Michigan Tech

Office Memo

Office of the Provost and
Senior Vice President for Academic Affairs

Phone: (906) 487-2440
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TO: Richard Koubek, President

FROM: Jacqueline E. Huntoon, Provost & Senior Vice President for Academic Affairs

Jacqueline E Huntoon

DATE: March 6, 2020

SUBJECT: Senate Proposal 24-20

Attached is Senate proposal 24-20, “Proposal for a Bachelor of Science Degree Program in Ecology and Evolutionary Biology,” and a memo stating the Senate passed this proposal at their March 4, 2020 meeting. I have reviewed this memo and recommend approving this proposal.

I concur X do not concur _____ with this recommendation.

Richard Koubek, President

04/14/20
Date

Michigan Tech

University Senate

DATE:	March 5, 2020
TO:	Richard Koubek, President
FROM:	Michael Mullins University Senate President
SUBJECT:	Proposal 24-20
COPIES:	Jacqueline E. Huntoon, Provost & Senior VP for Academic Affairs

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At its meeting on March 4, 2020, the University Senate approved Proposal 24-20, "Proposal for a Bachelor of Science Degree Program in Ecology and Evolutionary Biology"'. Feel free to contact me if you have any questions.

The University Senate of Michigan Technological University

Proposal 24-20

(Voting Units: Full Senate)

Proposal for a Bachelor of Science Degree Program in Ecology and Evolutionary Biology

(EEB, College of Science and Arts)

Developed by the Department of Biological Sciences (SBL)
Contacts: Dr. C.J Huckins (Professor) and Dr. C.P. Joshi (Professor and Chair)

Latest Revision – 3/18/2020 (approved as editorial changes)

TABLE OF CONTENTS

I. General description and characteristics of program 2
II. Rationale 4
III. Related programs 5
IV. Projected enrollment 6
V. Scheduling plans (Extension, Evening, Regular) 6
VI. Curriculum design 6
VII. New course descriptions 8
VIII. Model schedule demonstrating completion time 9
IX. Existing Learning Resources, Equipment, and Space 11
X. Program Administration, policies, regulations and rules 11
XI. Accreditation requirements 11
XII. Planned implementation date 11
XIII. Program costs, years 1, 2, and 3 11
Appendix A – New course proposals 13
Appendix B – Financial Documentation 23
Appendix C – Sample Degree Audit 26
Appendix D – Complete List of Directive Electives 28

I. General description and characteristics of the program

A. Mission:

To prepare students with immersive training in the fundamental science of Ecology and Evolutionary Biology and guide them in their discovery of the nature, dynamics, and principles of ecological and evolutionary systems. It is our mission for graduates of this degree program to be prepared to further understanding of the principles that structure and unite the fields of ecology and evolutionary biology to solve problems of the natural world into the future.

B. Goals:

The development of an undergraduate program in Ecology and Evolutionary Biology (EEB) at Michigan Tech is grounded in these motivations and programmatic goals:

- Provide a focused and scientifically rigorous education for undergraduate students in ecology and evolutionary biology, which are core strengths in the Department of Biological Sciences.
- Get students hands-on experience through field classes, research opportunities, and experiential learning on and off-campus.
- Prepare students to improve the future of ecological systems and the humans that depend on them through basic science, management, restoration, and conservation of ecosystems.
- Recruit the most competitive incoming undergraduate candidates who might otherwise overlook Michigan Tech due to the lack of ecology and evolutionary biology degree program grounded in basic science.
- Prepare graduates from this program to further their education by pursuing graduate education or to directly enter the workforce in Ecology, Evolution, Biological Sciences, and Environmental Science.

C. Objectives: This proposal will implement an undergraduate Bachelor of Science Degree in Ecology and Evolutionary Biology that 1) attracts and retains students interested in ecology and evolutionary sciences who seek a deeper understanding of fundamental sciences and the scientific method; 2) provides a broad-based curriculum that will allow students to obtain the knowledge and develop the skills necessary to study, understand, and alleviate environmental and human problems; and 3) addresses the Michigan Tech Undergraduate Student Learning Goals:

Undergraduate Student Learning Goals	Additional Areas of Focus
1: Disciplinary Knowledge - Students demonstrate a depth of knowledge in one area/ discipline, as well as a breadth of knowledge that (1) enables adaptability and flexibility as knowledge grows and changes, and (2) recognizes linkages/complementarity to other areas/disciplines.	● Students will learn about global issues and cultural constructs that influence the study of ecology and evolutionary biology. ● Students will build a strong set of field and analytical hands-on skills related to the study of ecology and evolutionary biology. ● Students will develop focused knowledge at all ecological levels of organization and within an evolutionary framework, and in broad relation to other basic sciences such as biology,

	chemistry, and mathematics.
2: Knowledge of the Physical and Natural World - Students demonstrate knowledge of the physical and natural world. This is accomplished by studying science and mathematics.	● Students will employ the scientific method to address ecological and evolutionary questions, formulate hypotheses, design basic studies, and synthesize and report results. ● Students will learn about global issues and cultural constructs that influence the study of ecology and evolutionary biology. ● Students will build a strong set of field and analytical hands-on skills related to the study of ecology and evolutionary biology ● Students will develop focused knowledge at all ecological levels of organization and within an evolutionary framework, and in broad relation to other basic sciences such as biology, chemistry, and mathematics.
3: Global Literacy - A globally literate student will demonstrate the ability to understand and analyze issues on multiple scales and from diverse perspectives, acknowledging interconnectivity and complexity. As globally literate, students should 1) become informed and open-minded people who are attentive to diversity across the spectrum of differences, 2) seek to understand how their actions affect the human and natural world on multiple scales, and 3) address the world's most pressing and enduring issues while considering context, complexity, and interconnectivity.	● Students will examine socio-ecological dynamics and the ethics of humans in ecology and evolutionary biology. ● Students will learn about global issues and cultural constructs that influence the study of ecology and evolutionary biology.
4: Critical and Creative Thinking - Students will be able to think critically and creatively, as demonstrated by their broad, adaptable and versatile use of reasoning, logic, and evidence, to access and evaluate information and solve complex problems both independently and in groups.	● Students will employ the scientific method to address ecological and evolutionary questions, formulate hypotheses, design basic studies, and synthesize and report results.
5: Communication - Students will be able to communicate effectively, orally, in writing and in new media, to a wide variety of audiences.	● Students will communicate effectively (orally and in writing) about issues related to ecology and science, in general. ● Students will employ the scientific method to address ecological and evolutionary questions, formulate hypotheses, design basic studies, and synthesize and report results.
6: Information Literacy - Students will be able to analyze the need for, strategically access, critically evaluate, and use information effectively, ethically, and legally.	● Students will employ the scientific method to address ecological and evolutionary questions, formulate hypotheses, design basic studies, and synthesize and report results.
7: Technology - Students will demonstrate knowledge of technology and its implications in society, and be able to design and/or use technology for creative activities or innovative solutions to problems.	● Students will build a strong set of field and analytical hands-on skills related to the study of ecology and evolutionary biology

8: Social Responsibility and Ethical Reasoning - Students will be able to identify and address conflicting ethical values and develop a sense of responsibility for the broad impacts of individual actions and social institutions. They will understand their role as citizens and their responsibility to work with others in promoting quality of life and sustainable society.	● Students will examine socio-ecological dynamics and the ethics of humans in ecology and evolutionary biology ● Students will learn about global issues and cultural constructs that influence the study of ecology and evolutionary biology.

D. Administration: The undergraduate degree in (EEB) will be administered by SBL with core courses being taught by Biological Sciences faculty and instructors. The BS degree will be overseen by the Chair of Biological Sciences and the Curriculum Committee. The curriculum committee meets every 2-4 weeks during the academic year to discuss degree requirements, course offerings, university assessment, and to resolve any issues related to degree administration for all of the degrees administered through the Department of Biological Sciences. Degree program assessment is ongoing following university policies, and external review will be conducted by SBL every 6 years. SBL was externally reviewed in 2018, suggesting the EEB BS will undergo its initial formal review in 2024.

Students matriculated into the EEB BS will be advised by the SBL advisor. The advisor, with support from the Curriculum Committee and other SBL staff, will also coordinate advertising and outreach to new potential students, communicating successes and programmatic highlights, and tracking of existing students during their education and after graduation, as they do for the other degree programs in Biological Sciences.

II. Rationale

Ecology is the scientific study of interactions between organisms and their environment, and evolutionary biology studies the evolutionary process that produce and modify the diversity of life on earth. An understanding each of these fields and how they are interwoven is core for education in the Biological Sciences focused on behavior, biodiversity, conservation, and function from individuals to ecosystems. The modern study of ecology and evolutionary biology draws on a host of integrative fields such as physiological ecology, developmental biology, molecular evolution, and biogeochemistry. The interwoven nature of ecology and evolutionary biology is recognized in the common structure of departments and BS degrees in Ecology and Evolutionary Biology at universities across the US. A dedicated Ecology and Evolutionary Biology curriculum at Michigan Tech would better attract and prepare students to understand and solve contemporary questions and problems, and prepare them for careers in research with public and private companies, management with state and federal agencies, or to pursue additional graduate training in Biological Sciences.

Solving complex environmental problems like population impacts, climate change, land-use degradation, and altered nutrient cycles first require a thorough understanding of the fundamental science of the ecological processes and feedbacks resulting from stressors that may control and

limit our ability to effectively manage ecological systems. The relevance and need for continued basic science in ecology and evolution are underscored by our increasing understanding of the importance of connections between ecosystem sustainability, evolutionary dynamics, ecosystem function, human health, and the management and restoration of natural resources. Moreover, the need for better understanding of these linkages and interactions is heightened within a rapidly changing environment. The likelihood of novel solutions to environmental and societal problems will be increased through greater and more efficient communication and infrastructure linking the diverse group of scholars in these fields at Michigan Tech.

The Department of Biological Sciences (SBL) has a strong reputation for training students in biology with a solid ecological focus through our existing Biology BS with a concentration in Ecology (SBL3). The development of this proposed EEB B.S. degree results from the ongoing process of assessment, improvement and refocusing of our Biology degree offerings, in part motivated by recommendations from our external department review in 2018. While the current SBL3 degree concentration well-serves students interested in achieving a broad education in Biology with some more focused training in Ecology, the intense core in general natural science and general biology leaves little room in the student's degree training to deeply engage in coursework training in advanced Ecology and Evolutionary Biology. Moreover, the lack of required experiential learning places these students at a disadvantage when they seek opportunities after they complete their undergraduate training. The degree program proposed here provides core training in the basic sciences of biology, chemistry, and mathematics, which are essential for an integrative understanding of ecological and evolutionary patterns and processes. It will also provide opportunities for students to specialize their training in molecular biology, genetics, field techniques, analysis of ecological and evolutionary data, and countless other topics through experiences in classroom, laboratory, and field.

III. Related Programs

A. Within MTU: Our proposed EEB BS adds a critical dimension and educational opportunity for students considering MTU as their undergraduate institution, and with a desire to build a career on a foundation of an integrated education in the sciences of ecology and evolution. This will complement existing and high-quality degrees currently offered. Our Biology BS with a concentration in ecology provides a degree option for students broadly interested in biology, but with a focus in ecology. The College of Forest Resources and Environmental Science offers students options to major in Wildlife Ecology and Management, or Applied Ecology and Environmental Sciences, which are more specialized approaches to focused areas in natural resources. In addition, their new Natural Resource Management major will allow students to focus and build their career on technical and vocational aspects of natural resources and ecosystem management.

B. Within the Region: There are many high-ranking ecology and evolutionary programs in our country. For instance, Princeton, Harvard, UC-Berkeley, UC-Davis, and Stanford offer EEB type programs are ranked in the top ten globally. There are no programs similar to this proposed Ecology and Evolutionary Biology program in the Upper Peninsula of Michigan or the northern Great Lakes region. The programs most similar to the one proposed here elsewhere in the broader Great Lakes region are:

- University of Michigan – Department of Ecology and Evolutionary Biology. B.S. Degree in EEB. https://lsa.umich.edu/eeb
- The University of Minnesota – College of Biological Sciences. B.S. Degree in Ecology, Evolution, and Behavior. https://cbs.umn.edu/academics/majors-minors/eeb
- Minnesota State Moorhead – Department of Biological Sciences. B.S. Degree in Ecology and Evolutionary Biology. https://www.mnstate.edu/ecology-evolutionary-biology/
- Michigan State University – Department of Zoology. B.S. Degree in Zoology – concentration in Ecology, Evolution, and Organismal Biology. https://integrativebiology.natsci.msu.edu/undergraduate-program/undergraduate-degrees/
- The Ohio State University – Department of Evolution, Ecology, and Organismal Biology. B.S. Degree in Evolution and Ecology Major Program. https://eeob.osu.edu/

IV. Projected Enrollment

We project a sustained enrollment of about 40 students in the EEB BS Degree. Currently, there are 18 students majoring in Biological Sciences with the Ecology concentration (SBL3), and an additional 17 students in the General Biology concentration (SBL1). The SBL3 concentration was reinstituted in 2014, and has increased from 12 students in 2015 to 18 in both 2018 and 2019. It is reasonable to expect a doubling of enrollment to about 40 students with the increased visibility of a dedicated EEB program that would attract increased numbers of high-quality students that would not otherwise consider Michigan Tech. We also expect that our initial cohorts of students will include students currently on-campus and enrolled in SBL3 and possibly other degree programs who would choose to transfer into this new degree. Most importantly, we expect this program would increase gender diversity at MTU. For example, 42% of current SBL3 majors are female.

V. Scheduling Plans (Extension, Evening, Regular)

Regular

VI. Curriculum Design

Required courses –To obtain a B.S. degree in EEB, students will be required to take a minimum of 78 credits in courses fundamental to ecology and evolutionary biology. Of those credits, 58-61 are dedicated to core courses that will allow the students to gain in-depth education while leaving

23-26 credits in major electives to allow students to specialize and diversify their learning and 9-15 credits in free electives. To ensure that EEB students are broadly trained, they will be required to take 5-6 credits of experiential courses that can be fulfilled by a variety of options, including SBL field focused classes, international field courses, and/or research experience credits. In addition, all students will be required to take 24 credits of general education (Core and HASS), for a total of 120 total credits. We recognize that there are additional high quality MTU courses that could have been included as requirements because they would be beneficial to a given student's education in EEB. However, we designed this curriculum to include the core course requirements we determined to be important for all EEB students while maintaining flexibility for students to specialize their course work plan for a more individually focused and enriching experience. This allows them to enhance their EEB degree design so that it best suits their proposed career, as well as their unique desired breath in their education. To meet these goals we have constrained degree requirements to 120 credits to allow for free electives, and we will insure that each EEB student will work closely with their academic advisor to plot the course path that builds from the degree requirements to include specific additional courses beneficial to their area of specialization.

1. **Major Requirement: Professional Development Seminars (5 credits)**
    - **a.** BL 1580: First-Year Experience in Biological Sciences (1)
    - **b.** BL 2XXX: EEB Field Experience and Data Collection Seminar (1)
    - **c.** BL 3XXX: EEB Data Analysis Interpretation and Presentation Seminar (1)
    - **d.** BL 3782: Writing Practicum in Biology (2)

2. **Major Requirement: Biology Courses (19 credits)**
    - **a.** BL 1010: General Biology I (4)
    - **b.** BL 1020: General Biology II (4)
    - **c.** BL 2200: Genetics (3)
    - **d.** BL 2210: Genetics Laboratory (1)
    - **e.** BL 3190: Evolution (3)
    - **f.** BL 3400: Principles of Ecology (4)

3. **Major Requirement: Related Science and Mathematics (19-20 credits)**
   Required
    - **a.** CH 1150: University Chemistry I (3)
    - **b.** CH 1151: University Chemistry I (1)
    - **c.** CH 1160: University Chemistry II (3)
    - **d.** CH 1161: University Chemistry II (1)
    - **e.** MA 1135: Calculus for Life Sciences (4)
    - **f.** MA 3715: Biostatistics (4)

Select one of the following specializations (3-4 credits)

- **g.** CH 2410 and CH2411: Organic Chemistry I (3,1)
- **h.** MA 2160: Calculus with Technology 11 (4)
- **i.** PH 1110 and PH 1111: College Physics I (3,1)
- **j.** CS 1121: Introduction to Programming I (3)

4. **Major Requirement: Social Ecology (3 credits)**

Select 1 course

- **a.** BL 2001: Valuing the Great Lakes (3)
- **b.** SS 2300: Environment and Society (3)
- **c.** SS 3300: Environmental Problems (3)
- **d.** SS 3315: Population and Environment (3)
- **e.** SS 3520: U.S. Environmental Policy and Politics (3)
- **f.** SS/FW 3760: Human Dimensions of Natural Resources (3)

5. **Major Requirement: Organismal Biology (7-8 credits)**

Select 2 courses

- **a.** BL 2160: Botany (4)
- **b.** BL 2170: Zoology (4)
- **c.** BL 3310: Environmental Microbiology (3)
- **d.** BL 4440: Fish Biology (4)

6. **Major Requirement: Field / Lab Experience (5-6 credits)**

- **a.** BL 3999: Biological Science Field Experience (1-9)
- **b.** BL 4000: Research in Biological Sciences (1-9)
- **c.** BL 4036: Ecology and Evolution of Interactions Between Plants, Herbivores, and Pollinators (3)
- **d.** BL 4090: Tropical Island Biology (2)
- **e.** BL 4421: Lake Superior Exploration (3)
- **f.** BL 4447: Stream Ecology (3)
- **g.** BL 4999: Biological Science Internship (1-9)

7. **Major Approved Electives (23-26 credits)**

Select at least 23 credits not taken to fulfil other requirements

- **a.** BL 2160: Botany (4)
- **b.** BL 2170: Zoology (4)
- **c.** BL 3012: Essential Cell Biology (3)
- **d.** BL 3020: Biochemistry I (3)
- **e.** BL 3310: Environmental Microbiology (3)
- **f.** BL 3999: Biological Science Field Experience (1-9)

- **g.** BL 4000: Research in Biological Sciences (1-9)
- **h.** BL 4034: Community Ecology & Evolutionary Dynamics (3)
- **i.** BL 4036: Ecology and Evolution of Interactions Between Plants, Herbivores, and Pollinators (3)
- **j.** BL 4070: Environmental Toxicology (3)
- **k.** BL 4090: Tropical Island Biology (2)
- **l.** BL 4140: Plant Physiology (3)
- **m.** BL 4145: Plant-Microbe Interactions (3)
- **n.** BL 4421: Lake Superior Exploration (3)
- **o.** BL 4440: Fish Biology (4)
- **p.** BL 4447: Stream Ecology
- **q.** BL 4450: Limnology (3)
- **r.** BL 4461: Ecosystem Ecology (3)
- **s.** BL 4465: Biological Oceanography (3)
- **t.** BL 4999: Biological Science Internship (1-9)
- **u.** FW 3020: Forest Ecology (3)
- **v.** FW 3320: Fundamentals of Forest Genetics and Genomics (3)
- **w.** FW 3410: Conservation Biology (3)
- **x.** FW 3610: Ornithology (4)
- **y.** FW 4220: Wetlands (4)
- **z.** FW 4240: Mammalogy (4)
- **aa.** FW 4260: Population Ecology (3)
- **bb.** GE 2000: Understanding the Earth (3)

8. **Core and HASS (24 Credits)**
   - **a.** UN 1015 (3)
   - **b.** UN 1025 (or upper-level modern language course) (3)
   - **c.** Goal 4 elective (3)
   - **d.** Goal 8 elective (3)
   - **e.** HASS electives (12)

9. **Free Electives (9-15 Credits)**

Academic advising

VII. New Course Descriptions

BL 2xxx Field observation and data collection

Description: Best practices for observing, collecting, recording and analyzing ecological and evolutionary biology data in the lab and field.

Learning objectives:

- Employ observation in field and lab to characterize ecological and evolutionary pattern

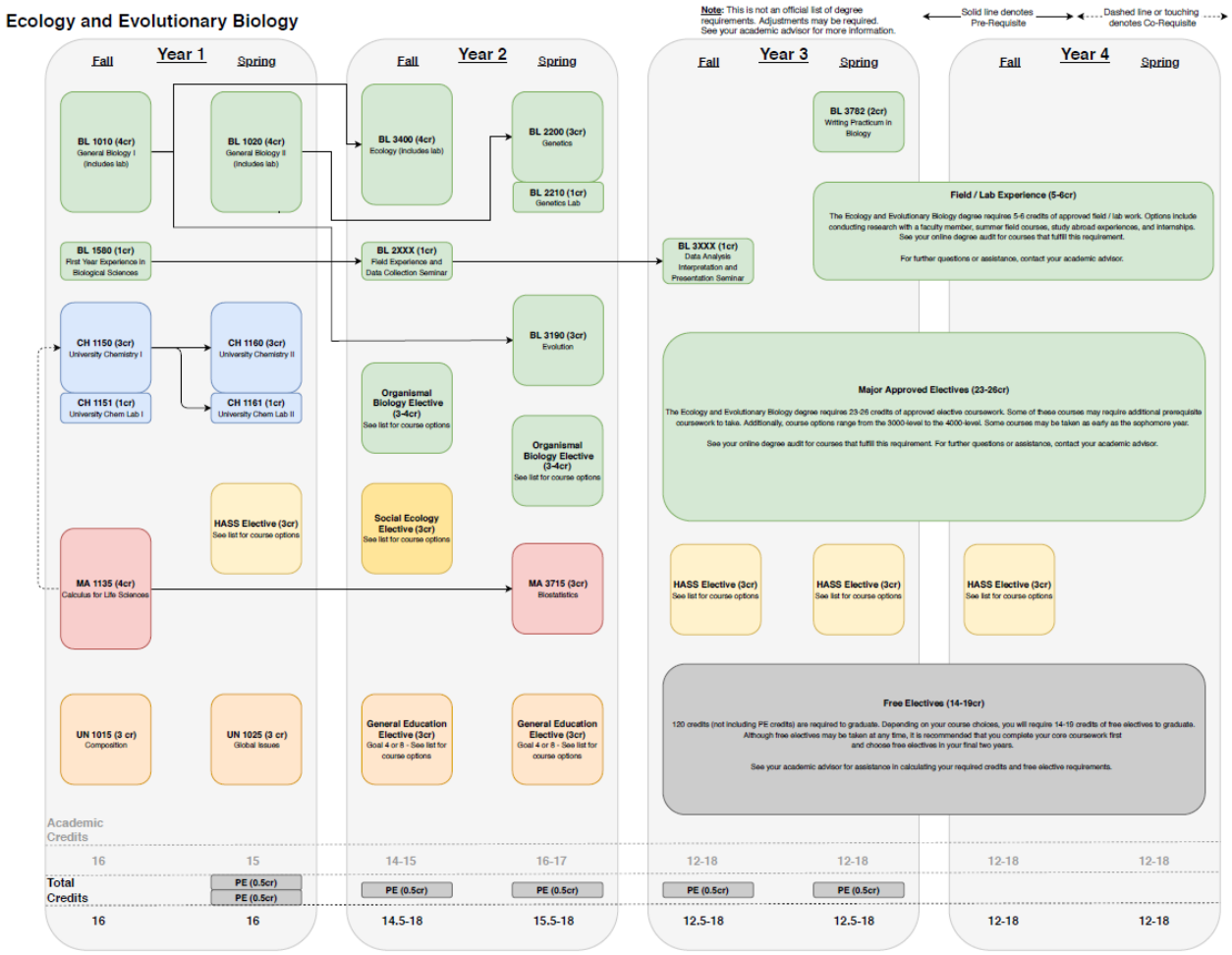
and process
- Organize qualitative and quantitative observations in a research notebook.
- Use observational data to formulate hypotheses for novel experiments

BL 3xxx Data Interpretation and critical analysis

***Description*:** This class will develop skills for interpreting and critically evaluating data and analyses of data to evaluate hypotheses in ecological and evolutionary biology. Peer reviewing skills and how to get the most out of research articles.

***Learning objectives*:**
- Interpret figures and statistical analyses relative to hypotheses about ecological and evolutionary patterns and processes.
- Critically evaluate the application and presentation of data in published literature and media.

VIII. Model Schedule



IX. Existing Learning Resources, Equipment, and Space

No new equipment, space, or other resources will be required for this degree program.

X. Program Administration, policies, regulations, and rules

The responsibility for the administration of the program will reside with the Department of Biological Sciences within the College of Sciences and Arts.

XI. Accreditation requirements

There are no accreditation requirements for this program.

XII. Planned implementation date

We are designing this degree program to be available in Fall 2020.

XIII. Program costs, Years 1, 2, and 3

The implementation of a new EEB undergraduate degree program at Michigan Tech with its integrative educational plan will be fully consistent with Michigan Tech's Strategic Plan

(https://www.banweb.mtu.edu/pls/owa/strategic_plan2.p_display). The financial benefit of this program is that it will attract and retain high-quality students.

Impact on Resources: To address criteria as outlined in Senate Procedures 108.1.1 (IIIa,b), we are requesting no additional faculty lines or space to implement the EEB program. The Biological Sciences department will develop recruiting and advancement material for the EEB program, as well as to provide information to university level recruiters. New scholarship opportunities will be sought as part of this program and will be headed by the chair of the Department of Biological Sciences. There will be additional advising time and potential additional time for student meetings and prospective student visits if enrollment increases.

Appendix A: New Course Proposals

Michigan Tech

— Course Add Proposal —

PLEASE COMPLETE THIS FORM IN RED

A guide for completing this form is located at http://www.mtu.edu/registrar/faculty-staff/course-proposal/

1) Course Information

Is this a **half-semester course proposal?** ☐ Yes ■ No

NOTE: All half-semester courses must follow rules set in Faculty Senate Proposal 4-00. See Senate website for details: http://www.sas.it.mtu.edu/usenate/propose/03/10-03.htm

Course Prefix/Number *(i.e. MEEM 2110)*: BL 2xxx

Course Title *(abbreviated; used on transcript - Up to 30 characters including spaces)*

Observation & data collection

Alternative Title for Catalog *(Up to 100 characters including spaces)*

Field observation and data collection

2) Credits

Number of credits assigned to this course 1

OR

Range of credits if variable ☐ to ☐ *(Number of credits to be taken in a given semester)*

3) Schedule

Contact Hours per Week *(Lec & Rec: 1 credit =1 contact hour; Lab: 1 credit =1-3 contact hours. (i.e. a 3-credit course may be 2 contact hours of lecture or recitation and up to 3 contact hours of lab OR 1 contact hour of lecture or recitation and up to 6 contact hours of lab)*

1		
Lecture	Recitation	Lab

OR

Research Course? ☐ Yes ☐ No

OR

Special Topics Course? ☐ Yes ☐ No

4) Additional Credits

May students receive **additional credits** by taking and passing this course more than once?

■ No

☐ Yes, for a maximum of _____ credits. *(Must be a multiple of the course credits, i.e. Research or Special Topics)*

☐ Yes, for an unlimited number of credits. *(i.e. Music, Varsity sports, etc.)*

Course Add Proposal
Rev: 08/14/2019

www.mtu.edu/registrar

Page 1 of 5

5) **Pass/Fail**

Will this course be offered as a **pass/fail option ONLY**? *(grade of S or E)* ☐ Yes ■ No

6) **Cross Listed/Equivalent Course**

Cross Listed: Is there an identical course offered in a different subject or at a different level? ☐ Yes ■ No

If yes, what is the other subject and course number? _____

Equivalent Course: Does this course replace a dropped course with no change in course content for degree requirements, prerequisites, and repeating purposes? ☐ Yes ■ No

If yes, what is the subject and course number of the dropped course? _____

7) **Corequisites and Prerequisites**

Corequisites are courses that are **REQUIRED to be taken at the SAME TIME** as this course (courses MUST be offered during the same term):

Required corequisite course(s):

_____

_____

Prerequisites are courses that are **REQUIRED to be taken PRIOR** to enrollment in this course. **Select appropriate box and use parentheses where needed.**

Required prerequisite course(s):

1 BL 1580

☐ And ■ Or 2 BL 1570

☐ And ☐ Or 3 _____

☐ And ☐ Or 4 _____

☐ And ☐ Or 5 _____

☐ And ☐ Or 6 _____

A **concurrent prerequisite** is a defined prerequisite course (from list above) that **MAY** be taken **EITHER** simultaneously in the same semester **OR** in a prior semester. Indicate below applicable courses.

Concurrent prerequisite course(s):

_____

_____

_____

8) **Catalog Course Description**
The traditional catalog style description for a course is limited to **350 characters including spaces**. If course is proposed as a half-semester course, please include that information in the description. **Please refer to the Course Proposal Guide for examples and suggestions on developing a course description.**

Best practices for observing, collecting, recording and analyzing ecological and evolutionary biology data in the lab and field.

9) **Registration Restrictions**

- If permission is <u>always</u> **required** for registration purposes (a student cannot enter the course without department or instructor signature), please select the appropriate permission.

  Do not select unless EVERY STUDENT must get "SIGNED INTO" the class.

  ☐ Department **OR** ☐ Instructor

- Students who register for this course may be restricted by their **College/School OR** their **Major**. Please indicate if any college or major restrictions should be applied to this course. If there are no restrictions please indicate in the check box provided.

☐ **No College/School Restrictions**

Colleges/Schools who MAY NOT enroll (EXCLUDE)

_____

-OR-

Colleges/Schools who MAY enroll (INCLUDE)

_____

☐ **No Major Restrictions**

Majors that MAY NOT enroll (EXCLUDE)

_____

-OR-

Majors that MAY enroll (INCLUDE)

EEB (proposed), SBL

-- Restrictions continued on next page --

- A restriction may also be placed on **Class Standing** (freshman, sophomore, junior, senior, graduate). Please indicate if any class restrictions should be applied to this course. If there are no restrictions please indicate in the check box provided.

☐ **No Class Restrictions**

Class of students who MAY NOT enroll (EXCLUDE)
_____
-OR-
Class of students who MAY enroll (INCLUDE)
_____

10) Semester(s) Offered

☐ Fall ☒ Spring ☐ Summer *(Check all that apply)*

OR ☐ On Demand

If offered in a specific semester, will the course be offered only in alternate years? ☐ Yes ☐ No

If yes, what will be the starting academic year? *(i.e. 2014-15 or 2015-16)*_____

11) General Education

Is this course being proposed for General Education? ☐ Yes ☒ No

Proposal forms are available at: http://www.mtu.edu/registrar/faculty-staff/course-proposal/.

12) Course Computing Lab and Expendables Fees

DO NOT RECORD FEE INFORMATION HERE. Submit new course fee information on the New Course Fees Form available at: http://www.mtu.edu/registrar/faculty-staff/course-proposal/.

13) Course Learning Objectives (Required)

- Employ observation in field and lab to characterize ecological and evolutionary pattern and process
- Organize qualitative and quantitative observations in a research notebook.
- Use observational data to formulate hypotheses for novel experiments

14) Degree Programs which this course will affect

List the degrees, minors, and certificates in which this course will be required or used as an elective: ***

Degree Program(s):
Required for EEB (proposed)

*** **Be sure to adjust the appropriate degree audits in sections 7 and 8 in your department's binder.**

15) Course Rationale *(Required)*

This course is part 2 in a series of seminar courses designed to build practical skills and bring together the cohort of students who are part of the Ecology and Evolutionary Biology (EEB) BS program. Part 1 of the series is a first-year experience seminar (BL 1570 or BL 1580, which will be prerequisites for this class). This class will specifically focus on best practices for observing living systems, recording those observations in field and lab notebooks, organizing those observations to gain insight, and finally using observations to generate hypotheses that can be tested using subsequent experiments. This suite of skills is absolutely key for ecologists and evolutionary biologist, yet is not explicitly taught in any of our existing courses. This seminar is deisgned to make these vital practices a central focus for one semester, and to instill basic observational skills that can then be scaffolded in later courses, seminars and capstone/field experiences.

16) Faculty Contact

Faculty proposing this course *(please print)*: Name Amy Marcarelli

Email ammarcar@mtu.edu

DID YOU USE RED INK TO COMPLETE THIS FORM?

IF NOT, PLEASE HIGHLIGHT YOUR ANSWERS SO NOTHING IS MISSED IN PROCESSING.

Michigan Tech

— Course Add Proposal —

PLEASE COMPLETE THIS FORM IN RED

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1) Course Information

Is this a **half-semester course proposal?** ☐ Yes ■ No

NOTE: All half-semester courses must follow rules set in Faculty Senate Proposal 4-00. See Senate website for details: http://www.sas.it.mtu.edu/usenate/propose/03/10-03.htm

Course Prefix/Number *(i.e. MEEM 2110)*: BL 3xxx

Course Title *(abbreviated; used on transcript - Up to 30 characters including spaces)*

Data interpretation & analysis

Alternative Title for Catalog *(Up to 100 characters including spaces)*

Data Interpretation and critical analysis

2) Credits

Number of credits assigned to this course 1

OR

Range of credits if **variable** ☐ to ☐ *(Number of credits to be taken in a given semester)*

3) Schedule

Contact Hours per Week *(Lec & Rec: 1 credit =1 contact hour; Lab: 1 credit =1-3 contact hours. (i.e. a 3-credit course may be 2 contact hours of lecture or recitation and up to 3 contact hours of lab OR 1 contact hour of lecture or recitation and up to 6 contact hours of lab)*

1		
Lecture	Recitation	Lab

OR

Research Course? ☐ Yes ☐ No

OR

Special Topics Course? ☐ Yes ☐ No

4) Additional Credits

May students receive **additional credits** by taking and passing this course more than once?

■ No

☐ Yes, for a maximum of _____ credits. *(Must be a multiple of the course credits, i.e. Research or Special Topics)*

☐ Yes, for an unlimited number of credits. *(i.e. Music, Varsity sports, etc.)*

5) **Pass/Fail**

Will this course be offered as a **pass/fail option ONLY**? *(grade of S or E)* ☐ Yes ■ No

6) **Cross Listed/Equivalent Course**

Cross Listed: Is there an identical course offered in a different subject or at a different level? ☐ Yes ■ No

If yes, what is the other subject and course number? _____

Equivalent Course: Does this course replace a dropped course with no change in course content for degree requirements, prerequisites, and repeating purposes? ☐ Yes ■ No

If yes, what is the subject and course number of the dropped course? _____

7) **Corequisites and Prerequisites**

Corequisites are courses that are **REQUIRED to be taken at the SAME TIME** as this course (courses MUST be offered during the same term):

Required corequisite course(s):

_____

_____

Prerequisites are courses that are **REQUIRED to be taken PRIOR** to enrollment in this course.
Select appropriate box and use parentheses where needed.

Required prerequisite course(s):

1 BL 2xxx (proposed)

☐ And ☐ Or 2 _____

☐ And ☐ Or 3 _____

☐ And ☐ Or 4 _____

☐ And ☐ Or 5 _____

☐ And ☐ Or 6 _____

A **concurrent prerequisite** is a defined prerequisite course (from list above) that **MAY** be taken **EITHER** simultaneously in the same semester **OR** in a prior semester. Indicate below applicable courses.

Concurrent prerequisite course(s):

_____

_____

_____

8) **Catalog Course Description**
The traditional catalog style description for a course is limited to **350 characters including spaces**. If course is proposed as a half-semester course, please include that information in the description. **Please refer to the Course Proposal Guide for examples and suggestions on developing a course description.**

This class will develop skills for interpreting and critically evaluating data and analyses of data to evaluate hypotheses in ecological and evolutionary biology. Students will practice peer review and analyzing published research articles.

9) **Registration Restrictions**

- If permission is <u>always</u> **required** for registration purposes (a student cannot enter the course without department or instructor signature), please select the appropriate permission.

  Do not select unless EVERY STUDENT must get "SIGNED INTO" the class.

  ☐ Department **OR** ☐ Instructor

- Students who register for this course may be restricted by their **College/School OR** their **Major**. Please indicate if any college or major restrictions should be applied to this course. If there are no restrictions please indicate in the check box provided.

☐ **No College/School Restrictions**

Colleges/Schools who MAY NOT enroll (EXCLUDE)

_____

-OR-

Colleges/Schools who MAY enroll (INCLUDE)

_____

☐ **No Major Restrictions**

Majors that MAY NOT enroll (EXCLUDE)

_____

-OR-

Majors that MAY enroll (INCLUDE)

EEB (proposed), SBL

-- Restrictions continued on next page --

- A restriction may also be placed on **Class Standing** (freshman, sophomore, junior, senior, graduate). Please indicate if any class restrictions should be applied to this course. If there are no restrictions please indicate in the check box provided.

☐ **No Class Restrictions**

Class of students who MAY NOT enroll (EXCLUDE)
_____
-OR-
Class of students who MAY enroll (INCLUDE)
_____

10) Semester(s) Offered

☐ Fall ☒ Spring ☐ Summer *(Check all that apply)*

OR ☐ On Demand

If offered in a specific semester, will the course be offered only in alternate years? ☐ Yes ☐ No

If yes, what will be the starting academic year? *(i.e. 2014-15 or 2015-16)*_____

11) General Education

Is this course being proposed for General Education? ☐ Yes ☒ No

Proposal forms are available at: http://www.mtu.edu/registrar/faculty-staff/course-proposal/.

12) Course Computing Lab and Expendables Fees

DO NOT RECORD FEE INFORMATION HERE. Submit new course fee information on the New Course Fees Form available at: http://www.mtu.edu/registrar/faculty-staff/course-proposal/.

13) Course Learning Objectives (Required)

- Interpret figures and statistical analyses relative to hypotheses about ecological and evolutionary pattern and process.
- Critically evaluate the application and presentation of data in published literature and media.

14) Degree Programs which this course will affect

List the degrees, minors, and certificates in which this course will be required or used as an elective: ***

Degree Program(s):
Required for EEB (proposed)

*** **Be sure to adjust the appropriate degree audits in sections 7 and 8 in your department's binder.**

15) Course Rationale *(Required)*

This course is part 3 in a series of seminar courses designed to build practical skills and bring together the cohort of students who are part of the Ecology and Evolutionary Biology (EEB) BS program. Part 1 of the series is a first-year experience seminar (BL 1570 or BL 1580, which will be prerequisites for this class), and part 2 (BL 2xxx, proposed) is focused on observation and data collection. This class will specifically focus on critically interpreting data relative to hypotheses - whether in the context of their own research, or research proposed and completed by other scientists. This class will build critical thinking skills that are required for the scientific process that are translatable in any field, and address a key degree learning objective: "Students will employ the scientific method to address ecological and evolutionary questions, formulate hypotheses, design basic studies, and synthesize and report results."

16) Faculty Contact

Faculty proposing this course *(please print)*: Name Amy Marcarelli

Email ammarcar@mtu.edu

DID YOU USE RED INK TO COMPLETE THIS FORM?

IF NOT, PLEASE HIGHLIGHT YOUR ANSWERS SO NOTHING IS MISSED IN PROCESSING.

Appendix B: Financial Documentation

I. Relation to University Strategic Plan

a. Relation of program to the University's educational and research goals.
The proposed major fits with the Education portion of the strategic plan "Provide a distinctive and rigorous action-based learning experience grounded in science, engineering, technology, sustainability, business, and an understanding of the social and cultural contexts of our contemporary world." Specifically, the proposed major is a science-based major with ecology and evolutionary biology at the core.

b. Consistency with the university's resource allocation criteria.
We are requesting no additional salary or resources to establish this degree, as described above in section **XIII. Program costs, Years 1, 2, and 3**.

II. Impact on University Enrollment

a. Projected number of students in the program.
We project an annual enrollment of 10 new students per year in this program. This number is higher than the existing yearly enrollment of incoming SBL3 students, but we expect that retention and thus total program enrollment will be considerably stronger. As the program becomes established we expect yearly enrollment to improve as well.

b. Source of new students; in particular, will the students be drawn from existing programs, or will they be students who would otherwise not have come to Michigan Tech?
We expect that some of the students who choose this program would have traditionally chosen the Biological Sciences degree with Ecology concentration (SBL3). It is possible that some students may come from other majors at Michigan Tech, but the true goal of this program is to attract new students who are looking for an Ecology and Evolutionary Biology degree program with a strong basis in fundamental science and therefore would not have otherwise come to Michigan Tech.

c. What is the likely correlation between demand for the new program and existing enrollment patterns at Michigan Tech?
Long-term enrollment patterns in Biological Sciences are stable, with the recent growth in well-defined degrees and marketable degrees like Medical Lab Science. The addition of a specialized degree with a focus in Ecology and Evolutionary Biology should similarly lead to increased enrollment through improved recruiting for the reasons described above.

d. What is the current enrollment in the unit?

Current enrollment in Biological Sciences in 2019-2020 is 263 students including 222 undergraduate and 41 graduate students.

III. Impact on Resources Required by Department in Which the Program is housed. This would include, but not be limited to:

a. Faculty lines.

No new faculty lines are requested. The current student: faculty ratio in Biological Sciences is 11.52, suggesting we have capacity to grow our undergraduate enrollment and stay close to the university-wide ratio of 12:1.

b. Faculty and student labs, including ongoing maintenance.

No new faculty, labs, or maintenance are requested.

c. Advising.

Advising will be conducted by the Biological Sciences department advisor.

d. Assessment.

This program will be assessed as part of the ongoing University assessment program. All of the University learning goals will be addressed by one or more classes in the proposed program. Courses that are outside of the general education requirements will address disciplinary knowledge as well as other university learning goals. Assessment of this program will be conducted by the Department of Biological Sciences, alongside the existing degree programs in the department.

IV. Impact on Resources Required by other Units Within the University. This analysis would include, but not necessarily be limited to, the impacts on:

a. Other academic (e.g., Gen Ed) units with regard to faculty, labs and assessment. (NOTE: The current Student to Faculty ratio for the university as a whole is approximately 12:1 per Institutional Analysis.)

Because the proposed enrollment in this major is relatively small and most classes will be taught in Biological Sciences, we do not anticipate any significant impact of this program on other units. Any required classes in other academic units will be reviewed by those units to confirm that the capacity is available to serve the students in the new major.

b. Information Technology, the Library, central administration, and career planning with respect to the impact on the need for computing services, library resources, advising, record keeping, development of employer relations, etc.

Existing IT, library and central administration resources are sufficient to support the new major.

V. Assessment of the ability to obtain the necessary resources assuming requested funds are obtained

a. For high demand fields (e.g., business fields, etc.), will it be possible to fill allocated lines?

No lines are requested at the initiation of this degree program

VI. Past proposals. Has the department initiated any other new degree programs in the last five years? If so:

Biological Sciences has not initiated any new degree programs in the past five years. Concurrent with this proposal, the department is proposing a new BS in Human Biology. The development of both of these proposals resulted from the ongoing process of assessment, improvement and refocusing of our Biology degree offerings, in part motivated by recommendations from our external department review in 2018.

VII. Departmental Budget contribution

a. What is the department's total general fund budget?

For FY 2019-2020, the department's total general fund budget is $2,004,463.80

b. How much tuition does the department generate? This information should be provided for both the credit hours taught by the department and the number of credit hours taken by the department's majors.

In FY 2017-2018, the Biology department generated $4,302,539 in tuition for credit hours taught by the Biological Sciences department, and $4,742,692 in the form of tuition by the number of credit hours taken by Biological Sciences enrolled students.

Appendix C- Sample Degree Audit

Proposed Audit
Bachelor of Science in Ecology and Evolutionary Biology
SEEB

Student Name and ID Number

Estimated Graduation Date

Major Requirements: 58-61 Credits		
Course Number	**Credits**	**Course Status Code M, R, P, WVD, SUB***
Professional Development Seminars: 5 credits		
BL 1580	1	
BL 2XXX	1	
BL 3XXX	1	
BL 3782	2	
Biology Requirment: 19 credits		
BL 1010	4	
BL 1020	4	
BL 2200 **and**	3	
BL 2210	1	
BL 3190	3	
BL 3400	4	
Related Science and Math Requirements: 19-20 credits		
CH 1150 **and**	3	
CH 1151	1	
CH 1160 **and**	3	
CH 1161	1	
MA 1135	4	
MA 3715	4	
Select one of the following specializations.		
CH 2410 **and**	3	
CH 2411	1	
MA 2160	4	
PH 1110 **and**	3	
PH 1111	1	
CS 1121	3	
Social Ecology Requirement: 3 credits		
BL 2100	3	
SS 2300	3	
SS 3300	3	
SS 3315	3	
SS 3520	3	
SS/FW 3760	3	
Organismal Biology Requirements: 7-8 credits		
BL 2160	4	
BL 2170	4	
BL 3310	3	
BL 4400	4	

Field /Lab Experience: 5-6 credits		
BL 3999	1-9	
BL 4000	1-9	
BL 4036	3	
BL 4090	2	
BL 4421	3	
BL 4447	3	
BL 4999	1-9	
Credit Subtotal		

Major Electives: 23-26 Credits		
Course Number	**Credits**	**Course Status Code M, R, P, WVD, SUB***
Select at least 23 credits from the elective lists below. Some courses may have additional prerequisite requirements. Courses used towards other major requirements may not count in this section as well.		
BL 2160	4	
BL 2170	4	
BL 3012	3	
BL 3020	3	
BL 3999	1-9	
BL 4000	1-9	
BL 4034	3	
BL 4036	3	
BL 4070	3	
BL 4090	2	
BL 4140	3	
BL 4145	3	
BL 4421	3	
BL 4440	4	
BL 4450	3	
BL 4461	3	
BL 4465	3	
BL 4447	3	
BL 4999	1-9	
FW 3020	3	
FW 3320	3	
FW 3410	3	
FW 3610	4	
FW 4220	4	
FW 4240	4	
FW 4620	3	
GE 2000	3	
Credit Subtotal		

General Education Requirements: 24 credits		
Course Number	Credits	Course Status Code M, R, P, WVD, SUB*

Courses used to complete General Education may not be used to complete other degree requirements.

Core: 12 credits		
UN 1015	3	
UN 1025 or upper level modern language	3	
Critical and Creative Thinking	3	
Social Responsibility and Ethical Reasoning	3	

- ✓ Students must complete 12 credits of HASS course work
- ✓ Each course can satisfy only one requirement
- ✓ No more than three credits may come from the Restricted List
- ✓ Six credits of HASS must be at the 3000- or 4000- level (an upper level language course in place of UN1025 does not meet this requirement).

HASS: 12 credits		
Communication/ Composition	minimum 3	
Humanities and Fine Arts	minimum 3	
Social and Behavioral Sciences	minimum 3	
Course from any list above or Restricted List	0-3	

Co-Curricular Activities: 3 Credits		
Required for graduation, but not included in the GPA calculation or in the overall credits required for the degree.		

Free Electives: 14-19 credits		
Course Number	Credits	Course Status Code M, R, P, WVD, SUB*
Credit Subtotal		

*M-Passed with valid grade, transfer, or Advance Placement

Advisor Use Only	
Total Credits Required	120
Total Credits Completed	
Total Credits Needed	

Student Signature Date

Departmental Approval Date

Appendix D- Complete List of Directive Electives

Course descriptions for Major Requirement: Professional Development Seminars

BL 1580 - First Year Experience in Biological Sciences Introduction to fields and career opportunities in the biological sciences. Credits: 1.0 Lec-Rec-Lab: (0-1-0) Semesters Offered: Fall Restrictions: Must be enrolled in one of the following Major(s): Biological Sciences, Biochem & Molec Biology-Bio Sc, Bioinformatics; Must be enrolled in one of the following Class(es): Freshman, Sophomore

BL 3782 - Writing Practicum in Biology Students will develop and improve their skill level in searching for scientific literature, incorporating that into scientific writing, evaluating and incorporating the work of others, and develop critique skills for review of scientific source material and basic statistical methods. Credits: 2.0 Lec-Rec-Lab: (0-2-0) Semesters Offered: Fall, Spring Restrictions: Must be enrolled in one of the following Major(s): Biological Sciences, Biochem & Molec Biology-Bio Sc, Bioinformatics; May not be enrolled in one of the following Class(es): Freshman

Course descriptions for Major Requirement: Biology Courses

BL 1010 - General Biology I: Introduction to Organismal Biology, Ecology, and Evolution A discussion of the principles of ecology and organismal biology, using the theme of physiological ecology and adaptations. This course will emphasize biodiversity, scientific method, experimental design and written and oral presentation of results. Credits: 4.0 Lec-Rec-Lab: (3-0-3) Semesters Offered: Fall

BL 1020 - General Biology II: Introduction to Cellular and Molecular Biology Discussion of the major principles by which life is organized. Topics include scientific methods, biological chemistry, cell structure and organization, multicellular organization, diversity of organisms, energetics and photosynthesis, cellular reproduction genetics, gene structure and expression, and recombinant DNA. Credits: 4.0 Lec-Rec-Lab: (3-0-3) Semesters Offered: Spring, Summer

BL 2200 – Genetics A study of classical and molecular genetics. Topics include one- and two-locus genetics, recombination, gene structure, regulation and function, quantitative and population genetics, and genetic engineering. Covers both prokaryotes and eukaryotes. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Spring, Summer Pre-Requisite(s): (BL 1020 or BL 1040 or BE 2400) and (BL 2100 or CH 4710)

BL 2210 - Genetics Laboratory A laboratory to complement BL2200. Covers applications of techniques used in genetics, including Mendelian analysis, tetrad analysis, karyotyping, DNA and protein electrophoresis, DNA and plasmid purification, transformation and restriction mapping, and PCR amplification of DNA. Credits: 1.0 Lec-Rec-Lab: (0-0-3) Semesters Offered: Spring Pre-Requisite(s): BL 2200(C)

BL 3190 – Evolution A study of the patterns and processes of organic evolution. Topics include genetics of populations, mechanisms of deterministic and stochastic genetic change, history of life on earth, biogeography, molecular evolution, units of selection, sexual selection, speciation, and human evolution. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Spring Pre-Requisite(s): BL 1020 or BL 1040

BL 3400 - Principles of Ecology Study of both accepted and currently debated principles that describe ecological relationships at the organism, population, community, and ecosystem levels. Credits: 4.0 Lec-Rec-Lab: (3-0-3) Semesters Offered: Fall Pre-Requisite(s): BL 1020 or BL 1040

Course descriptions for Major Requirement: Related Science and Mathematics Courses

CH 1150 - University Chemistry I Introduces the foundations of chemistry, including electronic structure of atoms and molecules, intermolecular forces, states of matter, chemical reactions, organic chemistry, chemical equilibria, kinetics, and acid-base chemistry. Includes laboratory component that emphasizes lecture components. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall, Spring, Summer Co-Requisite(s): CH 1151 Pre-Requisite(s): MA 1031(C) or MA 1032(C) or MA 1160(C) or MA 1161(C) or MA 1135(C) or ALEKS Math Placement >= 56 or CEEB Calculus AB >= 2 or CEEB Calculus BC >= 2 or CEEB Calculus AB Subscore >= 2

CH 1151 - University Chemistry Lab I Laboratory to accompany CH1150. Credits: 1.0 Lec-Rec-Lab: (0-0-3) Semesters Offered: Fall, Spring, Summer Co-Requisite(s): CH 1150 Pre-Requisite(s): MA 1031(C) or MA 1032(C) or MA 1160(C) or MA 1161(C) or MA 1135(C) or ALEKS Math Placement >= 56 or CEEB Calculus AB >= 2 or CEEB Calculus BC >= 2 or CEEB Calculus AB Subscore >= 2

CH 1160 - University Chemistry II A continuation of CH 1150. Introduces more complex concepts in chemistry, including kinetics, chemical equilibria, acid-base equilibria, thermodynamics, electrochemistry, and chemical analysis. Additional topics may include chemistry of the metals and non-metals, biochemical systems, and nuclear chemistry. Includes laboratory component that emphasizes lecture concepts. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall, Spring, Summer Co-Requisite(s): CH 1161 Pre-Requisite(s): CH 1112 or (CH 1150 and CH 1151)

CH 1161 - University Chemistry Laboratory II Laboratory to accompany CH1160. Credits: 1.0 Lec-Rec-Lab: (0-0-3) Semesters Offered: Fall, Spring, Summer Co-Requisite(s): CH 1160 Pre-Requisite(s): CH 1112 or (CH 1150 and CH 1151)

CH 2410 – Organic Chemistry I A study of the chemistry of carbon compounds. Review of hybrid orbitals, covalent bonding, and resonance. Introduction to nomenclature, stereochemistry, mass spectrometry and infrared spectroscopy, functional group chemistry based on reaction mechanisms, and multi-step synthesis. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall, Summer Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161)

CS 1121 - Introduction to Programming I Starting point of the computer science programs. A high-level, object-oriented programming language is introduced as a problem-solving tool. Topics include design, coding, documentation, debugging, and testing of programs. Programming assignments are given in both a closed lab setting and as homework. Credits: 3.0 Lec-Rec-Lab: (0-2-2) Semesters Offered: Fall, Spring, Summer Pre-Requisite(s): MA 1031(C) or MA 1032(C)

MA 1135 - Calculus for Life Sciences Topics include analytic geometry, limits, continuity of functions, transcendental functions, derivatives, integrals, and applications of the derivative in the fields of economics, biological sciences, and socials sciences. Extensive use of graphing calculator. (See mathematical sciences department for recommended calculator). Credit applicable only to those curricula specifying this course. Credits: 4.0 Lec-Rec-Lab: (0-4-0), Semesters Offered: Fall, Spring, Summer Restrictions: May not be enrolled in one of the following College(s): College of Engineering Pre-Requisite(s): MA 1032 or MA 1031 or ALEKS Math Placement >= 70 or CEEB Calculus AB >= 2 or CEEB Calculus BC >= 2 or CEEB Calculus AB Subscore >= 2

MA 2160 - Calculus with Technology II Continued study of calculus, which includes a computer laboratory. Topics include integration and its uses, function approximation, vectors, and elementary modeling with differential equations. Credits: 4.0 Lec-Rec-Lab: (0-3-1) Semesters Offered: Fall, Spring, Summer Pre-Requisite(s): MA 1160 or MA 1161 or MA 1135 or CEEB Calculus AB >= 3 or CEEB Calculus BC >= 3 or CEEB Calculus AB Subscore >= 3

MA 3715 – Biostatistics Introduction to the design and analysis of statistical studies in the health and life sciences. Topics include study design, descriptive and graphical methods, probability, inference on means, categorical data analysis, and linear regression. Not open to students with credit in MA2710, MA2720, or MA3710. Credits: 3.0 Lec-Rec-Lab: (0-3-0) Semesters Offered: Spring Pre-Requisite(s): MA 1135 or MA 1160 or MA 1161

PH 1110 - College Physics I An overview of basic principles of kinematics, dynamics, elasticity, fluids, heat, thermodynamics, mechanical waves, and interference and diffraction of mechanical waves. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall, Summer Restrictions: May not be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Major(s): Physics, Construction Management, Surveying Engineering, Electrical Eng Tech, General Technology, Mechanical Engineering

Tech, Applied Physics, Computer Network & System Admn Co-Requisite(s): PH 1111 Pre-Requisite(s): MA 1031 or MA 1032 or MA 1135(C) or MA 1160(C) or MA 1161(C) or ALEKS Math Placement >= 56 or CEEB Calculus AB >= 2 or CEEB Calculus BC >= 2 or CEEB Calculus AB Subscore >= 2

PH 1111 - College Physics I Laboratory Experiments covering kinematics, forces, conservation of momentum and energy, waves, and thermodynamics are explored through guided construction. The course provides inquiry-based laboratory experiences for concepts explored in PH1110. Credits: 1.0 Lec-Rec-Lab: (0-0-2) Semesters Offered: Fall, Summer Restrictions: May not be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Major(s): Physics, Construction Management, Surveying Engineering, Electrical Eng Tech, General Technology, Mechanical Engineering Tech, Applied Physics, Computer Network & System Admn Co-Requisite(s): PH 1110

Course descriptions for Major Requirement: Social Ecology

BL 2001 - Valuing the Great Lakes The Great Lakes are used as the subject to examine environmental issues. A combination of reading, lecture, and discussion will be used to study the unique ecology, biology, and history of the Great Lakes. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall

SS 2300 - Environment and Society Examines social approaches to understanding why environmental problems happen and how environmental problems are resolved. Includes concepts such as sustainability, market-based environmental policies, property systems, and environmental justice. Case studies may include biodiversity, deforestation, climate change, water quality, and toxics. Credits: 3.0 Lec-Rec-Lab: (2-1-0) Semesters Offered: Spring

SS 3300 - Environmental Problems An examination of local, regional, and global contemporary environmental problems. Critical consideration of underlying social, historical, and economic causes. Case studies drawn from topics such as global warming, ozone depletion, groundwater pollution, solid waste disposal, deforestation, and resource depletion. Studies proposed solutions and their impacts. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: On Demand Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3315 - Population and Environment This course investigates relationships between the world's population, population change, population distribution, resource consumption, and environmental and social consequences. Addresses local and global relationships and the population processes (mortality, fertility, and migration) involved. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall, Summer - Offered alternate years beginning with the 2019-2020 academic year Restrictions: May not be enrolled in one of the following Class(es): Freshman Pre-Requisite(s): (MA 1030 and MA 1031) or MA 1032 and UN 1015 and (UN 1025 or Modern

Language - 3000 level or higher)

SS 3520 - U.S. Environmental History Examines how human interaction with physical environment has changed in North America over the last four centuries. Topics include uses of land by Native Americans, changes associated with European colonization, incorporation of natural resources into industrial economy, early conservation and preservation movements, and environmental concerns accompanying urbanization and industrialization. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall Restrictions: May not be enrolled in one of the following Class(es): Freshman Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS/FW 3760: Human Dimensions of Natural Resources Uses sociological concepts to cover facets of human relationships to natural resources, including human values, beliefs, and attitudes regarding the environment; rural resource-dependent communities; natural resource professions and expert knowledge; and the history of American perspectives on the environment. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

Course descriptions for Major Requirement: **Organismal Biology**

BL 2160 – Botany Covers structure, function, reproduction, and classification of plants and algae, relating these current ecological, agricultural, or other human issues. Credits: 4.0 Lec-Rec-Lab: (3-0-3) Semesters Offered: Spring

BL 2170 – Zoology Biology of animals from first organized multi-cell through Hominids; the origin and evolution of the metazoa phyla, their physiology, development, ecology, behavior, natural history, and systematics. Credits: 4.0 Lec-Rec-Lab: (3-0-3) Semesters Offered: Fall Pre-Requisite(s): BL 1010 or BL 1040

BL 3310 - Environmental Microbiology General principles of microbiology, focusing on both the use and control of microorganisms. Topics include microbial structure, function, growth, metabolism, and diversity, as well as microbial involvement in water and waste treatment, waterborne diseases, and pollution control. Not open to students with credit in BL3210. Credits: 3.0 Lec-Rec-Lab: (2-0-3) Semesters Offered: Spring Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore Pre-Requisite(s): BL 1020 or BL 1040 or BL 3080

BL 4440 - Fish Biology Fishes and their habitat, native and exotic fishes of the Great Lakes region, and ocean fishery resources will be examined. Basic topics in Ichthyology and fish ecology, evolution, genetics, reproduction strategies and identification of early life stages, fish community structure, food webs and dynamics. Laboratory exercises on sampling, identification and classification of fishes and basic fish anatomy and discussion of scientific papers relevant to the subject material. Credits: 4.0 Lec-Rec-Lab: (3-0-3) Semesters Offered: Fall - Offered

alternate years beginning with the 2018-2019 academic year Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore Pre-Requisite(s): BL 1020 or BL 1040

Course descriptions for Major Requirement: Field / Lab Experience

BL 3999 - Biological Sciences Field Experience In this course students will gain intensive field experience in Biological Sciences emphasizing immersion and observation in novel field settings. Students in this course will visit different ecosystems during day and weekend trips that explore aspects of ecology, evolution, community dynamics and human impacts on ecosystems. Credits: variable to 9.0; Repeatable to a Max of 9 Semesters Offered: On Demand Restrictions: Permission of instructor required

BL 4000 - Research in Biology A literature and laboratory research problem that culminates in a written report on the work performed. Credits: variable to 9.0; Repeatable to a Max of 9 Semesters Offered: Fall, Spring, Summer Restrictions: Permission of instructor required

BL 4036 - Ecology and Evolution of Interactions Between Plants, Herbivores, and Pollinators Plants, herbivores, and pollinators have played major roles in influencing each others evolutionary diversification. We will examine the ecology and evolution of plant-herbivore-pollinator interactions in basic and applied contexts. A solid foundation of tools in ecology and evolution will be established and class will include lectures and interactive discussions from readings of of primary literature. Students will design, conduct, and analyze independent research projects in the lab. Credits: 3.0 Lec-Rec-Lab: (2-0-2) Semesters Offered: Summer - Offered alternate years beginning with the 2019-2020 academic year Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore Pre-Requisite(s): BL 3400 or BL 3190

BL 4090 - Tropical Island Biology A survey of island biology, including marine and terrestrial habitats. Topics include formation of carbonate islands, geological history of the Bahamas, island plant communities, intertidal, grass bed, mangrove and coral reef communities. Special course fees. Consult department before enrolling. Completion of BL1020 or BL1040 desirable but not necessary. Credits: 2.0 Lec-Rec-Lab: (0-2-0) Semesters Offered: Spring Restrictions: Permission of instructor required

BL 4421 - Lake Superior Exploration A field intensive course with significant time spent on a research vessel (R/V Agassiz or other) where students will learn the use of a variety of state-of-the-art techniques to characterize biological communities and measure important physical and biological processes. Credits: 3.0 Lec-Rec-Lab: (4-0-6) Semesters Offered: Summer - Offered alternate years beginning with the 2018-2019 academic year Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

BL 4447 - Stream Ecology Field course combining river and stream ecosystem and foodweb study with fishes in lake systems. Students will be exposed to research methods used in lakes for

comprehensive abiotic and biotic understanding. Credits: 3.0 Lec-Rec-Lab: (2-0-3) Semesters Offered: Summer - Offered alternate years beginning with the 2019-2020 academic year Restrictions: May not be enrolled in one of the following Class(es): Freshman Pre-Requisite(s): BL 1010 or BL 1040 or BL 3400

BL 4999 - Biological Sciences Internship Practical and didactic internship experience directly related to student's course of study in biochemistry and molecular biology, bioinformatics, biological sciences, or ecology. Students conduct work at an approved internship site in addition to academic assignments that encourage them to connect their professional and academic experience. Credits: variable to 9.0; Repeatable to a Max of 9 Semesters Offered: Fall, Spring, Summer Restrictions: Permission of instructor required

Course descriptions for Major Requirement: Major Approved Electives (only included here if not also listed above)

BL 3012 - Essential Cell Biology This course will provide an understanding of cell structure and function with emphasis on eukaryotic cells. Topics include macromolecules, membranes, organelles, cytoskeleton, division, differentiation, cell-cell interactions, intracellular trafficking, protein sorting, cell signaling, and motility. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Spring Restrictions: May not be enrolled in one of the following Class(es): Freshman Pre-Requisite(s): BL 1020 or BL 1040 and BL 2100

BL 3020 – Biochemistry I Introductory overview to biochemistry. Topics include the biochemistry of amino acids, proteins, coenzymes, carbohydrates, nucleotides, nucleic acids, lipids, and water, as well as bioenergetics and photosynthesis. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall Pre-Requisite(s): (BL 1020 or BL 1040 or BE 2400) and (CH 2410 or CH 2420)

BL 4034 - Community Ecology and Evolutionary Dynamics This is an advanced course that looks at the study of ecology and evolutionary biology at the community level: how populations interact with the abiotic environment and each other to determine patterns of diversity, distribution, and abundance of plants and animals. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore Pre-Requisite(s): BL 3400 and BL 3190

BL 4070 - Environmental Toxicology Introduction to the range of anthropogenic pollutants released into the environment. Concepts of bioaccumulation, biomagnification and environmental persistence, modes of toxicity and detoxification, transport and fate in aquatic and terrestrial ecosystems. Toxic equivalent factors and quotients, regulatory guidelines and practices. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Spring. Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore. Pre-Requisite(s): BL 1040

or (BL 1010 and BL 1020) and CH 1150 and CH 1160

BL 4140 - Plant Physiology Physiology and biochemistry of plants. Emphasizes photosynthesis, plant hormones, water and nutrient relations, and light-regulated development. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Spring - Offered alternate years beginning with the 2005-2006 academic year Pre-Requisite(s): BL 2160 and CH 2420

BL 4145 - Plant-Microbe Interactions Interactions between plants and microorganisms in the environment. Topics include microbial virulence, signaling, gene expression, beneficial interactions and disease resistance in plants. Laboratory will focus on plant biochemical and microbiological methods as they relate to environmental problems. Credits: 3.0 Lec-Rec-Lab: (2-0-2) Semesters Offered: Fall - Offered alternate years beginning with the 2012-2013 academic year Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore Pre-Requisite(s): BL 2200

BL 4450 – Limnology The study of biological, physical, and chemical processes of freshwater systems using a watershed perspective. Movement of nutrients/organisms from land, via streams/rivers, into lakes will be studied, with emphasis on field work in local lakes/streams. Credits: 4.0 Lec-Rec-Lab: (0-3-3) Semesters Offered Spring. Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161)

BL 4461 – Ecosystem Ecology Study of processes in aquatic and terrestrial ecosystems, including energy flow, ecosystem production, and nutrient cycling. We will explore these processes through a historical overview of influential research programs and regional to global case studies. Credits: 3.0 Lec-Rec-Lab: (0-3-0) Semesters Offered: Spring - Offered alternate years beginning with the 2011-2012 academic year. Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore. Pre-Requisite(s): BL 3400 and CH 1122 or (CH 1160 and CH 1161)

BL 4465 - Biological Oceanography An overview of ocean environments and marine life. Topics include: trophic level interactions, nutrient cycling, ecology of plankton, invertebrates, fish, mammal and bird resources, and human influences on marine ecosystems. Will cover basic water chemistry and light in oceans. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Spring Restrictions: May not be enrolled in one of the following Class(es): Freshman Pre-Requisite(s): BL 1010 or BL 1040 or BL 3070

CH 2410 – Organic Chemistry I A study of the chemistry of carbon compounds. Review of hybrid orbitals, covalent bonding, and resonance. Introduction to nomenclature, stereochemistry, mass spectrometry and infrared spectroscopy, functional group chemistry based on reaction mechanisms, and multi-step synthesis. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall, Summer Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161)

FW 3020 - Forest Ecology Environmental factors and plant and animal characteristics which control composition, structure, and function of forest ecosystems. Emphasis on how ecosystems change across space and time and knowledge needed to sustainably manage forest ecosystems for social, economic, and ecological benefits. Credits: 3.0 Lec-Rec-Lab: (2-0-3) Semesters Offered: Fall Pre-Requisite(s): FW 2010(C) and FW 2051(C)

FW 3320 - Fundamentals of Forest Genetics and Genomics This course will teach fundamental and applied genetic principles that are essential for management of forest and other ecosystems to maintain their long-term health and sustainability. The class will cover the following topics: structure and function of DNA, inheritance, molecular evolution, population and quantitative genetics, gene conservation, genomics and biotechnology. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Spring Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

FW 3410 - Conservation Biology Introduction to biological, social, political, and economic facets of conservation biology. Emphasizes evaluation of how best to maintain and restore biodiversity through management of populations and ecosystems. Topics include mass extinctions, global change, loss and degradation of habitat, and over exploitation of biological resources. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Spring

FW 3610 – Ornithology An ecological and evolutionary approach to the study of birds. Topics include behavioral, anatomical, and physiological adaptations to flight, life history, mating systems, migration, communication and conservation. Laboratory emphasizes identification and experimental use of birds as model organisms. Credits: 4.0 Lec-Rec-Lab: (3-0-3) Semesters Offered: Spring Pre-Requisite(s): BL 1040 or BL 1020

FW 4220 – Wetlands Study of the physical, chemical, and biological characteristics of wetlands. Describes functions and values of individual wetland types. Presents management of wetlands and laws governing wetlands. Labs concentrate on field techniques used to assess specific plant, animal, soil, and hydrological characteristics of wetlands. Credits: 4.0 Lec-Rec-Lab: (3-0-3) Semesters Offered: Fall Restrictions: May not be enrolled in one of the following Class(es): Freshman

FW 4240 – Mammalogy Covers the classification, structure, and natural history of mammals, including physiological, behavioral, and ecological adaptations. Through laboratory and fieldwork, emphasizes field techniques and the distribution and identification of mammals, especially those species found in the western Great Lakes. Credits: 4.0 Lec-Rec-Lab: (3-0-3) Semesters Offered: Fall Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore Pre-Requisite(s): BL 1020 or BL 1040

FW 4260 - Population Ecology Covers the principles of population ecology. Topics include

measures of populations, population dynamics, and models used to describe the theories related to population dynamics. Credits: 3.0 Lec-Rec-Lab: (0-3-0) Semesters Offered: Fall

GE 2000 - Understanding the Earth Introduction to materials and processes that shape the earth we live on. Lecture and laboratories acquaint students with minerals, rocks, earth resources, weathering, geologic time, landslides, groundwater, streams, shorelines, deserts, glaciers, geologic structures, earthquakes, plate tectonics, and the dynamics of the earth's crust, mantle, and core. Credits: 3.0 Lec-Rec-Lab: (2-0-3) Semesters Offered: Fall, Spring

PH 1110 - College Physics I An overview of basic principles of kinematics, dynamics, elasticity, fluids, heat, thermodynamics, mechanical waves, and interference and diffraction of mechanical waves. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall, Summer Restrictions: May not be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Major(s): Physics, Construction Management, Surveying Engineering, Electrical Eng Tech, General Technology, Mechanical Engineering Tech, Applied Physics, Computer Network & System Admn Co-Requisite(s): PH 1111 Pre-Requisite(s): MA 1031 or MA 1032 or MA 1135(C) or MA 1160(C) or MA 1161(C) or ALEKS Math Placement >= 56 or CEEB Calculus AB >= 2 or CEEB Calculus BC >= 2 or CEEB Calculus AB Subscore >= 2

PH 1111 - College Physics I Laboratory Experiments covering kinematics, forces, conservation of momentum and energy, waves, and thermodynamics are explored through guided construction. The course provides inquiry-based laboratory experiences for concepts explored in PH1110. Credits: 1.0 Lec-Rec-Lab: (0-0-2) Semesters Offered: Fall, Summer Restrictions: May not be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Major(s): Physics, Construction Management, Surveying Engineering, Electrical Eng Tech, General Technology, Mechanical Engineering Tech, Applied Physics, Computer Network & System Admn Co-Requisite(s): PH 1110

Course Descriptions for Required General Education Courses

UN 1015 – Composition Provides direct instruction in composition. Students examine and interpret communication practices and apply what they learn to their own written, aural, and visual compositions. Class projects ask students to communicate in a variety of modes and to attend to audience, purpose, and context. Credits: 3.0 Lec-Rec-Lab: (0-3-0) Semesters Offered: Fall, Spring, Summer Restrictions: Must be enrolled in one of the following Class(es): Freshman

UN 1025 - Global Issues Study of contemporary global issues, their origins, impacts, and solutions through the thematic and comparative exploration of worldview and culture, population, globalization, development, politics and global governance, environment, and sustainability. Emphasis on global literacy and information literacy. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall, Spring, Summer Restrictions: Must be enrolled in one of the following Class(es): Freshman