and train diverse, outstanding doctoral students in **ecosystem genomics**, an emergent discipline that integrates across biotic systems from genes to ecosystems to solve grand challenges in sustainability and innovation in a rapidly changing world. As an innovative, interdisciplinary area of study, ecosystem genomics represents the synthesis of ecosystem- and genomic sciences via the tools of computational biology, modeling, data science, experiments, theory, applications, and the approaches and power of 'big data' in a collaborative and convergent framework. The **ultimate aim** of the Ecosystem Genomics GIDP is to foster a new generation of diverse transdisciplinary scientists to address the challenges of sustaining natural and managed ecosystems on which humans depend, including wildlands, agricultural systems, forests, arid lands, and marine environments. The coursework supported by this minor will help students think across scales from 'genes to ecosystems' as they develop skills in interdisciplinarity, scientific communication, and collaboration. At is core the minor will foster and extend students' excellence in areas such as data science, microbiology, plant sciences, insect science, environmental science, atmospheric science,	The T^3 option in Ecological and Environmental Informatics enhances the Informatics (INF) PhD program at NAU, providing innovative training in informatics, ecology, team-based research, and communication. It is funded by the prestigious National Science Foundation's Research Traineeship (NRT) program, as is the initial phase of the Ecosystem Genomics NRT at the University of Arizona, through which the Ecosystem Genomics GIDP Minor is being initiated. Students enrolled in the INF PhD program with an emphasis in Ecological and Environmental Informatics have the opportunity to enhance their training through coursework in team science and communication along with cohort-building activities. **Goal:** The EEI T3 option seeks to train students to independently and collaboratively leverage cutting-edge informatics tools with skills and knowledge of ecology and related environmental science disciplines to address the most pressing environmental issues facing societies today. This program differs from the Ecosystem Genomics GIDP proposed for the University of Arizona in several key ways. • T3 is an option within an informatics major, rather than a minor for students in diverse STEM majors. • T3 is oriented distinctively toward informatics and computation, providing informatics students with ecological and ecosystem thinking skills and context. In contrast, the UArizona	The Environmental Life Sciences PhD program is a unique degree that trains students to solve complex environmental challenges and explore ecological questions in the context of natural and human-caused environmental change. Environmental Life Sciences is an interdisciplinary program providing focused training on ecological and environmental questions in a changing world. 84 credits are required, including one core class, electives, seminars, reading groups and research. We encourage you to explore and solve complex questions in the context of natural and anthropogenic environmental change. This program differs from the Ecosystem Genomics GIDP proposed for the University of Arizona in several key ways. • This PhD major does not explicitly train students in the convergent, emergent science of ecosystem genomics. • Electives in the ASU program center on geology, hydrology, behavior, physiology, evolutionary biology/population genetics, ecology, ecosystem science, and sustainability. They are not explicitly oriented specifically to interdisciplinary training, training in collaboration, development of complementary skill sets in genomics and ecosystem sciences, data science, or 'big data' -- the strengths of the UArizona proposed GIDP.

	biosystems engineering, ecology and evolutionary biology, geography and informational science, and it is intended to attract students majoring in these UArizona programs. Ultimately the minor will help students translate ideas into meaningful scientific advances while cultivating deep and broad skill sets and promises to prepare students for important roles in solving grand challenges relevant to regional, national, and international issues in sustainability and innovation.	Ecosystem Genomics GIDP brings together students in seven STEM graduate majors spanning ecosystem science and genomics and connects them with informatics tools/informatics/computation to train them in the emergent, convergent science of ecosystem genomics. • Thus, the programs are distinct and highly complementary.	• Thus, the programs are distinct and highly complementary.
Minimum total units required	11 (3 core + 8 or more elective units)	60+ (option within a graduate major; T3 option itself, see below)	80+ (graduate major)
Pre-admission expectations (i.e., academic training to be completed prior to admission)	Active graduate student with background and training in the field, enrolled as a doctoral student in a relevant graduate program aligned with ecosystem genomics (e.g., but not limited to, EEB, EIS, SPLS, BE, HAS, ENVS, SNRE, INFO, GEOG).	Admitted to INF PhD program	Admitted to the PhD program of the School of Life Sciences
Minor requirements. List all minor requirements including core and electives. Courses listed must include course prefix, number, units, and title. Mark new coursework (New). Include any limits/restrictions needed (house number limit, etc.). Provide email(s)/letter(s) of support from home department head(s) for	Active graduate student with a background and training in ecology, evolutionary biology, entomology, plant sciences, biosystems engineering, hydrology, atmospheric science, environmental science, and/or natural resource management; enrolled as a doctoral student in a relevant graduate program aligned with ecosystem genomics (e.g., but not limited to, Ecology and Evolutionary Biology (EEB), Entomology and Insect Sciences (EIS), School of Plant Sciences (SPLS), Biosystems Engineering (BE), Hydrology and Atmospheric Sciences (HAS), Environmental Sciences (ENVS), School of Natural Resources and the Environment (SNRE), School of Information (INFO) and School of Geography, Development, and Environment (GEOG). To apply, an interested student should contact the Program Coordinator or co-chairs. There are no additional GPA requirements beyond a 3.0.	INF Core Requirements: INF501 (Informatics & Computing Seminar), INF502 (Software Development Methodologies), INF503 (Large-scale data structures and organization), INF504 (Data Mining & Machine Learning), INF 511 & 512 (Modern Regression I & II), INF 605 (Professional & Career Development), Dissertation credits **T3 Emphasis Area Requirements:** INF 623 (Ecoinformatics Seminar - enroll multiple semesters), INF690 (Team-based Interdisciplinary Research), INF550 (Survey in Ecoinformatics Tools), Electives - 11 credits total - student can choose at least 3 credits from INF	Core requirement: **ELS 501** Grand Challenges in Environmental Life Sciences Electives: At least two elective courses (3 credit hours each) are required from 500+ level courses related to the following topics: Earth sciences (e.g., geology, hydrology); organismal biology (e.g., physiology and behavior); evolutionary biology (e.g., population genetics); ecology/ecosystems/biogeochemistry; sustainability and social/policy

courses not owned by your department.	Complete 3 units of **core coursework:** -RNR 696A (2) Ecosystems Genomics Seminar, fall -EIS 596A (1) Ecosystem Genomics Seminar, spring **Complete 3 elective courses**, choosing one course from each of three of the following four areas (to be chosen in conjunction with major and minor advisor/doctoral advising committee) for a minimum of 8 units. All courses already exist and are taught regularly in person on the UArizona main campus. We have reached out to instructors and unit/department heads to confirm that the graduate certificate would not create enrollment challenges. Letters of support are included. 11 units required (3 core + 8 or more elective units) **Complete 3 units of core coursework:** -RNR 696A (2) Ecosystems Genomics Seminar, fall -EIS 596A (1) Ecosystem Genomics Seminar, spring **Complete 3 courses, choosing <u>one</u> course from each of three of the following four areas (to be chosen in conjunction with advisor/graduate advising committee) for a minimum of 8 units** 1. *Communication & Dissemination* -ENVS 508 (3) Scientific Writing for Env., Ag., & Life Sciences -ENVS 515 (3) Translating Environmental Science -WSM/GEOS 595E (currently 1, will become 3 after fall 2021) Scientific Writing (Topics in Dendrochronology) -INFO 520 (3) Ethical Issues in Information -INFO 536 (3) Data Science and Public Interests 2. *Theory & Concepts: Ecosystem & Earth Science*	grad classes and 9 or more credits from INF, CS, EE, BIO, FOR, SES, STA, MAT grad courses.	

	-ENVS 511 (3) Environmental Metabolomics -ENVS510 (3) Microbial Biogeochemistry and Global Change -RNR 558 (3) Ecosystem Ecology and a Sustainable Future -ENVS 525 (3) Environmental Microbiology -ECOL 578 (3) Global Change -ATMO 536A (3) Fundamentals of Atmospheric Sciences -GC 530 (3) The Climate System -GC 597A (3) Global Change Research, Application, and Decision Making 3. *Theory & Concepts: Genomic Biology* -ECOL 553 (4) Functional and Evolutionary Genomics -ECOL 596A (1) Evolutionary Ecology -ECOL 600A (3) Fundamentals of Evolution -ECOL 565 (3) Phylogenetic Biology -EIS 544 (3) Insect Ecology -PLP 550 (4) Principles of Plant Microbiology 4. *Tools & Data: Data Analytics* -BE 534 (3) Biosystem Analytics -BE 587 (3) Metagenomics: From Genes to Ecosystems -ECOL 580 (3) Mathematical Models in Biology -ENVS 567 (3) Introductory Statistics & Multivariate Statistics with R (undergoing course name change to Statistical analysis of ecological and environmental data with R) -INFO 533 (3) Medical On-Line Searching -INFO 544 (3) Informatics in Biology -INFO 597 (1-6) Biodiversity Informatics		
Research methods, data analysis, & methodology requirements. (Yes/No. If yes, provide description)	Yes, integrated into the required Ecosystem Genomics seminar and delivered through training for their majors.	Yes - coursework in software and statistical methods; course in Ecological Informatics tools and products (INF550)	Part of the graduate training requirement for doctoral students in the program, through their own research; students also must take one quantitative class. No additional research methods/data analysis/methodology requirements.
Internship, practicum, applied course	No	No	No

requirements (Yes/No). If yes, provide description.			
Additional requirements (provide description)	No	No	No

*Note: comparison of additional relevant programs may be requested.

THE UNIVERSITY OF ARIZONA®

BUDGET PROJECTION FORM

Name of Proposed Program or Unit: Graduate Interdisciplinary Program: Ecosystem Genomics

Budget Contact Person: Heather Ingram, Program Coordinator; A. Elizabeth Arnold and Bonnie Hurwitz, GIDP CO-Chairs

METRICS				
	1st Year 2021 - 2022	**2nd Year** 2022 - 2023	**3rd Year** 2023 - 2024	**Notes**
Net increase in annual college enrollment UG	NA	NA	NA	
Net increase in college SCH UG	NA	NA	NA	
Net increase in annual college enrollment Grad	2-5	4-10	6-15	
Net increase in college SCH Grad	12-30	48-72	72-96	
Number of enrollments being charged a Program Fee	NA	NA	NA	
New Sponsored Activity (MTDC)	NA	NA	NA	
Number of Faculty FTE: 14 core faculty, providing admin and teaching in existing courses	0.37	0.37	0.37	Includes admin and instruction. Existing faculty and courses. No new hires or courses.
FUNDING SOURCES				
Continuing Sources				
UG RCM Revenue (net of cost allocation)				
Grad RCM Revenue (net of cost allocation)				
Program Fee RCM Revenue (net of cost allocation)				
F and A Revenues (net of cost allocations)				
UA Online Revenues				
Distance Learning Revenues				
College fund balances	$28,000	$28,000	$28,000	Non GIDP funded. Allocated by Dean of COS, Head of EEB, and Assoc Dean for Research, CALS.Funding towards Program Manager/ Coordinator
Institutional Strategic Investment				
Gift Funding				
Personnel	$70,169	$71,572	$74,003	NSF NRT: Program Manager/Coordinator (.75 FTE) + ERE; Website developer (Indept. Cont.). Funding for personnel for the GIDP will be non-Graduate College/GIDP resources.
Other Items	$6,500	$6,500	$6,500	Amount includes the Chair stipend amount for the minor ($4,000) and the certificate ($2,500)- in effect the first year students admitted
Other items continued	$2,000	$2,000	$2,000	$2,000 operations budget from GIDP Admin
Total Continuing	**$106,669.00**	**$108,072.00**	**$110,503.00**	
One-time Sources				
Total One-time	**$0.00**	**$0.00**	**$0.00**	
TOTAL SOURCES	**$106,669.00**	**$108,072.00**	**$110,503.00**	
EXPENDITURE ITEMS				
Continuing Expenditures				
Faculty				
Other Personnel	$70,169	$71,572	$74,003	NSF NRT: Program Manager/Coordinator (.75 FTE) + ERE; Website developer (Indept. Cont.). Funding for personnel for the GIDP will be non-Graduate College/GIDP resources.
Employee Related Expense				
Graduate Assistantships				
Other Graduate Aid				
Operations (materials, supplies, phones, etc.)				
Additional Space Cost				

College fund balances (COS, EEB, and CALS)	$28,000	$28,000	$28,000	Non GIDP funded. Allocated by Dean of COS, Head of EEB, and Assoc Dean for Research, CALS.Funding towards Program Manager/ Coordinator
Other Items (attach description)	$6,500	$6,500	$6,500	Amount includes the Chair stipend amount for the minor ($4,000) and the certificate ($2,500)- in effect the first year students admitted
Other items continued	$2,000	$2,000	$2,000	$2,000 operations budget from GIDP Admin
Total Continuing	**$106,669.00**	**$108,072.00**	**$110,503.00**	
One-time Expenditures				
Construction or Renovation				
Start-up Equipment				
Replace Equipment				
Library Resources				
Other Items (attach description)				
Total One-time	**$0.00**	**$0.00**	**$0.00**	
TOTAL EXPENDITURES	**$106,669.00**	**$108,072.00**	**$110,503.00**	
Net Projected Fiscal Effect	**$0.00**	**$0.00**	**$0.00**	All expenditures covered; no net cost. Gain from SCH and

This form includes the budget and expenses for both the GIDP Graduate Certificate and PhD Minor.

****The GIDP Graduate Certificate is intended to attract students to our participating graduate programs, with the aim of increasing graduate student enrollment in courses offered by units in our partner colleges.***

College and Departmental Support Documentation

From: Cheu, Elliott C - (echeu) <echeu@arizona.edu>
Sent: Tuesday, October 20, 2020 12:05 PM
To: Saleska, Scott R - (saleska) <saleska@arizona.edu>; Worobey, Michael - (worobey) <worobey@arizona.edu>
Cc: Grimm, Kelly J - (grimmk) <grimmk@arizona.edu>
Subject: RE: NSF NRT and BII grants on the cusp, request

Hi Scott,

Mike and I will split the $20K/year for the duration of the grants.

Best regards,

Elliott Cheu, Ph.D.
Interim Dean, College of Science
Distinguished Professor of Physics
University of Arizona
(520) 621-4092

On Wed, Oct 21, 2020 at 10:46 AM Antin, Parker B - (pba) <pba@arizona.edu> wrote:
Hi Betsy,

While we don't directly connect investments such as this to IDC return, the CALS Research Office will be pleased to provide $8000 per year for the next five years to help fund this position.

Best,

Parker

THE UNIVERSITY OF ARIZONA
Office of the Provost

Administration Building 512
PO Box 210066
Tucson, Arizona 85721-0066

Of: 520-621-1856
Fax: 520-621-9118

February 5, 2020

Dear Dr. Saleska,

We are pleased to support your team's proposal to the NSF Research Traineeship program (NRT) in the priority area of Rules of Life (RoL), entitled "**NRT-RoL: BRIDGETS – Building Resources for InterDisciplinary training in Genomics and Ecosystem Sciences**."

We commit to collaborating with you to support this important training initiative in concrete ways (see below), and more fundamentally, to advance long-term sustainability of ecosystem genomics as an emerging critical science at University of Arizona (UA), through continued recruitment of new faculty; supporting your team's endeavors in research, teaching, curriculum development, outreach, and mentorship through the ecosystem genomics initiative; and enhancing and formalizing graduate student training through formation of a new graduate interdisciplinary program (GIDP) in ecosystem genomics.

The University has fostered the growth of an interdisciplinary, interdepartmental faculty cluster in ecosystem genomics: in the last year and a half, we have hired seven new assistant or associate professors across five departments (all of whom are now part of your core team). ***This represents a multi-million dollar long-term investment in advancing this field at UA, directly illustrating our institutional commitment to recruiting and supporting the kind of faculty needed to make an NRT-catalyzed training program in ecosystem genomics a long-term success.***

To support your NSF NRT program in Ecosystem Genomics we will:

- *Provide tuition assistance for the NRT trainees in your program*, in the form of out-of-state tuition waivers **(up to 15 waivers annually)**. These will reduce non-resident tuition to in-state levels for NRT trainees who are not residents of the state of Arizona. The grant would be responsible for covering in-state tuition and fees for trainees as outlined in your budget.
- *Advance the long-term sustainability of ecosystem genomics at UA* through ongoing support of tangible initiatives, as showcased by our commitment to hiring new faculty in this field (above).
- *Advance recruitment of diverse trainees* through the leverage and fostering of strong diversity programs, including UA's #1 ranking in PhDs awarded to Native Americans, and its recent designation as a Hispanic-Serving Institution. The Graduate College oversees the successful program called University of Arizona/Alfred P. Sloan Indigenous Graduate Partnership (UA/SIGP) that provides fellowships for Native American students to pursue graduate degrees in science, technology, engineering, and mathematics. In addition, the UA Graduate College runs a strong undergraduate diversity mentoring program called the Undergraduate Research Opportunities Consortium (UROC) that works with NSF-affiliated Research Experiences for Undergraduates. The Graduate College office of Diversity and Inclusion, under the directorship of **Dr. Frans Tax**, commits to work with you to make connections with UROC and UA/SIGP to recruit seniors to the NRT Trainee Program.
- *Support your team's development of curriculum, mentorship, and training*, in order to leverage the expertise and advance the aims of the PIs, key personnel, and affiliated faculty relevant to the NRT.
- *Support and assist in the creation of a new GIDP*, enabling graduate students based in multiple departments across campus to declare and receive a certificate (minor) in Ecosystem Genomics.

We are pleased that you have received additional internal commitments of partnership and collaboration form diverse professionals, leaders, and partners at the UA, including the following:

- **The BIO5 Institute**, directed by **Dr. Jennifer Barton**, which promotes excellence in interdisciplinary biosciences research, translation, and education outreach and training, will provide space (offices and laboratories for faculty and students) and a centralized home for the UA's Ecosystem Genomics Initiative and cluster hire, and if funded, the proposed NRT. This commitment includes offices for NRT Co-PI's Wing and Hurwitz, offices for the junior faculty who are among the core personnel of the proposed NRT (BarberanTfaily, Meredith, and U'ren), with office and lab space at BIO5 for NRT PI Saleska. We recognize that the availability of common space for scholars from across different Departments and Colleges is invaluable for fostering the sense community and teamwork that is critical to the success of a program like NRT. **In addition, Dr. Barton and BIO5** will support an NRT Ecosystem Genomics Seminar series that will bring 2-3 domestic and international speakers per year to UA, thus providing institutional support for the NRT training program.
- **University of Arizona's Biosphere 2**, directed by **Joaquin Ruiz**, will provide access to the resources and experimental biomes of Biosphere 2, enabling one of the proposed NRT student research experiences in ecosystem genomics (section C.1.(iii)). Biosphere 2 consists of diverse biomes (desert, savannah, ocean, mangrove, tropical rainforest) and the Landscape Evolutionary Observatory (LEO), which are controlled environments for sampling and studying taxonomic and metabolic diversity in different ecosystem components. These provide a basis for achieving key NRT research goals in genes-to-ecosystem scaling through links to ongoing observations of ecosystem-scale metabolic function (e.g., soil fluxes of greenhouse gases methane, nitrous oxide, carbon dioxide, and water vapor). **Biosphere 2 is also a foundation** for outreach about the globally connected nature of earth's biosphere to the general public, using Biosphere 2's biomes as a nexus for connecting with the ~100,000 visitors per year to Biosphere 2's outreach program;
- **Dr. Uwe Hilgert**, Director of Industry Relations, STEM Training & Workforce Development in BIO5, will assist with coordinating outreach to high school students, connect NRT trainees to career opportunities, and enhance our recruitment and placement of underrepresent students in STEM.
- **Directors/Coordinators/Chairs of Graduate studies** have also agreed to coordinate student recruitment into the NRT of students from participating academic units, including:
    - **Drs. Michelle McMahon**, Plant Sciences and Plant Pathology, School of Plant Sciences;
    - **Dr. Jeremiah Hackett**, Associate Department Head, Ecology and Evolutionary Biology;
    - **Dr. Marcel Schaap**, Environmental Science;
    - **Dr. Martha S. (Molly) Hunter**, Chair, GIDP in Entomology & Insect Science;
    - **Dr. Rachel Gallery**, Associate Director, School of Natural Resources & the Environment;
    - **Dr. Christopher Castro**, Hydrology and Atmospheric Sciences;
    - **Dr. Muluneh Yitayew**, Biosystems Engineering; and
    - **Dr. Lars Fogelin**, Anthropology; **Dr. Eithne Luibheid**, Gender & Women's Studies

In conclusion, we wish you the best of luck in your proposal submission and look forward to hearing the results of the review of your NRT-RoL proposal at NSF.

Sincerely,

Liesl Folks, PhD, MBA
Senior Vice President and Provost

Andrew Carnie, PhD
Vice Provost/Dean, Graduate Education

THE UNIVERSITY OF ARIZONA
COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES
School of Geography, Development & Environment

ENR2 Building, South 4th Floor
PO Box 210137
Tucson, Arizona 85721-0137
Ofc: 520-621-1652
Fax: 520-621-2889
geography.arizona.edu

October 14, 2021

Dr. Andrew Carnie
Dean, Graduate College
Administration 322
CAMPUS

Dear Andrew:

This letter is to convey my strong support for the newly proposed Graduate Interdisciplinary Program in Ecosystem Genomics, which I understand will offer both a PhD Minor and a Graduate Certificate.

These tracks will provide interdisciplinary education for students working at the boundary of ecosystem sciences and genomics. We anticipate that some of our graduate students in Geography will be interested in these new options. Also, several of our graduate courses will be included in the recommended list for these GIDP students as options for their minor or certificate, including GEOG 530 *The Climate System* and GC 597a *Global Change Research, Application, and Decision-Making* (which is taught by one of our faculty members for the Global Change GIDP).

Based on discussions with our faculty, I don't foresee any conflicts in curriculum or related matters within our School in relation to the establishment of this new GIDP. As mentioned above, we expect this minor to appeal to certain incoming and current students in our program, which will provide useful links between SGDE and the other participating graduate programs.

Sincerely,

Andrew C. Comrie, Ph.D.
Professor & Director

THE UNIVERSITY OF ARIZONA

SCHOOL OF INFORMATION

1103 E. 2nd St.,
Tucson, AZ 85721

September 30, 2021

Dr. Andrew Carnie, PhD
Dean, Graduate College
University of Arizona
Administration 322
PO Box 210066
Tucson, AZ 85721-0066

Dear Dean Carnie,

I am writing to express my support for the newly proposed Graduate Interdisciplinary Program in Ecosystem Genomics, which will offer both a PhD Minor and a Graduate Certificate.

I understand that these tracks will consist of 12 credit hours over four semesters and will provide interdisciplinary training at the interface of ecosystem sciences and genomics.

We anticipate that several of our graduate courses will be recommended to GIDP students as optional courses for their minor or certificate:

INFO 520: Ethical Issues in Information

INFO 533: Medical On-Line Searching

INFO 536: Data Science and Public Interests

INFO 554: Informatics in Biology

INFO 597: Biodiversity Informatics

I foresee no conflicts in curriculum or related matters within my department with the establishment of this GIDP. In fact, I expect this minor to appeal to incoming and current students in our program, and further connect our unit and graduate program with other participating graduate programs on the University of Arizona campus.

Sincerely,

Winslow Burleson, Ph.D.
Professor, Director of Research, & Associate Director, School of Information

Hexagon Bio

04/20/21

Dr. Andrew Carnie, PhD
Dean, Graduate College
University of Arizona
Administration 322
PO Box 210066
Tucson, AZ 85721-0066

Dear Dean Carnie,

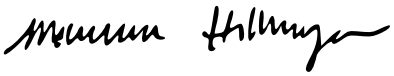
I am writing to express support for the newly proposed Graduate Interdisciplinary Program (GIDP) in Ecosystem Genomics at the University of Arizona.

The GIDP will train diverse graduate students to think across scales from 'genes to ecosystems'. By earning a graduate certificate or PhD minor in the emergent science of ecosystem genomics, students will complement and extend their core disciplinary training in a way that we consider highly promising for successful careers in industry positions such as the ones we offer. One of the grand challenges of our company is to sequence the pangenome of the Earth's microbes and discover novel therapeutics. The cross-cutting skillsets that this GIDP will provide will leave graduates poised to address such challenges at the bench and at the computer.

The coursework and transdisciplinary research supported by this GIDP will help students develop skills in interdisciplinarity, scientific communication, and collaboration while also fostering their excellence in areas such as data science, microbiology, plant sciences, insect science, environmental science, atmospheric science, biosystems engineering, ecology, and evolutionary biology. The GIDP will help students translate ideas into meaningful scientific advances while cultivating deep and broad skill sets via rich coursework and robust mentorship. This GIDP promises to prepare students for important roles in solving grand challenges relevant to regional, national, and international issues in sustainability and innovation. The University of Arizona has already demonstrated excellence in this area, with two recent UA trainees joining Hexagon Bio and bringing powerful insights given their prior interdisciplinary training. By formalizing this type of training and recognizing it in a minor this GIDP promises to help PhD students advertise these skillsets to potential employers.

Our company is excited to see this kind of training program, as we view the skills and training fostered by this GIDP to be key to preparing new generations of diverse scientists to enter a cutting-edge workforce. The University of Arizona's GIDP in Ecosystem Genomics is innovative and unique, and it will be a welcome addition to graduate training experiences across diverse disciplines.

Sincerely,



Maureen Hillenmeyer, PhD

Co-founder and CEO, Hexagon Bio

PLUTON® BIOSCIENCES

April 20, 2021

Dr. Andrew Carnie, PhD
Dean, Graduate College
University of Arizona
Administration 322
PO Box 210066
Tucson, AZ 85721-0066

Dear Dean Carnie,

I am writing to express support for the newly proposed Graduate Interdisciplinary Program (GIDP) in Ecosystem Genomics at the University of Arizona.

The GIDP will train diverse graduate students to think across scales from 'genes to ecosystems.' By earning a graduate certificate or PhD minor in the emergent science of ecosystem genomics, students will complement and extend their core disciplinary training in a way that we consider highly promising for successful careers in industry positions in companies such as Pluton Bio.

The coursework and transdisciplinary research supported by this GIDP will help students develop skills in interdisciplinarity, scientific communication, and collaboration while also fostering their excellence in areas such as data science, microbiology, plant sciences, insect science, environmental science, atmospheric science, biosystems engineering, ecology, and evolutionary biology. The GIDP will help students translate ideas into meaningful scientific advances while cultivating deep and broad skill sets via rich coursework and robust mentorship. This GIDP promises to prepare students for important roles in solving grand challenges relevant to regional, national, and international issues in sustainability and innovation.

Our company is excited to see this kind of training program, as we view the skills and training fostered by this GIDP to be key to preparing new generations of diverse scientists to enter a cutting-edge workforce. The University of Arizona's GIDP in Ecosystem Genomics is innovative and unique. It will be a welcome addition to graduate training experiences across diverse disciplines.

Sincerely,

Barry Goldman, PhD

CEO/CSO
Pluton Biosciences

THE UNIVERSITY OF ARIZONA

School of Plant Sciences
College of Agriculture and
Life Sciences
520.621.1977 Telephone

1145 E. South Campus Drive
P.O. Box 210036
Tucson, Arizona 85721-0036
520.621.7186 FAX
www.cals.arizona.edu/pls

MEMORANDUM

Date: March 29, 2021

To: Dr. Andrew Carnie, Dean of the UArizona Graduate College

From: Dr. Matthew A. Jenks, Director for the School of Plant Sciences

Subject: Graduate Interdisciplinary Minor and Certificate in Ecosystem Genomics

Dear Dr. Carnie,

I am writing to express my support for the newly proposed Graduate Interdisciplinary Program in Ecosystem Genomics, which will offer both a PhD Minor and a Graduate Certificate. I understand that these tracks will consist of 12 credit hours over four semesters and will provide interdisciplinary training at the interface of ecosystem sciences and genomics. We anticipate that one of our graduate courses will be recommended to GIDP students as an optional course for their minor or certificate:

PLP 550: Principles of Plant Microbiology

I foresee no conflicts in curriculum or related matters within my School with the establishment of this GIDP. In fact, I expect this minor to appeal to incoming and current students in our program, and further connect our unit and graduate program with other participating graduate programs on the University of Arizona campus.

Sincerely,

Matthew A. Jenks
Director for the School of Plant Sciences

COLLEGE OF AGRICULTURE & LIFE SCIENCES
School of
Natural Resources
& the Environment

Office of the Director
ENR-2 – Room N333
1064 Lowell Street
Tucson, AZ 85721
Telephone: (520) 626-0058
Fax (520) 621-8801
http://snre.arizona.edu/

March 13, 2021

Dr. Andrew Carnie, PhD
Dean, Graduate College
University of Arizona
Administration 322
PO Box 210066
Tucson, AZ 85721-0066

Dear Andrew:

I am writing to express my full support for the newly proposed Graduate Interdisciplinary Program in Ecosystem Genomics, which will offer both a PhD Minor and a Graduate Certificate.

I understand that these tracks will consist of 12 credit hours over four semesters and will provide interdisciplinary training at the interface of ecosystem sciences and genomics.

We anticipate that several of our graduate courses will be recommended to GIDP students as optional courses for their minor or certificate:

RNR 558: Ecosystem Ecology and a Sustainable Future
RNR 621: Applied Statistics
RNR 696A: Ecosystem Genomics

I foresee no conflicts in curriculum or related matters within my department with the establishment of this new GIDP. In fact, I expect this minor to appeal to incoming and current students in our program, and further connect our unit and graduate program with other participating graduate programs on the University of Arizona campus.

Sincerely,

Willem J.D. van Leeuwen, Interim Director and Professor
School of Natural Resources and the Environment

Department of Environmental Science
College of Agriculture and Life Sciences

THE UNIVERSITY OF
ARIZONA®
TUCSON ARIZONA

429 Shantz Building, #38
1177 E. Fourth St. POB 210038
Tucson, AZ 85721-0038 USA
(520) 621-1646
FAX: (520) 621-1647
sw@ag.arizona.edu

March 26, 2021

Dr. Andrew Carnie, PhD
Dean, Graduate College
University of Arizona
Administration 322
PO Box 210066
Tucson, AZ 85721-0066

Dear Dean Carnie,

I am writing to express my support for the newly proposed Graduate Interdisciplinary Program in Ecosystem Genomics, which will offer both a PhD Minor and a Graduate Certificate.

I understand that these tracks will consist of 12 credit hours over four semesters and will provide interdisciplinary training at the interface of ecosystem sciences and genomics.

I foresee no conflicts in curriculum or related matters within the Indige-FEWSS GIDP with the establishment of the Ecosystem Genomics GIDP. In fact, I expect this program will complement ours and will further connect graduate programs on the University of Arizona campus.

Please contact me at kchief@arizona.edu or 520-247-6030 if you have any questions.

Sincerely,

Karletta Chief , Associate Professor & Extension Specialist

THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
Hydrology &
Atmospheric Sciences

Harshbarger Building, Room 122
1133 E. James E. Rogers Way
P.O. Box 210011
Tucson, AZ 85721-0011
Office: 520-621-7120
Fax: 520-621-1422

March 16, 2021

Dr. Andrew Carnie, PhD
Dean, Graduate College
University of Arizona
Administration 322
PO Box 210066
Tucson, AZ 85721-0066

Dear Dean Carnie,

I am writing to express my support for the newly proposed Graduate Interdisciplinary Program in Ecosystem Genomics, which will offer both a PhD Minor and a Graduate Certificate.

I understand that these tracks will consist of 12 credit hours over four semesters and will provide interdisciplinary training at the interface of ecosystem sciences and genomics.

We anticipate that one of our graduate courses will be recommended to GIDP students as an optional course for their minor or certificate:

ATMO 536A: Fundamentals of Atmospheric Sciences

I foresee no conflicts in curriculum or related matters within my department with the establishment of this GIDP. In fact, I expect this minor to appeal to incoming and current students in our program, and further connect our unit and graduate program with other participating graduate programs on the University of Arizona campus.

Sincerely,

Thomas Meixner,
Professor and Head

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES
Environmental Science

1177 E. Fourth Street
P.O. Box 210038
Tucson, AZ 85721-0038
Tel: (520) 621- 1646
Fax: (520) 621- 1647
http://environmentalscience.cals.arizona.edu/

March 15, 2021

Dr. Andrew Carnie, PhD
Dean, Graduate College
University of Arizona
Administration 322
PO Box 210066
Tucson, AZ 85721-0066

Dear Dean Carnie,

I am writing to express my support for the newly proposed Graduate Interdisciplinary Program in Ecosystem Genomics, which will offer both a PhD Minor and a Graduate Certificate.

I understand that these tracks will consist of 12 credit hours over four semesters and will provide interdisciplinary training at the interface of ecosystem sciences and genomics.

We anticipate that several of our graduate courses will be recommended to GIDP students as optional courses for their minor or certificate:

ENVS 508: Scientific Writing for Env., Ag., & Life Sciences
ENVS 510: Microbial Biogeochemistry and Global Change
ENVS 511: Environmental Metabolomics
ENVS 515: Translating Environmental Science
ENVS 525: Environmental Microbiology
ENVS 567: Introductory Statistics & Multivariate Statistics with R

I foresee no conflicts in curriculum or related matters within my department with the establishment of this GIDP. In fact, I expect this minor to appeal to incoming and current students in our program, and further connect our unit and graduate program with other participating graduate programs on the University of Arizona campus.

Sincerely,

Jon Chorover

Professor and Head
Department of Environmental Science

THE UNIVERSITY OF ARIZONA

Department of Entomology
College of Agriculture and
Life Sciences

Forbes Building, Room 410
P.O. Box 210036
Tucson, AZ 85721-0036
PH: (520) 621-1151
FAX: (520) 621-1150

Dr. Andrew Carnie, PhD
Dean, Graduate College
University of Arizona
Administration 322
PO Box 210066
Tucson, AZ 85721-0066

April 11, 2021

Dear Dean Carnie,

I am writing to express my support for the newly proposed Graduate Interdisciplinary Program in Ecosystem Genomics, which will offer both a PhD Minor and a Graduate Certificate. I understand that these tracks will consist of 12 credit hours over four semesters and will provide interdisciplinary training at the interface of ecosystem sciences and genomics.

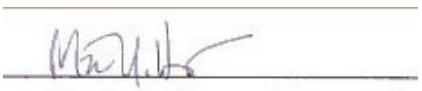
There is considerable overlap of interests between faculty of this proposed GIDP minor and those of our faculty and students in our program, the GIDP in Entomology & Insect Science. We expect that several EIS students will elect the GIDP in Ecosystem Genomics as their minor. We already have an incoming EIS student who will be a fellow in the inaugural NSF supported BRIDGES program cohort.

We also anticipate that one of our graduate courses will be recommended to GIDP EG students as an optional course for their minor or certificate: **EIS 544: Insect Ecology**

The class is regularly offered as part of our existing curriculum and seats are available. I foresee no conflicts in curriculum or related matters within our graduate program with the establishment of this additional GIDP, especially as I understand the plan for the sustainability of this GIDP Minor will not draw from the current GIDP budget.

Instead, I expect this minor will further connect our graduate program with other participating graduate programs on the University of Arizona campus.

Sincerely,



Martha S. (Molly) Hunter
Professor, Department of Entomology, and
Department of Ecology & Evolutionary Biology
Chair, Graduate Interdisciplinary Program
in Entomology & Insect Science
mhunter@ag.arizona.edu +1-520-621-9350

THE UNIVERSITY OF ARIZONA

Ecology & Evolutionary Biology
College of Science
University of Arizona

P.O. Box 210088
Tucson, Arizona 85721-0088
(520) 621-1588
FAX: (520) 621-9190
http://eebweb.arizona.edu

April 8, 2021

Dr. Andrew Carnie, PhD
Dean, Graduate College
University of Arizona
Administration 322
PO Box 210066
Tucson, AZ 85721-0066

Dear Dean Carnie,

I am writing to express my support for the newly proposed Graduate Interdisciplinary Program in Ecosystem Genomics, which will offer both a PhD Minor and a Graduate Certificate.

I understand that these tracks will consist of 12 credit hours over four semesters and will provide interdisciplinary training at the interface of ecosystem sciences and genomics.

We anticipate that several of our graduate courses will be recommended to GIDP students as optional courses for their minor or certificate:

ECOL 553: Functional and Evolutionary Genomics
ECOL 565: Phylogenetic Biology
ECOL 578: Global Change
ECOL 580: Mathematical Models in Biology
ECOL 600A: Fundamentals of Evolution

I foresee no conflicts in curriculum or related matters within my department with the establishment of this GIDP. In fact, I expect this minor to appeal to incoming and current students in our program, and further connect our unit and graduate program with other participating graduate programs on the University of Arizona campus.

Sincerely,

Dr. Michael Worobey
Department Head
Louise Foucar Marshall Science Research Professor
Ecology and Evolutionary Biology

Research Discovery Innovation

THE UNIVERSITY OF ARIZONA
TUCSON ARIZONA

Data Science Institute
BSRL 200A
P.O.Box 210077
(520) 621-4064
FAX: (520) 621-1364

March 30, 2021

Dr. Andrew Carnie, PhD
Dean, Graduate College
University of Arizona
Administration 322
PO Box 210066
Tucson, AZ 85721-0066

Dear Dean Carnie,

I am writing to express my support for the newly proposed **Graduate Interdisciplinary Program in Ecosystem Genomics**, which will offer both a PhD Minor and a Graduate Certificate.

I understand that these tracks will consist of 12 credit hours over four semesters and will provide interdisciplinary training at the interface of ecosystem sciences and genomics.

I foresee no conflicts in curriculum or related matters within the Data Science Institute with the establishment of the Ecosystem Genomics GIDP. In fact, I expect this program will complement our ongoing training and learning activities and will further connect graduate programs on the University of Arizona campus. Students trained in computational and statistical methods in Ecosystem Genomics will also provide valuable capacity of trained students for our campus.

Please feel free to contact me if you need any further information, we look forward to working closely with the Ecosystems Genomics GIDP

Nirav Merchant
Director, UA Data Science Institute (Data 7)
Co-PI NSF CyVerse
University of Arizona

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES
COLLEGE OF ENGINEERING
Biosystems Engineering

Shantz, Room 403
1177 E 4th Street
PO Box 210038
Tucson, AZ 85721-0038

Tel: 520-621-3691
Fax: 520-621-3963

http://be.arizona.edu

April 12, 2021

Dr. Andrew Carnie, PhD
Dean, Graduate College
University of Arizona
Administration 322
PO Box 210066
Tucson, AZ 85721-0066

Dear Dean Carnie,

I am writing to express my support for the newly proposed Graduate Interdisciplinary Program (GIDP) in Ecosystem Genomics, which will offer both a PhD Minor and a Graduate Certificate.

I understand that these tracks will consist of 12 credit hours over four semesters and will provide interdisciplinary training at the interface of ecosystem sciences and genomics.

We anticipate that two of our graduate courses will be recommended to GIDP students as optional courses for their minor or certificate:

BE 534: Biosystem Analytics
BE 587: Metagenomics: From Genes to Ecosystems

I foresee no conflicts in curriculum or related matters within my department with the establishment of this GIDP. In fact, I expect this minor to appeal to incoming and current students in our program, and further connect our unit and graduate programs with other participating graduate programs on the University of Arizona campus.

Sincerely,

K. L. Farrell-Poe

Kathryn L. Farrell-Poe
Head, Specialist, and Professor

COLLEGE OF AGRICULTURE & LIFE SCIENCES
School of
Natural Resources
& the Environment

Office of the Director
ENR-2 – Room N333
1064 Lowell Street
Tucson, AZ 85721
Telephone: (520) 626-0058
Fax (520) 621-8801
http://snre.arizona.edu/

April 7, 2021

Dr. Andrew Carnie, PhD
Dean, Graduate College
University of Arizona
Administration 322
PO Box 210066
Tucson, AZ 85721-0066

Dear Andrew:

This letter serves to confirm our support for the proposed Graduate Interdisciplinary Program in Ecosystem Genomics, especially with regard to the Ecosystem Genomics seminar (RNR 696A).

The School of Natural Resources and the Environment is listed as the home unit for the Ecosystem Genomics seminar (RNR 696A), a required course included in the initial curriculum listing for the minor. The seminar, currently taught by Dr. Laura Meredith, is regularly offered as part of our existing curriculum and seats are available.

Sincerely,

Willem J.D. van Leeuwen, Interim Director and Professor
School of Natural Resources and the Environment