ARIZONA STATE UNIVERSITY

GENERAL STUDIES COURSE PROPOSAL COVER FORM

Course information:

*Copy and paste **current** course information from Class Search/Course Catalog.*

College/School: College of Liberal Arts and Sciences | Department: **School of Life Sciences**

Prefix: **BIO** | Number: **112** | Title: Discovery: Why Sex? | Units: 4

Is this a cross-listed course? No | If yes, please identify course(s)

Is this a shared course? No | If so, list all academic units offering this course

*Note- For courses that are crosslisted and/or shared, a letter of support from the chair/director of **each** department that offers the course is required for **each** designation requested. By submitting this letter of support, the chair/director agrees to ensure that all faculty teaching the course are aware of the General Studies designation(s) and will teach the course in a manner that meets the criteria for each approved designation.*

Is this a permanent numbered course with topics? No

If yes, all topics under this permanent numbered course must be taught in a manner that meets the criteria for the approved designation(s). It is the responsibility of the chair/director to ensure that all faculty teaching the course are aware of the General Studies designation(s) and adhere to the above guidelines.

Chair/Director Initials _____ (Required)

Course description: **attached**

Requested designation: Natural Sciences-SG

*Note- a **separate** proposal is required for each designation requested*

Eligibility:

Permanent numbered courses must have completed the university's review and approval process.
For the rules governing approval of omnibus courses, contact Phyllis.Lucie@asu.edu or Lauren.Leo@asu.edu.

Submission deadlines dates are as follow:

For Fall 2016 Effective Date: October 6, 2015

For Spring 2017 Effective Date: March 15, 2016

Area(s) proposed course will serve:

A single course may be proposed for more than one core or awareness area. A course may satisfy a core area requirement and more than one awareness area requirements concurrently, but may not satisfy requirements in two core areas simultaneously, even if approved for those areas. With departmental consent, an approved General Studies course may be counted toward both the General Studies requirement and the major program of study.

Checklists for general studies designations:

Complete and attach the appropriate checklist

- Literacy and Critical Inquiry core courses (L)
- Mathematics core courses (MA)
- Computer/statistics/quantitative applications core courses (CS)
- Humanities, Arts and Design core courses (HU)
- Social-Behavioral Sciences core courses (SB)
- Natural Sciences core courses (SQ/SG)
- Cultural Diversity in the United States courses (C)
- Global Awareness courses (G)
- Historical Awareness courses (H)

A complete proposal should include:

- ☐ Signed course proposal cover form
- ☐ Criteria checklist for General Studies designation(s) being requested
- ☐ Course catalog description
- ☐ Sample syllabus for the course
- ☐ Copy of table of contents from the textbook and list of required readings/books

It is respectfully requested that proposals are submitted electronically with all files compiled into one PDF.

Contact information:

Name: Stephanie Sowl | E-mail: stephanie.sowl@asu.edu | Phone: 480.965.7937

Department Chair/Director approval: *(Required)*

Chair/Director name (Typed): Bertram Jacobs | Date: 7/29/15

Chair/Director (Signature): Bertram Jacobs

Arizona State University Criteria Checklist for

NATURAL SCIENCES [SQ/SG]

Rationale and Objectives

Public scientific literacy, critical for sound decisions on scientifically infused issues such as climate change, includes understanding of basic science concepts, such as the fundamental behavior of matter and energy. It also includes the understanding that "science" is not an encyclopedic collection of facts. Rather, it is a process of exploration that embraces curiosity, inquiry, testing, and communication, to reduce uncertainty about nature. Absent understanding of scientific concepts and of the nature of science, science and pseudoscience are difficult to distinguish, and normal scientific disagreements may be misinterpreted as ideological or political disputes. The goal of the natural sciences (SQ/SG) requirement, including the laboratory requirement, is to instill understanding of basic science content and of the nature of science in every ASU graduate.

10/1989
REV: 1/1991, 3/1991, 1/2000, 10/2008, 4/2014

Proposer: Please complete the following section and attach appropriate documentation.

ASU--[SG] CRITERIA			
I. - FOR ALL *GENERAL* [SG] NATURAL SCIENCES CORE AREA COURSES, THE FOLLOWING ARE CRITICAL CRITERIA AND MUST BE MET:			
YES	**NO**		**Identify Documentation Submitted**
☒	☐	**1.** Course emphasizes the mastery of basic scientific principles and concepts.	Criteria Justification, detailed syllabus
☒	☐	**2.** Addresses knowledge of scientific method.	Criteria Justification, detailed syllabus
☒	☐	**3.** Includes coverage of the methods of scientific inquiry that characterize the particular discipline.	Criteria Justification, detailed syllabus
☒	☐	**4.** Addresses potential for uncertainty in scientific inquiry.	Criteria Justification, detailed syllabus
☒	☐	**5.** Illustrates the usefulness of mathematics in scientific description and reasoning.	Criteria Justification, detailed syllabus
☒	☐	**6.** Includes **weekly** laboratory and/or field sessions that provide hands-on exposure to scientific phenomena and methodology in the discipline, and enhance the learning of course material.	Criteria Justification, detailed syllabus
☒	☐	**7.** Students submit written reports of laboratory experiments for constructive evaluation by the instructor.	Criteria Justification, detailed syllabus
☒	☐	**8.** Course is general or introductory in nature, ordinarily at lower-division level; not a course with great depth or specificity.	Criteria Justification, detailed syllabus
II. - AT LEAST ONE OF THE ADDITIONAL CRITERIA THAT MUST BE MET WITHIN THE CONTEXT OF THE COURSE:			
☒	☐	**A.** Stresses understanding of the nature of basic scientific issues.	Criteria Justification, detailed syllabus
☒	☐	**B.** Develops appreciation of the scope and reality of limitations in scientific capabilities.	Criteria Justification, detailed syllabus
☐	☒	**C.** Discusses costs (time, human, financial) and risks of scientific inquiry.	

[SG] REQUIREMENTS CANNOT BE MET BY COURSES:		
	• Presenting a qualitative survey of a discipline.	
	• Focusing on the impact of science on social, economic or environmental issues.	
	• Focusing on a specific or limiting but in-depth theme suitable for upper-division majors.	

Course Prefix	Number	Title	General Studies Designation
BIO	112	Discovery: Why Sex?	SG

Explain in detail which student activities correspond to the specific designation criteria. Please use the following organizer to explain how the criteria are being met.

Criteria (from checksheet)	How course meets spirit (contextualize specific examples in next column)	Please provide detailed evidence of how course meets criteria (i.e., where in syllabus)
Course emphasizes the mastery of basic scientific principles and concepts.	This course requires that students learn a number of fundamental scientific principles from a number of different fields/disciplines.	For example, Contextual Items (CI) 1-5 (quantification and the scientific method), 6-10 (biology/genetics), 11-13 (earth and space science), 16-18 (physics/chemistry), 20-24 biology/energetics)
Addresses knowledge of scientific method	Use of the scientific method as a rigorous way to address scientific questions is a unifying theme in this course.	Scientific method is directly addressed in CI 1-5, 24 readings in Module 1 and referred to throughout the course
Includes coverage of the methods of scientific inquiry that characterize the particular discipline	This course transcends a focus on narrow disciplinary methods to showcase how methods once specific to a particular discipline are increasingly being used across the sciences. On the way to this understanding, students encounter content considered central to a number of disciplines.	All laboratories place the student in the role of "researcher". For example, Lab 2 turret-building in tiger beetles, Lab 5 tilt of the earth affects global climate, Lab 8 chemical energy in living systems.
Addresses potential for uncertainty in scientific inquiry	This course uses a historical perspective combined with the student's own process of hypothesis revision to show uncertainty in the scientific process.	CI 10, 24, 25 Reading Modules 2, 5, 6
Illustrates usefulness of mathematics in scientific description and reasoning	This course directly addresses the importance of quantitative measurement in scientific description and reasoning.	CI 2-4, 6, 7, 18 Labs 3, 6, 7-10

Includes weekly laboratory and/or field sessions that provide hands-on exposure to scientific phenomena and methodology in the discipline, and enhance the learning of course material.	Interactive in silica research explorations, virtual field trips, and "do at home" laboratories will be required weekly.	All labs
Students submit written reports of laboratory experiments	Students will be required to submit weekly lab reports that include statements of hypotheses, a discussion of methods, an analysis of data, and a discussion of results	All labs
Course is general or introductory in nature, ordinarily at lower-division level; not a course with great depth or specificity.	Discovery: Why Sex? is a transdisciplinary scientific survey course that uses a discussion of sex to give students an introduction to a variety of scientific fields with an overarching theme of the dynamics of the scientific process.	For example, Contextual Items (CI) 1-5 (quantification and the scientific method), 6-10 (biology/genetics), 11-13 (earth and space science), 16-18 (physics/chemistry), 20-24 biology/energetics)
Stresses the understanding of the nature of basic scientific issues	Discovery prompts students to explore and come to an understanding of basic scientific content issues and process issues such as how to reduce bias, effectively communicate results, the reality of uncertainty in science, and the importance of and increasingly common nature of transdisciplinary inquiry.	For example, Contextual Items (CI) 1-5 (quantification and the scientific method), 6-10 (biology/genetics), 11-13 (earth and space science), 16-18 (physics/chemistry), 20-24 biology/energetics) CI 10, 24, 25, Reading Modules 2, 5, 6
Develops appreciation of the scope and reality of limitations in scientific capabilities.	Using an historical account of a real thread of scientific inquiry (the question of Why Sex?) this course demonstrates how hypotheses change along with developments in the field of study and with advancements in seemingly unrelated fields.	CI 10, 22, 23 Reading Modules 2, 5 Lab 8, 9

C. Discusses costs (time, human, financial) and risks of scientific inquiry.	This course does not specifically address the cost and risk of scientific inquiry directly; however it does show the scientific process as being ongoing and dynamic.	Not a formal course component

Criteria Justification: Discovery: Why Sex?

ASU [SG] Criteria

I. Critical Criteria

Course emphasizes the mastery of basic scientific principles and concepts

Although firmly rooted in biology, the question of "Why sex?" is thoroughly transdisciplinary. As such, this course presents opportunities for students to learn basic scientific principles, as well as build content knowledge in multiple disciplines, through the exploration of a process that sits at the very heart of the natural world. Discovery students explore concepts such as scale, adaptation, evolution, and genetic diversity, as well as the structure of the solar system and planetary dynamics, the pervasiveness of interdependent relationships in the natural world, thermodynamics, energetics, and climate change.

In contrast to traditional introductory science courses, Discovery focuses students on how concepts transcend scientific disciplines and interact with each other. As non-science majors, Discovery students will likely encounter scientific information—in news articles or campaign speeches or internet blogs—that doesn't fall neatly into separate disciplinary buckets. Similarly, as voters they can expect to encounter such issues as energy use, sustainability, and climate change. These issues require an understanding of the interconnectedness and complexity of the natural world. Discovery drives home the point that in order to truly understand natural phenomena—in this case, reproduction—one must move beyond disciplinary borders and engage in transdisciplinary inquiry.

Addresses knowledge of scientific method

One of the primary goals of Discovery is to introduce science as a dynamic process, guided not by a rigid, dusty set of rules, but by a methodology that facilitates discovery and elucidates fact from perception. The scientific method is integral to every module in the course.

Beginning in Module 2 and continuing throughout the course, students use a digital learning tool called "Lizard Island" to engage questions about the advantages and disadvantages of sexual and asexual reproduction. Each successive module introduces new information that complicates students' understanding of reproduction and drives home the complexity of the living world. At its core, though, Lizard Island showcases how the scientific method can be used to sort out this complexity.

Another goal of this course is to show how scientists continually test and refine their hypotheses. Beginning with the very first module, students are prompted to ask questions and formulate hypotheses based on a limited data set. As students encounter new data, they engage in the process of refining their hypotheses. In addition, Discovery offers historical examples of how scientists have modified their hypotheses and conclusions over time. Module 2 includes resources that trace the roots of the question of why organisms reproduce sexually back to the 1800s, demonstrating how new tools and methods of scientific inquiry shape inquiry and lead to new conclusions.

Includes coverage of the methods of scientific inquiry that characterize the particular discipline

This course transcends a focus on narrow disciplinary methods to showcase how methods once specific to a particular discipline are increasingly being used across the sciences. On the way to this understanding, students encounter content considered central to a number of disciplines.

For example, one of the key understandings students arrive at as they move through Discovery is that genetic variation is advantageous. In its focus on genetic variation, Discovery introduces students to one of the key principles of biology, that is, evolution/natural selection. Beyond core concepts like evolution, students also explore areas of particular interest to biologists, such as how the structure and function of organisms shape behavior. For example, in Module 1 students learn how structures built by tiger beetle larvae facilitate their ability to catch prey and in Module 4 they examine how the anatomy of elephant seals facilitates mating rituals that influence sexual selection.

Discovery also incorporates elements of Earth/Space science. Although students learn content at the core of that discipline, the larger aim is for students to acknowledge the interconnectedness and complexity of the natural world and the necessity of transdisciplinary inquiry. Thus, in Module 3A students use a digital manipulative to understand the relationships between the tilt of the earth and Earth's seasons and weather patterns. Ultimately, students come to understand that these factors help explain how and why species engage in certain reproductive behaviors.

By way of a final example, the second half of Discovery includes lab exercises that focus student inquiry on energy flow and conservation, issues commonly considered the domain of physicists and engineers. In Module 4, students calculate the energy costs of reproductive behavior. In Module 5, they return to Lizard Island to conduct a cost/benefit analysis of sexual/asexual reproduction in light of various energetic, climatological, and biotic parameters. While these activities introduce students to core physical science concepts, they also expose students to emerging transdisciplinary discussions between biologists and physicists that focus on natural selection as a mechanism for creating efficiency. Students learn that biologists, physicists, earth scientists, and others can learn more about their own fields by viewing a familiar question from the viewpoint of another discipline.

Addresses potential for uncertainty in scientific inquiry

Discovery engages the issue of uncertainty in science in a number of ways. First, the course tackles the reality that science reflects the understanding of available facts at any given moment in time. Drawing on historical examples, Discovery shows how subsequent scientific discoveries have expanded the number of facts, toppled previous explanations and, in effect, reduced uncertainty.

More creatively, the course engages this concept in its design. The modules are designed to show students how the availability of information impacts the conclusions we draw about the natural world. For example, students' explorations of the energy costs involved in asexual and sexual reproduction may convince them that asexuality is the "better" option. However, looking at the issue through the lens of genetic diversity complicates this understanding. The course concludes by further expanding upon their perspectives with evidence from the microbial world. This progression reinforces the reality that science is a reflection of the facts available at the time. The introduction of new data requires scientists to revisit previously held conclusions.

Finally, the course raises issues related to uncertainty by presenting students with competing hypotheses about a particular natural phenomenon. At their core, competing hypotheses reflect a need

for more study. It is an acknowledgement that we don't have enough facts to come to consensus. This uncertainty contributes to a deeper understanding of the dynamism of the scientific process.

Illustrates the usefulness of mathematics in scientific description and reasoning

Even before Discovery addresses the question Why sex?, it asks the more fundamental question of Why? Module 1 demonstrates how scientists rely on measurement to construct answers to "why" questions. The module includes an in-depth look at the importance of measurement and the integral role quantification and the communication of quantitative data plays in the scientific process. During laboratory investigations, students make observations and collect, collate, and graphically represent their data.

For example:

Modules 2, 3B, and 5 incorporate calculations of population growth such as:

- Finding the factor at which a population is increasing r=(Births-Deaths)/N Where r is the growth rate of the population and N is the initial number of individuals in the population
- the students will be asked to calculate how many individuals would be added to the population per unit time (season, year, generation, etc.) using r to calculate I, the increase in population per unit time t (also expressed as $\Delta N/\Delta t$) using the equation $I=\Delta N/\Delta t=rN$
- the students will then be shown how to extrapolate population growth to many generations using algebra, spreadsheets, and population modeling software. This demonstrates the fundamental mathematical basis of high-tech tools used in scientific description and reasoning.

Module 4 students investigate the thermodynamics of living systems by assessing the caloric "value" of a food item (such as a cricket) and determining the number of crickets a lizard needs to lay an egg or do mate-attracting "push ups." The module drives home the reality that quantification and measurement enable us to make highly accurate statements about the natural world.

Includes weekly laboratory and/or field sessions that provide hands-on exposure to scientific phenomena and methodology in the discipline, and enhance the learning of course material

Beginning with the first module, this course stresses the components and importance of scientific methods. In weekly activities, students formulate hypotheses and analyze data or make observations to test their hypotheses. Cumulatively, the modules compel students to revisit conclusions in light of new information/data, highlighting the iterative nature of scientific inquiry.

Students submit written reports of laboratory experiments for constructive evaluation by the instructor

Students will be required to submit weekly lab reports that include statements of hypotheses, a discussion of methods, an analysis of data, and a discussion of results

Course is general or introductory in nature, ordinarily at lower-division level; not a course with great depth of specificity

Discovery truly embraces its foundational identity. It works toward building students' understanding of science as a process of knowing that transcends disciplinary specifics. Beyond examining practices common to many scientific disciplines, the course also emphasizes the interconnectedness of the natural world—a much broader focus than most introductory science courses, which focus inquiry through a disciplinary lens.

At least one of the following additional criteria must be met

Stresses the understanding of the nature of basic scientific issues

Discovery prompts students to explore and come to an understanding of basic scientific content issues such as the importance of genetic diversity, the interdependent relationships within ecosystems, methods of reproduction, the relationship between structure and function, and the flow of energy.

The course also invites students to explore basic scientific process issues such as how to reduce bias, how to effectively communicate results, the value of iteration, the reality of uncertainty in science, and the importance of and increasingly common nature of transdisciplinary inquiry.

Develops appreciation of the scope and reality of limitations in scientific capabilities

Students develop an appreciation for the scope and reality of limitations in scientific capabilities through modules that examine historical examples of scientific inquiry, as well as through modules that highlight the connection between technology and scientific understanding. For example, Module 6 convolutes student understanding of the value of sexual reproduction by focusing on the incredible success of microbes, which reproduce asexually. Students come to understand that scientists' conclusions are dependent upon what tools scientists have at their disposal.

Course Description – Catalog

"Why?" is a question that animates the youngest of children to the most seasoned of scientists. The acts of asking and answering "Why?" highlight the integrated nature of scientific knowledge and discovery. Demonstrates scientific disciplines are not walled cities in which knowledge is neatly segregated from lines of inquiry and knowledge in other disciplines. Instead, scientific concepts weave throughout and between disciplines and scientists increasingly rely on colleagues from different scientific fields to find answers to scientific questions. So our journey to find responses to the question "Why Sex?" takes us not just to biology, but also to earth science and to physics. Along the way, scientists are linked together not only through concepts that crosscut the disciplines, but also in their reliance upon key scientific skills such as the ability to observe, think critically, measure, gather data and communicate their findings.

Course Description – Detailed

Discovery: Why Sex? is an introductory science course that was launched in spring 2014 as a BIO 194 topics course. During that time it gained SG general studies designation and we request for the permanent number, BIO 112, to also gain SG general studies designation.

It uses the intriguing question of Why Sex? to guide students into an exploration of whole-organismal biology. The course, though, pushes past biology, using it as a springboard for showing how even something as strongly rooted in life science as reproduction has powerful, underlying causes and effects in physics and earth science. This methodology not only demonstrates how different scientific disciplines are inextricably linked, but will also introduce physical and earth sciences principles to students who might not otherwise encounter them. The course demonstrates that even sex is governed by the fundamental rules of matter and energy flowing in a living system and that something as seemingly ordinary as baby animals being born in springtime has its origins in the formation of the Earth itself.

The course guides students toward a qualitative understanding of topics through readings, videos, lectures, and interactive gamelets. Students also explore topics quantitatively as they gather, interpret, and communicate data graphically and mathematically during the laboratory sections of the course.

Students' journey of discovery begins with the fundamental question of Why? Students will first learn to address this question according to the scientific method. This will be accompanied by fundamental skills such as measurement, data collection, and creating and understanding graphical and mathematical representations of data. Early modules will equip students with the necessary toolkit to master the basic scientific principles set forth in the rest of the course. Interactive laboratories allow the student to take a personal journey from scientific novice to field researcher.

Having mastered the fundamentals of hypothesis-driven scientific inquiry, the students now progress to the question of Why Sex? In order to answer this question, students learn about modes of reproduction in vertebrates. They investigate abiotic factors that shape reproduction, including the tilt and geometry of the Earth, global climate, and seasons and progress to analyzing biotic factors that shape reproduction, including natural selection. Students investigate the reproductive behaviors of various species and calculate the energetic costs of sexual reproduction. Through their investigation, students observe numerous examples of reproductive behaviors and assess the potential drawbacks of sexual reproduction (e.g., the tendency of male courtship displays to attract predators). Having become more aware of how much effort is really involved in sexual reproduction, students perform quantitative cost/benefits analyses of sexually and asexually reproducing populations. This comparison yields the

inevitable conclusion that sex is energetically expensive. This positions the student to really ask and develop an initial response to the question Why Sex? In subsequent modules, though, students explore more deeply the concept of genetic variation, which they come to realize is the payoff for sexual reproduction. Students will see first hand the effects of "shuffling the genetic deck" as they use population genetics modeling software to see what happens to populations of varying genetic diversity when conditions change.

Any course devoted to sex would be remiss to ignore the fact that the vast majority of life on Earth reproduces asexually. The course asks students to see the microbial world in light of the discoveries they have made about reproduction in multicellular organisms, investigating how organisms that do not have sex as we know it maintain genetic diversity.

The course endeavors to bring real content mastery in biology, physics, and earth science to non-science majors and pre-service teachers. To reach these target populations, Discovery scaffolds its content and activities to begin with fundamental concepts presented in a highly accessible manner. Introductory activities function to mitigate the acute science anxiety many students carry and build self-efficacy in preparation for more rigorous and complex subsequent activities, which typically require quantitative reasoning. Besides helping reduce science anxiety, this design aims to better prepare future K-8 teachers whose science training occurs primarily in general studies courses. Future teachers can easily revision the introductory activities they encounter in Discovery for use in K-8 classrooms.

Besides content mastery and skills building, Discovery will leave students with an appreciation for the vast scope of scientific inquiry and how even seemingly unrelated fields of natural science contribute to our understanding of the everyday world around us.

Course Number
BIO 112

Course Title
Discovery - Why Sex?

Credits
4

Prerequisites
- None

Faculty

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Office: ISTB 1 room 309
Office hours: Friday, 4:15 - 5:15 (ISTB 1 room 309) or arrange other times for in-person or Skype chats by e-mailing me for an appointment.

Course Description
Why? is a question that animates the youngest of children to the most seasoned of scientists. The acts of asking and answering *Why?* highlight the integrated nature of scientific knowledge and discovery. This course focuses on the question *Why Sex?*
One might think that this question can be answered fairly easily by experts in biology. But, as this course demonstrates, scientific disciplines are not walled cities in which knowledge is neatly segregated from lines of inquiry and knowledge in other disciplines. Instead, scientific concepts weave throughout and between disciplines and scientists increasingly rely on colleagues from different scientific fields to find answers to scientific questions. So our journey to find responses to the question *Why Sex?* will take us not just to biology, but also to earth science, to physics and to chemistry. Along the way, we will also find that scientists are linked together not only through concepts that crosscut the disciplines, but also in their reliance upon key scientific skills such as the ability to observe, think critically, measure, gather data, and communicate their findings.

Course Developers
Meredith Turnbough, Research Assistant Professor
David Pearson, Research Professor, School of Life Sciences
Steven Semken, Associate Professor of Geology, School of Earth and Space Exploration

Course Goals
This course aims to strengthen students' understanding of science as a process of inquiry driven by the formulation of questions that can be answered empirically through the analysis and interpretation of data. The course also aims to strengthen students' grasp of science content in the Physical, Life, and Earth and Space Sciences with the goal of building science literacy among non-science major undergraduates in general, and prospective elementary and middle school teachers in particular.

Course Objectives
1. Show how the scientific method is used within and beyond the sciences for problem solving and develop skills competency relevant to scientific inquiry, including:
a. The ability to recognize dimensional quantities and use appropriate units in scientific applications of mathematical formulas and graphs; (SEP5)
b. The ability to analyze and interpret data using tools such as tables, charts, and graphs and to summarize and display data. (SEP4)
2. Introduce reproductive processes, both sexual and asexual
3. Identify and explain how both abiotic and biotic environmental factors influence populations of organisms over multiple generations and their reproductive processes and behavior, including:
a. How the tilt of the Earth and annual climates affect sex; (EES1B)
b. How factors such as competition for resources (food, habitat), predation, and disease affect reproduction and how each contributes to natural selection.
4. Introduce students to the concept of energetics as it applies to living systems.
5. Expose students to the concept of genetic diversity and its importance.
6. Explain how single-celled organisms that reproduce asexually maintain genetic diversity

Learning Outcomes
By the end of this course, students will be able to:

- Use the scientific method and demonstrate how it helps people problem solve.
- Discuss measurement, size scales, and orders of magnitude.
- Compare/ contrast asexually reproducing population dynamics with those of sexually reproducing populations.
- Draw connections between the abiotic (nonliving) and biotic (living) factors in the world around us and reproductive patterns.
- Demonstrate how thermodynamics applies to living systems.

Course Topics, Schedule, & Grading
Activities used for instruction and assessment of learning include: Lab Reports, Discussion Board Participation, and Content Mastery Quizzes.

MODULE	TOPICS	ACTIVITIES/ASSIGNMENTS **Initial discussion board posts and lab reports due by 11:59pm on the Friday during the module.** **Follow-up discussion board posts and quizzes due by 11:59pm on the Monday following the module.** **ALL DUE TIMES/DATES ARE ALIGNED WITH THE TIME/DATE IN PHOENIX, ARIZONA, USA.**	DATES
MODULE 1: Why?	Welcome! (video) Getting at *Why? (video lecture)* What is DNA? (animated video) Story Time (video lecture) Why Measure? (video lecture) Decoding scientific publications (video lecture) The mystery of the tiger beetle turret (virtual field trip)	Discussion Board 1 - Introduce yourself! (4 pts) Initial post (1.1) due Oct 17. Follow up (1.2) due Oct. 19th. Lab 1 : Science Detectives : Training Room Escape (5 pts) Due Oct 17 Lab 2 : Graph Jam (5 pts) Due Oct. 19 Quiz 1 (4 pts) Due Oct. 19th	Oct 12-19
MODULE 2: Sex, No Sex or Both?	Asexual reproduction (video lec.) Sexual reproduction (video lec.) What is evolution? (animated video) Why sex? (video from SciShow) Lab manual exploration	Discussion Board 2 - Scientific Literature (4 pts) Initial post (2.1) due Oct. 22. Follow up (2.2) due Oct. 26. Lab 3 : Preparing for Lizard Island (5 pts) Due Oct. 22 Quiz 2 (4 pts) Due Oct. 26.	Oct. 20-26
MODULE 3: Sex is affected by *what*? - Abiotic Factors	Exploring the factors that shape the reproduction of organisms Physical Controls on Life Pt. 1 (video lec.) Physical Controls on Life Pt. 2 (video lec.) How do seasons and climate impact sex? (video lec.)	Discussion Board 3 (4 pts) Initial post (3.1) due Oct 29. Follow up (3.2) due Nov 2. Lab 4 : Seasons : Tilt, Orbit and Temperature. (5 pts) Due Oct. 29 (4 pts.) Quiz 3 (4 pts) Due Nov. 2.	Oct. 27-Nov. 2

MODULE 4: Sex is affected by *what*? - Biotic Factors	Mating systems (video lec.) All things considered - summary (discussion) Lab manual exploration	Discussion Board 4 (4 pts.) Initial post (4.1) due Nov. 5. Follow up (4.2) due Nov. 9. Lab 5 : Due Nov. 5 Peppered Moths Candy - coated Predation (5 pts) Quiz 4 (4 pts) Due Nov 9	Nov 3-9
MODULE 5: Sex is (energetically) expensive!	It takes energy to organize (video lec.) Energy in life (video lec.) Metabolic studies (video lec.) Lab manual exploration	Discussion Board 5 (4 pts) Initial post (5.1) due Nov. 12. Follow up (5.2) due Nov 16. Lab 6 - Chemical energy and lizard push ups (5 pts) Due Nov. 12. Quiz 5 (4 pts) Due Nov 16.	Nov. 10-16
MODULE 6: Why/Why NOT Sex?	Why NOT Sex? (video lec.) Genetic variation and coevolution (video lec.) If sex is so expensive, why is it so common? (video lec.) Hypotheses revisited (discussion)	Discussion Board 6 (4 pts) Initial post (6.1) due Nov. 19. Follow up (6.2) due Nov. 23. Lab 7 : Lizard Island - The fate of the population is in your hands. (5 pts) Due Nov. 19. Quiz 6 (4 pts) Due Nov. 23.	Nov 17-23
MODULE 7: How do bacteria do it?	What about the microbial world? (video lec.) Reproductive Race (video) What about genetic diversity? (video lec.) Mitochondria and chloroplasts (video lec.) Context is everything (discussion)	Discussion Board 7 (4 pts) Initial post (7.1) due Nov. 26 Follow up (7.2) due Nov. 30. Lab 8 : Sports Cars, Cadillacs and...bacteria? (5 pts) Due Nov. 26. Quiz 7 (4 pts) Due Nov. 30.	Nov. 24-Nov. 30

Grading

Grade	Percentage	Points Range
A	90 – 100%	90 – 100+
B	80 – 89%	80 – 89
C	70 – 79%	70 – 79
D	60 – 69%	60 – 69
E/F	Below 60%	60 and below

Grading Procedure

Grades reflect your performance on assignments and adherence to deadlines. Graded assignments will be available in the Gradebook.

Assignments and Grading

1. Lab Reports (49%)

Module lab report assignments will draw from multiple pedagogies, including multiple choice, inquiry - based questions requiring information literacy skills, and problems structured around learning progression. The content of these questions will span the Life, Physical and Earth and Space Sciences, with an emphasis on developing students' skills reading graphs, conducting dimensional analyses, understanding basic statistical terms such as probability and significance and analyzing and interpreting data. Lab reports will be due by 11:59 pm on the Wednesday during the module.

2. Discussion Board Participation (25.5%) Students will be asked to contribute posts of defined length and content. Unless otherwise noted, discussion board assignments will consist of an initial post due by 11:59pm on the Wednesday during the module and a follow-up post due by 11:59pm on the Sunday of the week of the module. I encourage you to make your discussion board posts well before the deadline to improve the quality of the discussion.
3. Content Mastery Quizzes (25.5%) There will be one quiz per Module covering the assigned content to allow the students to demonstrate content mastery. Quizzes must be taken by 11:59 pm on the Sunday the week of the module.
4. Syllabus Quiz - Please read the syllabus. The rest of the course content will not be available until you get 100% on the syllabus quiz.
5. Note: All due dates are given in local time for Phoenix, Arizona, USA

Lab Reports	49%
Discussion Board Participation	25.5%
Content Mastery Quizzes	25.5%
Syllabus Quiz	
Total	100%

Required Materials and Activities:
Students will access course content via a series of weekly course readings, video lectures, powerpoint presentations, virtual field trips and scientific simulations posted on the course homepage in the course management system. Readings will be chosen from reputable scientific journals and the Public Library of Science and/or will be created by participating instructors as needed.

Communicating With the Instructor
This course uses a discussion board called "Hallway Conversations" for general questions about the course. Prior to posting a question, please check the syllabus, announcements, and existing posts. If you do not find an answer, post your question. **You are encouraged to respond to the questions of your classmates.**

Email questions of a personal nature to your instructor. Although there are multiple lecturers in the course, Dr. Shaffer is your primary contact. You can expect a response within 48 hours.
Online Course
This is an online course. There are no face-to-face meetings.

Email and Internet
ASU email is an official means of communication among students, faculty, and staff. Students are expected to read and act upon email in a timely fashion. Students bear the responsibility of missed messages and should check their ASU-assigned email regularly.
All instructor correspondence will be sent to your ASU email account.

Course Time Commitment
This four-credit course requires approximately 135 hours of work. Please expect to spend around 18 hours each week preparing for and actively participating in this course.

Late or Missed Assignments
Notify the instructor **BEFORE** an assignment is due if an urgent situation arises and the assignment will not be submitted on time. Published assignment due dates (Arizona Mountain Standard time) are firm. Please follow the appropriate University policies to request an accommodation for religious practices or to accommodate a missed assignment due to University-sanctioned activities.

Submitting Assignments
All assignments, unless otherwise announced, MUST be submitted to the designated area of LearningStudio. Do not submit an assignment via email.

Drop and Add Dates/Withdrawals
This course adheres to a compressed schedule and may be part of a sequenced program, therefore, there is a limited timeline to drop or add the course. Consult with your advisor and notify your instructor to add or drop this course. If you are considering a withdrawal, review the following ASU policies: Withdrawal from Classes, Medical/Compassionate Withdrawal, and a Grade of Incomplete.

Grade Appeals
Grade disputes must first be addressed by discussing the situation with the instructor. If the dispute is not resolved with the instructor, the student may appeal to the department chair per the University Policy for Student Appeal Procedures on Grades.

Student Conduct and Academic Integrity
Academic honesty is expected of all students in all examinations, papers, laboratory work, academic transactions and records. The possible sanctions include, but are not limited to, appropriate grade penalties, course failure (indicated on the transcript as a grade of E), course failure due to academic dishonesty (indicated on the transcript as a grade of XE), loss of registration privileges, disqualification and dismissal. For more information, seehttp://provost.asu.edu/academicintegrity. Additionally, required behavior standards are listed in the Student Code of Conduct and Student Disciplinary Procedures, Computer, Internet, and Electronic Communications policy, and outlined by the Office of Student Rights & Responsibilities. Anyone in violation of these policies is subject to sanctions.
Students are entitled to receive instruction free from interference by other members of the class. An instructor may withdraw a student from the course when the student's behavior disrupts the educational process per Instructor Withdrawal of a Student for Disruptive Classroom Behavior.
Appropriate online behavior (also knows as *netiquette*) is defined by the instructor and includes keeping course discussion posts focused on the assigned topics. Students must maintain a cordial atmosphere and use tact in expressing differences of opinion. Inappropriate discussion board posts may be deleted by the instructor.
The Office of Student Rights and Responsibilities accepts incident reports from students, faculty, staff, or other persons who believe that a student or a student organization may have violated the Student Code of Conduct.

Prohibition of Commercial Note Taking Services
In accordance with ACD 304-06 Commercial Note Taking Services, written permission must be secured from the official instructor of the class in order to sell the instructor's oral communication in the form of notes. Notes must have the notetaker's name as well as the instructor's name, the course number, and the date.

Course Evaluation
Students are expected to complete the course evaluation. The feedback provides valuable information to the instructor and the college and is used to improve student learning. Students are notified when the online evaluation form is available.

Syllabus Disclaimer
The syllabus is a statement of intent and serves as an implicit agreement between the instructor and the student. Every effort will be made to avoid changing the course schedule but the possibility exists that unforeseen events will make syllabus changes necessary. Please remember to check your ASU email and the course site often.

Accessibility Statement
In compliance with the Rehabilitation Act of 1973, Section 504, and the Americans with Disabilities Act as amended (ADAAA) of 2008, professional disability specialists and support staff at the Disability Resource Center (DRC) facilitate a comprehensive range of academic support services and accommodations for qualified students with disabilities.

Qualified students with disabilities may be eligible to receive academic support services and accommodations. Eligibility is based on qualifying disability documentation and assessment of individual need. Students who believe they have a current and essential need for disability accommodations are responsible for requesting accommodations and providing qualifying documentation to the DRC. Every effort is made to provide reasonable accommodations for qualified students with disabilities.
Qualified students who wish to request an accommodation for a disability should contact the DRC by going to https://eoss.asu.edu/drc, calling (480) 965-1234 or emailing DRC@asu.edu. To speak with a specific office, please use the following information:

ASU Online and Downtown Phoenix Campus
University Center Building, Suite 160
602-496-4321 (Voice)

Polytechnic Campus
480-727-1165 (Voice)

West Campus
University Center Building (UCB), Room 130
602-543-8145 (Voice)

Tempe Campus
480-965-1234 (Voice)

Computer Requirements
This course requires a computer with Internet access and the following:

- Web browsers (Chrome, Internet Explorer, Mozilla Firefox, or Safari)
- Adobe Acrobat Reader (free)
- Adobe Flash Player (free)
- Microphone (optional) and speaker

Technical Support
This course uses Blackboard to deliver content. It can be accessed through MyASU at http://my.asu.edu or the Blackboard home page athttps://myasucourses.asu.edu
To monitor the status of campus networks and services, visit the System Health Portal at http://syshealth.asu.edu/.
To contact the help desk call toll-free at 1-855-278-5080.

Student Success
This is an online course. To be successful:

- check the course daily
- read announcements
- read and respond to course email messages as needed
- complete assignments by the due dates specified
- communicate regularly with your instructor and peers
- create a study and/or assignment schedule to stay on track