

WSU Five-Year Program Review
Self-Study

Cover Page

Department/Program: Zoology

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Brief Introductory Statement

The Department of Zoology includes: (1) courses for non-science majors that fulfill the life-science general-education requirement, (2) lower-division courses that are service courses for science and non-science majors pursuing careers in medicine (some fulfilling life-science general education requirements), (3) lower-division courses in Zoology for Zoology and other science majors (some fulfilling life-science general education requirements), and (4) upper-division courses in Zoology for Zoology and other science majors. Courses are diverse and emphasize both important zoological content and practical skills relevant to careers in the sciences. Most courses in categories 2 to 4 include laboratories that provide high-impact experiences. Faculty members are well-qualified, and students overall indicate teaching in the department is better or much better than average (based on student course evaluations, available in annual reports of faculty). Enrollment, number of graduates, and student-faculty ratio remained relatively stable during the review period (Table below). The number of graduates spiked recently, culminating in very high number recorded in 2021-22, a year in which Zoology had the highest number of majors and graduates in the College of Science. Zoology typically has the highest number of majors and graduates in the College of Science. The proportion of Zoology majors that are female exceeded males in every year, dramatically increased during the review period, and are presently almost 2:1 (Table below).

Zoology	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022
Student Credit Hours Total ¹	9,780	9,747	10,416	9,819	8,644
Student FTE Total ²	326.0	324.9	347.2	327.3	288.1
Student Majors ³	340	352	412	413	386
Second Major or Concentration	59	60	56	55	45
Minors	25	33	26	30	35
Program Graduates ⁴					
Associate Degree	0	0	0	0	0
Bachelor Degree	46	37	36	32	60
Student Demographic Profile ⁵					
Female	218	216	276	273	253
Male	122	136	136	140	133
Faculty FTE Total ⁶	16.86	15.1	16.37	16.29	N/A
Adjunct FTE	4.28	4.48	5	5.4	N/A
Contract FTE	12.58	10.62	11.37	10.89	N/A
Student/Faculty Ratio ⁷	19.34	21.52	21.21	20.09	N/A

Faculty work closely with students, especially in the laboratories, as well as in independent research. The department has a long-history of successful mentoring of undergraduates in research, grant-writing, presenting at conferences, and writing manuscripts (see lists below).

Standard A - Mission Statement

Mission

The Department of Zoology provides accessible, engaging, and relevant educational opportunities, resources, and expertise in all facets of animal biology and associated life sciences.

Values

- Encourage freedom of exploration in the life sciences.
- Serve diverse students at varied levels of engagement in animal biology including general education courses, support courses for non-zoology degrees across campus, and a diversity of courses relevant for careers in the sciences.
- Involve students in active research and community service.
- Through research and service, contribute new knowledge within fields of zoology and related life sciences.
- Through engaging coursework and independent instruction, confer skills in problem solving, critical thinking, communication, and disciplinary methods, which facilitate productive futures for Zoology students and, especially, Zoology graduates.
- Strengthen life-science education and practice across Weber State University and throughout associated communities along the northern Wasatch Front metropolitan areas of Weber, Davis, and surrounding counties.

Standard B - Curriculum

1. Types of degrees offered

The Zoology Department offers a BS degree, a minor, and participates in an interdisciplinary AS in Biology (along with the Departments of Botany and Microbiology)

The BS in Zoology is designed around courses rather than credits, and consists of eight required zoology classes (28 credits), four required upper-level elective classes (12-16 credits), Experience in Zoology (2 credits taken from 10 options), and additional classes outside of the department. These include one year of General Chemistry (10 credits), one Physics class (3 or 5 credits), one Math class (3/4/5 credits), one Statistics class (3 credits), and four classes (“Elective Support Classes”) taken from a list of 30 classes across eight departments (see major advising sheet in appendix). In 2020, the Department removed a required minor; students can select their additional classes among the 30 support classes to help focus specific classes that apply to career plans. Students may, and continue to select a minor program but one is no longer required.

The Department offers a minor in Zoology, that has three required classes (Zool 1110, 2220 & 3720) and eight additional credits above the 2000-level (see minor advising sheet in appendix).

2. Courses offered

The Zoology Department has a one-year sequence of introductory classes (Zool 1110: Principles of Zoology, and Zool 2220: Diversity of Animals). The former is a prerequisite for the latter. Once these are completed, students can take most of the upper-level classes. These include required classes in Evolution, Genetics, Ecology, Cell Biology, Comparative Physiology, and a (variable-topic) Seminar, which are offered every Fall and Spring semesters. Students are also required to take four elective classes, which are mostly offered in an alternate Spring/Fall rotation. These courses include regular offerings of our “ology” series of classes, including Mammalogy, Ornithology, Herpetology, Ichthyology, Entomology, and Parasitology. Other specialty classes include Animal Behavior, Marine Ecology, Aquatic Ecology, Wildlife Ecology and Management, Zoogeography and Conservation Biology. Our classes that may be of interest for more pre-professionally-oriented students include: Histology, Embryology, Biology of Cancer, Endocrinology, Comparative Anatomy, Advanced Human Physiology, and Research Applications in Genetics. A variable-title “Topics in Zoology” is also offered regularly and makes it possible for faculty to design new specialty courses that can eventually be converted into new classes.

All required classes (as well as all General Education classes) are offered every Fall and Spring Semester, with some offered during the Summer (based on faculty interest). Electives are offered on a rotating schedule with some offered every Spring (e.g., Mammalogy, Ornithology) or Fall (e.g., Herpetology, Aquatic Ecology). Other classes are offered within 1.5-2 years, depending on faculty availability. The release time of some faculty as well as sabbaticals makes flexible scheduling necessary. Students are encouraged to meet with the chair to plan upcoming semester schedules so that they can “catch” a needed class while they are still enrolled.

The department recognizes that the required and elective classes represent thorough coverage of our required and elective options. Periodically faculty will offer experimental classes that have been converted into actual classes. These are typically presented as “Topics in Zoology - Zoology 4700” and recent examples of this are “Biology of Cancer,” “Marine Ecology,” and “Animal Locomotion.”

Our “Experience in Zoology” part of the degree requires students to get “unique” experiences. Students can fulfill this requirement as an Anatomy or Physiology Lab Instructor (Zool 3099 or Zool 4820), or by doing independent study or undergraduate research (Zool 4800/4830), or by doing an internship or employment in a relevant field (Cooperative Work Experience, Zool 4890).

Zoology Program (Non-general education) Curriculum Map 2017-2022

A=Assessed Comprehensively		Learning Outcomes												
Number	Title	Hours	Concepts						Competencies					
			Evolution	Cellular Organization	Genetics	Ecosystems	Structure and Function	Systems Regulation	Process of Science	Quantitative Reasoning	Communication	Science and Society		
Required														
ZOOL 2220	Diversity of Animals	4	U	-	-	-	-	I	-	I	U	U	I	I
ZOOL 3200	Cell Biology	4	U	A	U	-	-	A	-	E	A	A	A	-
ZOOL 3300	Genetics	4	A	E	A	-	-	E	-	-	A	A	U	U
ZOOL 3450	Ecology	4	I	-	-	-	A	-	-	A	U	A	A	E
ZOOL 3600	Comparative Physiology	4	U	A	U	E	-	A	-	A	A	A	A	U
ZOOL 3720	Evolution	3	A	-	-	E	E	E	-	-	A	I	A	A
ZOOL 4990	Seminar	1	-	-	-	-	-	-	-	-	A	-	A	A
Elective (4 required)														
ZOOL 3470	Zoogeography	3	U	-	-	-	E	-	-	E	A	-	A	-
ZOOL 3500	Conservation Biology	3	U	-	-	I	U	I	-	I	I	U	U	E
ZOOL 3730	Population Biology													
ZOOL 3820	Biology of Cancer													
ZOOL 4050	Comparative Vertebrate Anat	4	A	-	-	-	-	A	-	-	-	-	-	-
ZOOL 4100	Vertebrate Embryology	4	A	-	-	I	-	A	-	-	-	-	-	-
ZOOL 4120	Histology	4	-	A	-	-	-	A	-	-	-	-	-	-
ZOOL 4210	Advanced Human Physiology	4	-	U	I	-	-	A	-	A	A	U	A	I
ZOOL 4220	Endocrinology	4	-	U	I	-	-	A	-	A	A	U	A	I
ZOOL 4250	Radiation Biology*	4												
ZOOL 4500	Parasitology	4	E	E	-	E	E	E	-	-	U	U	U	-
ZOOL 4600	Protozoology*	4												
ZOOL 4300	Research Applications in Genetics	4	I	E	A	-	-	I	-	-	U	A	E	U
ZOOL 4350	Animal Behavior	4	U	-	I	-	-	I	-	-	A	A	U	-
ZOOL 4470	Wildlife Ecology & Management	4	E	-	-	-	A	-	-	A	A	A	A	A
ZOOL 4480	Aquatic Ecology	4	E	-	-	-	A	E	-	A	A	A	A	E
ZOOL 4490	Marine Ecology	4												
ZOOL 4640	Entomology	4	I	-	-	-	I	A	-	-	-	-	-	-
ZOOL 4650	Ichthyology	4	A	-	U	-	-	A	-	E	A	A	A	A
ZOOL 4660	Herpetology	4	E	-	U	A	-	E	-	-	E	-	A	A
ZOOL 4670	Ornithology	4	U	-	-	E	U	A	-	E	U	E	A	A
ZOOL 4680	Mammalogy	4	A	-	U	-	-	A	-	-	A	A	A	A
Elective Support Course														
ZOOL 2100	Human Anatomy	4	-	I	-	-	-	I	-	-	-	-	-	-

Ratings: I = Introduced, E = Emphasized, U = Utilized, A = Assessed comprehensively

The Curriculum Map for the major has been reviewed and is being revised beginning Spring 2023 semester. The new version is shown below:

		RATINGS				ZOOLOGY							
		I=Introduced											
		E=Emphasized											
		A=Assessed Comprehensively											
						Learning Outcomes							
						Concepts				Competencies			
Number	Title	Hours	Evolution	Cellular Organization	Genetics	Ecosystems	Structure and Function	Systems Regulation	Process of Science	Quantitative Reasoning	Communication	Science and Society	
Required													
ZOOL 220	Diversity of Animals	4	A				A	I		E		E	
ZOOL 320	Cell Biology	4		A	E		E	I	A		E		
ZOOL 330	Genetics	4	A	E	A				E	A			
ZOOL 340	Ecology	4	I			A		A	E	A	A	E	
ZOOL 360	Comparative Physiology	4	E	A			A	A	A	A	A		
ZOOL 370	Evolution	3	A		E		E				E	A	
ZOOL 499	Seminar	1							A		A		
Elective (4 required)													
ZOOL 347	Zoogeography	3	A			A			E		A		
ZOOL 350	Conservation Biology	3				A		E			A	A	
ZOOL 373	Population Biology	3	A		E					A			
ZOOL 382	Biology of Cancer	3		A	A			A	A		E	A	
ZOOL 405	Comparative Vertebrate Anatomy	4	A				A				E		
ZOOL 410	Vertebrate Embryology	4	E		E		A				A		
ZOOL 412	Histology	4			E		A				A		
ZOOL 421	Advanced Human Physiology	4		A			A	A	E		E		
ZOOL 422	Endocrinology	4		A			A	A	E		E		
ZOOL 450	Parasitology	4	E			I	A					A	
ZOOL 430	Research Applications in Genetics	4			A			E	A		E		
ZOOL 435	Animal Behavior	4	A				E		A		E		
ZOOL 447	Wildlife Ecology & Management	4	E			A		A	E	A	E		
ZOOL 448	Aquatic Ecology	4				A	E		A	E			
ZOOL 449	Marine Ecology	4	E			A	E		E		I	I	
ZOOL 464	Entomology	4	E		E	A			I			A	
ZOOL 465	Ichthyology	4	A				A		E				
ZOOL 466	Hespetology	4	E			A			I		A		
ZOOL 467	Ornithology	4	A		I	E	A	E	E		I	I	
ZOOL 468	Mammalogy	4	A				A		A		A		
Elective Support Course													
ZOOL 210	Human Anatomy	4		A			A						

The Zoology major classes are divided into required classes, elective classes, and support classes. All are assessed, and the required classes have a thorough assessment plan, as the learning concepts and Spring competencies are basic to the zoology criteria. The department has reviewed these (Fall 2022) and will be implementing a new, more focused grid, starting Spring semester 2023

(see new grid above). In this revision, we are using 3 levels of assessment competency (introduced, emphasized, assessed comprehensively), which more accurately represents the level of content in these classes.

In the revised grid, for required classes, every concept is assessed comprehensively at least once, and each class is assessed over a minimum of 3 concepts. All electives are assessed comprehensively in at least one concept category, and all assessed over a minimum of 2 categories.

For competencies, each required course is assessed in 2 categories, and most are assessed comprehensively. All upper division required courses are assessed comprehensively in at least one competency.

All electives are assessed in at least 1 competency, most in 2, and most classes assess 1 competency comprehensively.

Standard C - Student Learning Outcomes and Assessment

A. Measurable Learning Outcomes – Zoology Major Courses (Non-general Education)

CORE CONCEPTS

1. **EVOLUTION:** The diversity of life is the result of mutation, adaptation, and selection pressure over time.
2. **CELLULAR ORGANIZATION:** All living things consist of one or more cells, the units of structure, function, and reproduction.
3. **GENETICS:** All living things share basic genetic mechanisms, which are responsible for the organization and continuity of life.
4. **ECOSYSTEMS:** All organisms are interconnected, interacting with each other as well as with their dynamic environment.
5. **STRUCTURE AND FUNCTION:** There is a relationship between molecular and organismal structure and function.
6. **SYSTEMS REGULATION:** Biological systems are governed by chemical transformations and homeostasis.

CORE COMPETENCIES

1. **THE PROCESS OF SCIENCE:** Students will use observational strategies to test hypotheses and critically evaluate experimental evidence.
2. **QUANTITATIVE REASONING:** Students will represent diverse experimental data sets graphically and apply statistical methods to them.
3. **COMMUNICATION:** Students will explain scientific concepts to different audiences and work collaboratively to explore biological problems.
4. **SCIENCE AND SOCIETY:** Students will develop biological applications to evaluate and address societal problems.

B. Measurable Learning Outcomes – Zoology General Education Courses

FOUNDATIONS OF THE NATURAL SCIENCES

After completing the natural sciences general education requirements, students will demonstrate their understanding of general principles of science:

1. NATURE OF SCIENCE. Scientific knowledge is based on evidence that is repeatedly examined and can change with new information. Scientific explanations differ fundamentally from those that are not scientific.
2. INTEGRATION OF SCIENCE. All natural phenomena are interrelated and share basic organizational principles. Scientific explanations obtained from different disciplines should be cohesive and integrated.
3. SCIENCE AND SOCIETY. The study of science provides explanations that have significant impact on society, including technological advancements, improvement of human life, and better understanding of human and other influences on the earth's environment.
4. PROBLEM SOLVING AND DATA ANALYSIS. Science relies on empirical data, and such data must be analyzed, interpreted, and generalized in a rigorous manner.

THE LIFE SCIENCES

Students will demonstrate their understanding of the following characteristics of life:

1. LEVELS OF ORGANIZATION: All life shares an organization that is based on molecules and cells and extends to organisms and ecosystems.
2. METABOLISM AND HOMEOSTASIS: Living things obtain and use energy and maintain homeostasis via organized chemical reactions known as metabolism.
3. GENETICS AND EVOLUTION: Shared genetic processes and evolution by natural selection are universal features of all life.
4. ECOLOGICAL INTERACTIONS: All organisms, including humans, interact with their environment and other living organism

a. General Education Outcomes (if applicable)

This program supports General Education in the following area(s)

- | | | | | |
|------------------------------|-------------------------------|--|-----------------------------|-----------------------------|
| <input type="checkbox"/> AI | <input type="checkbox"/> Comp | <input type="checkbox"/> IL | <input type="checkbox"/> QL | |
| <input type="checkbox"/> CA | <input type="checkbox"/> HU | <input checked="" type="checkbox"/> LS | <input type="checkbox"/> PS | <input type="checkbox"/> SS |
| <input type="checkbox"/> WSU | <input type="checkbox"/> DV | | | |

Provide a brief summary of the program's contribution to supporting, improving, and/or revitalizing the General Education program at WSU:

The Zoology Department offers 3 General Education classes that count as Life Science GenEd: Animal Biology (Zoology 1010), Human Biology (Zoology 1020) and Nature of Sex (1030). These are offered both in person and online (1030 is currently only offered online) and multiple sections are made available most semesters (typically through the use of adjuncts). Two other classes in the major also have LS GenEd designations: Principles of Zoology (Zoology 1110) and Human Physiology (Zoology 2200). Zoology 1110 is the major's introductory class, and is a required class taken by all zoology majors as well as some other majors (e.g., Microbiology, Botany, Earth and Environmental Sciences). Zoology 2200 is in the Elective Support Group of classes and counts towards the major in that block (4 classes are required; more than 30 classes, across 8 departments are options). It is taken by many of our pre-professional students as well as by

many students in the College of Health Professions. It too is offered every Spring and Fall semesters with Face-to-Face and online options.

General education Curriculum Map

Zoology Curriculum Map: General education Zoology courses

Number	Title	Hours	Natural Science				Life Science			
			1	2	3	4	1	2	3	4
General Education (Required course)										
ZOOL 1110	Principles of Zoology	4	✓	✓	✓	✓	✓	✓	✓	✓
General Education (Elective Support course)										
ZOOL 2200	Human Physiology	4	✓	✓	✓	✓	✓	✓	✓	✓
General Education (non-Major)										
ZOOL 1010	Animal Biology	3	✓	✓	✓	✓	✓	✓	✓	✓
ZOOL 1020	Human Biology	3	✓	✓	✓	✓	✓	✓	✓	✓
ZOOL 1030	The Nature of Sex	3	✓	✓	✓	✓	✓	✓	✓	✓

C. Neuroscience Minor

The Zoology Department has been involved in the (interdisciplinary) Neuroscience minor since its inception, with Barb Trask acting as Zoology representative, advisor, member of the advisory board, and teacher of “Introduction to Neuroscience” (NEUR 2050). In Fall 2018, the Zoology department hired Elizabeth Sandquist, who gradually took over in that role and now is the Neuroscience Club’s co-advisor (since Spring 2020), chair of the program’s curriculum committee (since Spring 2021), and research advisor for neuroscience students. She also now teaches the NEUR 2050 class.

A number of zoology classes count towards the neuroscience minor, and over the last 5 years, the numbers are as follows:

ZOOL	1020	1120	2100	2200	3200	3300	4820	3720
# enrolled	24	1	12	29	12	49	4	2

Zoology 3300 (Genetics) has the highest enrollment, and the Neuroscience Program has been covering the cost of a zoology professor to teach an additional (online) section of Genetics to help their students take this class.

Over the review period, 10 Zoology graduates had Neuroscience minors; currently 7 students are minoring in Neuroscience.

D. Environmental Sciences Major

The new Environmental Sciences (ENVS) major (started 2021) has a number of Zoology classes as part of its curriculum. These include core classes Zool 1110 & Zool 3450 (Ecology). In addition, students may take a number of zoology electives as part of their degree (i.e., Zool 3470, 3500, 4480, 4490, 4640, 4700-Toxicology). Collectively, 31 ENVS students have enrolled in Zoology classes thus far. These additional

students have not yet created a burden for our class enrollments. Should numbers increase, we may need additional resources to offer an additional section of Ecology one or both semesters (see Neuroscience Genetics section, above).

E. Biology A.S.

A relatively new Biology A.S. degree first appeared in the 2019/2020 Catalog and our Zoology 1110 class forms a base part of that (along with Microbiology 2054 and Botany 2104) in addition to relevant Chemistry and Math classes that prepare students to pursue any of the three Life Sciences majors. As of Fall 2022, 179 students have a Biology A.S. declared. Five have completed the degree and graduated.

F. Concurrent Enrollment (if applicable) N/A

B. Five-year Assessment Summary

[In this section you should provide a summary of your assessment findings and actions since your last program review. Annual assessment reports for each of those years can be found at https://www.weber.edu/ie/Results/Department_Results.html. Please be sure to include information from each of the four years prior to this report. If you do have data to report for the last academic year, evidence-of-learning grids can be included in appendix G.]

General Education Assessment

As seen in our last two biennial assessments, for general-education courses within the department, students met the life-science learning outcomes and assessment approaches were deemed sufficient. In specific cases where learning thresholds were not met for a particular goal in a given semester, faculty devised strategies to improve learning in subsequent semesters. Thus, regular assessment is informing instructors of areas needing improvement.

A common suggestion from the General Education Improvement and Assessment Committee (GEIAC) is to evaluate designated learning thresholds and increase them where reasonable. This re-assessment occurs regularly, with each biennial report, and in some cases, has resulted in increased thresholds (e.g., the threshold for Zool 1110 was increased from 65% in 2018 to 73% in 2020). It has also been recommended that each threshold should have an accompanying rationale. The department will continue to assess these thresholds on a course-by-course basis.

Other suggestions from the last biennial report were to potentially use two-dimensional learning thresholds in cases where one-dimensional thresholds are used, to provide sample questions as part of assessment reports, use multiple measures for all outcomes. The department will consider modifications to assessment practices going forward.

General education courses in the department have employed Signature Assignments since their inception on campus for Fall semester 2019. Examples of assignments are appended to this report for Zool 1010, Zool 1110, and Zool 2200.

Zoology Major Class Assessment

As seen in our last two biennial assessments, for zoology major courses, students met the learning outcomes, and our assessment approaches were deemed sufficient. Learning thresholds were raised from 68% to 72% between the 2019 and 2021 assessments, and these higher thresholds were consistently met. The department will continue to assess these thresholds on a course-by-course basis moving ahead to future assessment reports. Representative major class assessment data is appended at the end of the report.

Most faculty rely on a set of exam questions for assessing learning outcomes. In a number of cases, additional peer-review assignments were used in addition to exam questions.

Recommendations were made to consider outcome level assessment (e.g., for one year, focus on one competency and another year, focus another on quantitative reasoning, etc.). In addition, it was suggested to consider using ePortfolio platform that includes an assessment component. ePortfolio could be used to collect artifacts that represent student learning at various stages in the curriculum. Those artifacts can be assessed by a group of faculty on a specified schedule and/or point in the curriculum.

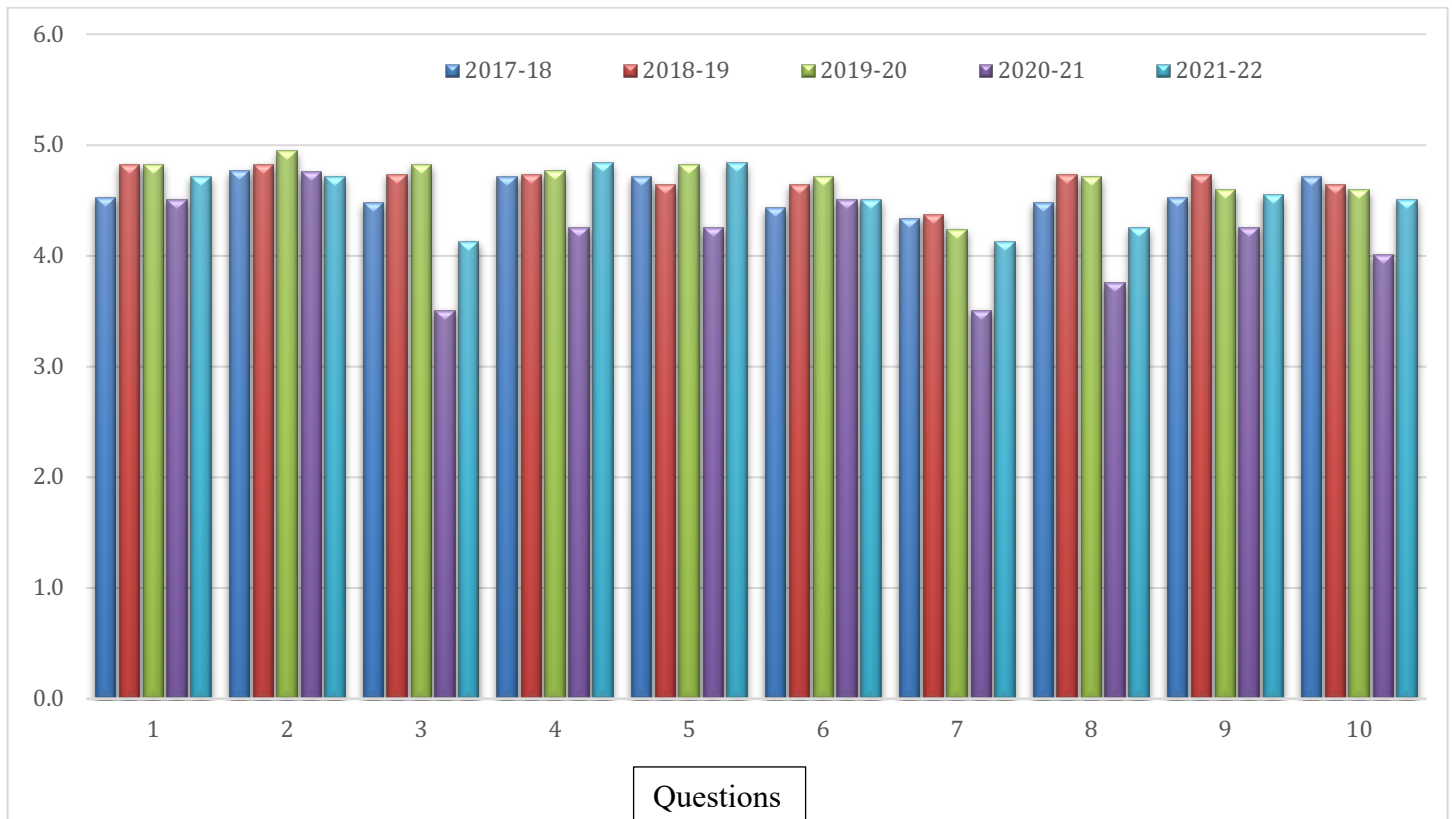
The department will consider modifications to assessment practices going forward.

Assessment of Graduating Students

Presently, we use an exit survey which is administered to the students in their last semester, at the time the department chair “signs-off” on their graduation (identifying that they have met all of the requirements for graduation). In the past we had used standardized test administered in our Zoology 4990 (Seminar) class but this was discontinued due to (1) cost, and (2) the fact that many students were not graduating (or even seniors) at the time of taking the seminar. Thus they weren’t really far enough along to assess their overall knowledge and skills. Since we do not offer a senior capstone class, there is no easy way to capture students in the last semester of their degree to assess competence at graduation. The department has discussed other options, such as ePortfolio, and we will discuss this and other possible future assessment tools for graduating students. A summary of the results of the last five years of exit question responses is presented below.

Graduate Exit Survey Questions (these align with our learning outcomes)

Question	Rating
	The same Somewhat better Much better
1. After completing my degree, my knowledge of the scientific method is:	1 2 3 4 5
	The same Somewhat better Much better
2. After completing my degree, my knowledge of evolution is:	1 2 3 4 5
	The same Somewhat better Much better
3. After completing my degree, my knowledge of genetics is:	1 2 3 4 5
	The same Somewhat better Much better
4. After completing my degree, my knowledge of the structure and function of animals is:	1 2 3 4 5
	The same Somewhat better Much better
5. After completing my degree, my knowledge of the organization of life, from molecules to ecosystems is:	1 2 3 4 5
	The same Somewhat better Much better
6. After completing my degree, my knowledge of ecology and the effect of humans on the biosphere is:	1 2 3 4 5
	Strongly disagree Neutral Strongly agree
7. My education in zoology has provided me with an awareness of career opportunities available in zoology.	1 2 3 4 5
	Strongly disagree Neutral Strongly agree
8. My education in zoology has prepared me for employment or for graduate or professional school.	1 2 3 4 5
	Strongly disagree Neutral Strongly agree
9. My education in zoology has provided me with an understanding of how scientific ideas are communicated.	1 2 3 4 5
	Strongly disagree Neutral Strongly agree
10. My education in zoology has enhanced my oral and written communication skills.	1 2 3 4 5
	Strongly disagree Neutral Strongly agree



Student responses over the 5-year review period were largely stable. Notably, values were somewhat lower during the height of COVID, when we were largely teaching via Zoom or online. A detailed look at the individual questions revealed that the question that had the lowest score consistently was number 7, regarding career opportunities. During Pre-COVID years, the department held regular seminars for students, many of which were career related. These seminars were strictly curtailed during COVID, and hopefully we will be able to start them up again and provide job opportunity information to our majors.

Success of Graduating Students

We do try to follow graduate success. Often students that get jobs, or get accepted to graduate schools inform various faculty (especially mentors). We are informed on the success of Pre-Medical and Pre-Dental students [latest 2021 data showed departmental acceptance rates for both (71% & 67%, respectively) were above the overall WSU acceptance rate (66.7% & 62.6) as well as the national average (41% & 54%)]. Other information is spotty, since it is via student corresponding with faculty "friends" or from lucky social media observations. Many students are now taking a "gap year" after their degree, which further time-separates them from the department and makes it more challenging to follow their progress. It would be valuable to determine an effective way to track graduate success.

Standard D - Academic Advising

Advising Strategy and Process

College of Science, General Education advising:

Students interested in science who have not yet declared a major are advised by Monica Linford and Emily Romo-Hendrix of the College of Science Academic Advisement Office. The mission of this office is to teach the purpose and value of higher education through one-on-one appointments, open orientation classes, provide opportunity for peer mentors through student clubs and organizations, and to help students select courses that will more efficiently prepare them for science majors. Once a student shows specific interest in zoology or a zoology-related field, Monica and Emily and their staff direct those students to the Department.

General zoology major advising:

Advising for Zoology majors has been restructured since the last program review. Although many Zoology majors declare their major upon enrollment, and thus are not subject to mandatory advising, all students who declare a major thereafter (meaning they must contact the Department to do so) are required to schedule an advising and orientation appointment with the Zoology New Major Advisor or the Department chair. With each student, the advisors review the coursework for the degree (including navigating the pre- and co-requisites for our introductory class (Zoology 1110), discuss career goals, and orient them to the Zoology curriculum and resources available in the Department. The advisors also direct them to other advisors within the department. Once these meetings are completed, permission is granted to declare a zoology major. Presently, Dr. Christopher Hoagstrom is the New Major Advisor. In addition, at the time the new semester schedule is viewable prior to registration, the department admin e-mails all majors to encourage them to schedule a meeting with the chair to plan their upcoming semester classes.

Pre-health-profession advising:

Students interested in health-related professions (e.g., physician, dentists, veterinarians, optometrists, chiropractors, podiatrists, pharmacists, physical and occupational therapists, and physician assistants) are directed to the staff pre-professional advisor (Dr. James Moore) who has expert knowledge in gaining entry into such programs. This type of advising is not specific to the Department of Zoology, because graduates with a variety of majors may apply to enter post-graduate professional schools.

Wildlife and Conservation Ecology advising:

Students interested in wildlife and natural resources are advised by Dr. John Cavitt. As part of this advising, Dr. Cavitt initiated a new student chapter of the Wildlife Society. The Wildlife Society's student chapters are composed of student and professional members of the Society. Based at college campuses across North America, these chapters establish their own locally focused objectives and have their own bylaws, officers, committees, and dues structure. The WSU chapter regularly hosts seminars by wildlife biologists.

Mentoring via Independent Study and Undergraduate Research activities:

Many students with Zoology majors and some students with majors in other departments engage in independent study courses and/or undergraduate research projects with members of the Zoology faculty. These students receive much informal advising via the professional relationship they establish with their mentors. All Zoology faculty members engage in mentoring students who are conducting undergraduate research.

Graduate School advising:

Students interested in pursuing graduate degrees (MS, PhD) are advised by Dr. Rebecka Brasso and Dr. Elizabeth Sandquist, who discuss the best way to find graduate programs and how to contact prospective graduate-research mentors. They hold a seminar each semester for interested students and have a Canvas page for graduate school resources.

Graduation Sign Off:

The Department of Zoology chair meets with all students early in the semester in which they plan to graduate. This serves as a last-call for advising. The chair ensures the student is qualified to graduate and discusses plans for attending graduation and for future endeavors. Information on future plans is recorded and students are encouraged to keep in touch as their future unfolds. This is the time that the exit survey (see above) is administered.

Zoology minor advising:

Students pursuing science degrees in other departments may choose Zoology as a minor. Dr. Nicole Berthélémy (who retired in 2022) served as advisor for such students. She ensured students are aware of minor requirements and discusses curriculum options with them as they relate to their academic and career goals. The current minor advisor (as of Summer 2022) is Dr. John Mull.

Bachelor of Integrated Studies advising:

Students pursuing a Bachelor of Integrated Studies (BIS) degree may choose Zoology as one of their areas of emphasis. The BIS degree is interdisciplinary, and majors select three areas or emphases (equivalent to having three minors). Students must work out a contract of courses to be taken for each area of emphasis by working with an advisor for each representative department. Dr. Brian Chung serves as BIS advisor for Zoology to help BIS majors determine courses that fit best with their other areas of emphasis and with their career goals.

Effectiveness of Advising

The Department does not currently assess effectiveness of advising. In general, students are very appreciative of advising and our present focus is to continue to increase and improve advising opportunities. Since implementing an e-mail solicitation of student advising to encourage majors to meet with the chair to schedule upcoming classes (begun in 2019) the chair has met with an average of 25 students prior to each semester's registration. An updated exit interview questionnaire will include questions on advising effectiveness and will be implemented beginning Spring semester 2023. The following questions will be asked:

Q I sought advising help from the College advisors (yes/no) and /or Zoology dept (yes/no). I did not seek advising []
Q I found advising helpful: College: 1 (low) 2 3 4 5 (hi) Department: 1 2 3 4 5 N/A []

Past Changes and Future Recommendations

As described above, advising has been re-structured such that all major and minor declarations made within the Department (i.e., post initial enrollment) require advising. We have also restructured our advising approach such that students are no longer assigned an advisor based on the alphabet. Instead, they are encouraged to select an advisor based on common areas of interest or based on their rapport with a specific professor after initial meetings with the Chair. In the second semester major's class, Zoology 2220 (Diversity of Animals), instructors review the advising sheet to direct students to specific advisors as they head into their upper-division classes. Speakers are also brought in to give presentation on a variety of career opportunities. This was curtailed during the height of COVID but will begin again.

Standard E - Faculty

Faculty Demographic Information

The Department of Zoology includes 13 full-time tenured or tenure-track faculty members with expertise in a breadth of topics. All have earned PhDs, representing 13 different North American universities (see table below). Ten faculty members are full professors.

Department of Zoology Full Time, Tenured Faculty

Name	Rank	Ph.D. granted by	Research (& Teaching) Emphasis
Berthélémy, Nicole*	Professor	Univ. California, Davis	Toxicology, Human Physiology (Physiology; Genetics)
Brasso, Rebecka	Assoc. Professor	Univ. North Carolina, Wilmington	Mercury Dynamics in Food Webs (Ecology; Marine Ecology)
Cavitt, John	Professor	Kansas State University	Avian Ecology, Wildlife Management (Ornithology; Ecology; Wildlife Ecology)
Chung, Brian	Professor	University of Calgary	Invertebrate Stress Response (Human Anatomy)
Clark, Jonathan	Professor	Ohio State University	Molecular Evolutionary Genetics (Genetics; Cell Biology)
Hoagstrom, Christopher	Professor	South Dakota State Univ.	Aquatic Ecology, Fish Biology (Aquatic Ecology, Ichthyology)
Marshall, Jonathon	Professor	Brigham Young University	Evolutionary Genetics; Herpetology (Genetics; Evolution; Herpetology)
Meyers, Ron	Professor	Brown University	Functional Evolutionary Morphology (Anatomy; Evolution; Histology)
Mull, John	Professor	Utah State University	Insect Ecology, Invertebrate Zoology (Ecology; Anim Behavior; Entomology)
Sandquist, Elizabeth	Asst. Professor	University of North Dakota	Stem Cell Regeneration (Cell Biology)
Skopec, Michele	Professor	University of Wisconsin	Physiology of Plant-Mammal Interactions (Physiology; Mammalogy)
Trask, Barbara Crippes	Professor	Washington Univ, Saint Louis	Molecular Cell Biology (Physiology; Cell Biology, Biology of Cancer)
Yesilyurt, Ezgi	Asst. Professor	Univ Nevada, Las Vegas	Life-science education (Life-science education)

*Retired at the end of 2022 academic year

Faculty in the Department have taken on leadership roles within the College of Science and across campus. Several of these include reductions in teaching load from the standard 12-hour assignments. This, in part, supports the hiring of adjunct faculty. These reassignments include:

1. John Cavitt, Director, Office of Undergraduate Research (6-hour reduction); Chair, University Curriculum Committee (3-hour reduction);
2. John Mull, Director, Ritchey Science Fair (3.5 hour-reduction) 2017-2019;
3. Barb Trask, Associate Dean College of Science (6-hour reduction);
4. Christopher Hoagstrom, Advisor, Environmental Sciences major (3-hour reduction) 2021-2022

The Department of Zoology also includes an Instructor with a Master's degree and nine adjunct professors (four PhDs, five Masters). All adjuncts have multiple semesters of teaching experience within the Department. Many are former students or retired faculty. Not all teach every semester.

Department of Zoology Full Time-Temporary and Adjunct Faculty 2017-2022

Name	Position	Degree	Institution
Brooks, Nicole	Adjunct	Masters	Clemson University
Gurr, Susan	Adjunct	Masters	Weber State University
Hoffman, Rosemary	Adjunct	Ph.D.	University of Mississippi Medical Center
Okazaki, Robert	Adjunct	Ph.D.	University of California, Santa Barbara
Pendleton, Maya	Adjunct	Masters	Utah State University
Pilcher, Brian	Instructor	Masters	Louisiana State University
Prothero, Walter	Adjunct	Masters	Utah State University
Robinson, Ami Sessions	Adjunct	Ph.D.	Southern Illinois University
Spainhower, Kyle	Adjunct	Masters	Youngstown State University
Zeveloff, Samuel	Adjunct	Ph.D.	University of Wyoming

Programmatic/Departmental Teaching Standards

Although there are no formal, written standards, certain educational values are adhered to. Student engagement is a high priority and a variety of methods are used to accomplish this. Class activities often emphasize skills fundamental to success in all fields of biology, such as experience with standard laboratory and field practices, written and oral communication, and use of scientific literature. The majority of courses address these goals in one way or another.

Most courses in the major include laboratories, and faculty expend considerable energy devising and administering laboratory activities. These activities include field trips and fieldwork experiences, laboratory experiments and observations, instruction in scientific methodologies, and student presentations and group projects. Faculty teach their own labs except in the cases of Human Anatomy (ZOOL 2100) and Human Physiology (ZOOL 2200), where students serve as lab instructors overseen by a professor.

There is a legacy of teaching excellence within the Department, with many faculty receiving various teaching awards and recognitions over decades. Within the last five years, Christopher Hoagstrom was recognized as a Brady Presidential Distinguished Professor (2020). Two faculty members (Brian Chung, 2020; Jon Marshall, 2022) were awarded the WSU Presidential Teaching Excellence Award. Two Zoology faculty members have received the WSU College of Science Dr. Spence L. Seager Distinguished Teaching Award (Michele Skopec, 2018; Jon Marshall, 2022). The legacy of these excellent teachers lives on in those award winners that remain in the Department as well as the faculty they and retired award winners have mentored.

Faculty Qualifications

	Tenure	Contract	Adjunct
Number of faculty with Doctoral degrees	13	-	4
Number of faculty with Master's degrees	-	1	5
Total	13	1	9

Faculty Scholarship

Scholarship is strong in the Department of Zoology. All faculty are actively engaged in research activities, including and especially research with undergraduate students. During the review period, Zoology faculty published 50 papers. Seven of these papers had undergraduate students as co-authors. These publications are listed below with faculty authors shown in **bold** and student authors in *bolded italics*.

In addition to publications, faculty and students are very active in giving presentations on and off campus, within the USA, and internationally. The number of such activities is too voluminous to provide here but is available in the curriculum vitae of departmental faculty (available upon request).

It is worth noting that research, publications, and presentations (especially) were greatly diminished during the height of the COVID-19 pandemic (2020-2022). We expect these numbers to increase as COVID restrictions loosen and faculty can again work with students and attend conferences.

- Balza U., **Brasso R.**, Lois, NA, Pütz, K, & Raya Rey A. (2021). The highest mercury concentrations ever reported in a South American bird, the Striated caracara (*Phalacrocorax auritus*). *Polar Biology* 44: 2189-2193.
- Benjamin T., **Brasso R.**, Midway S., Thompson D., & Harden, LA. (2018). Using non-destructive techniques to measure mercury (Hg) concentrations in gravid Blandings turtles (*Emydoidea blandingii*) in northeastern Illinois. *Bulletin of Environmental Contamination and Toxicology* 101: 295-299
- Brasso R.**, Rittenhouse, KA, & Winder, GL. (2020). Are wetlands hotspots for bioaccumulation of mercury for songbirds? *Ecotoxicology* 29: 1183-1194.
- Cruz-Lopez, M., Fernández, G., Hipperson, H., Palacios-Castro, E., **Cavitt, J.F.**, Galindo-Espinosa, D., Gómez del Angel, S., Pruner, R., Gonzalez, O., Morales, A., Burke, T., & Küpper, C. (2020). Allelic diversity and patterns of selection at the Major Histocompatibility Complex class I and II loci in a threatened shorebird, the Snowy Plover (*Charadrius nivosus*). *Evolutionary Biology* 20:114-129.
- Deniz, H., Kaya, E., **Yesilyurt, E.**, & Trabia, M. (2020). The influence of an authentic engineering design experience on elementary teachers' nature of engineering views. *International Journal of Technology and Design Education* 30: 635-656. <https://doi.org/10.1007/s10798-019-09518-4>
- Deniz, H., Kaya, E., **Yesilyurt, E.**, Newley, A., & Lin, E. (2021). Integrating Engineering, Science, Reading, and Robotics across Grades 3-8 in a STEM Education Era. *Journal of Learning and Teaching in Digital Age*, 6(1), 40-45

- Dodino S., Riccialdelli L., Polito MJ, Pütz K, **Brasso RL**, & Raya Rey A. (2021). Mercury exposure driven by geographic and trophic factors in Magellanic penguins from Tierra del Fuego. *Marine Pollution Bulletin*, 174: <https://doi.org/10.1016/j.marpolbul.2021.113184>
- Echelle, AA, Lang NJ, Borden, WC, Schwemm, MR, **Hoagstrom, CW**, Eisenhour, DJ, Mayden, RL, & Bussche, R. (2018). Molecular systematics of the North American chub genus *Macrhybopsis* (Teleostei: Cyprinidae). *Zootaxa* 4375:537-554.
- Ellis, K., **Cavitt, J.F.** & R. Larson. (2018). Using remote cameras to validate estimates of nest fates in shorebirds. *Ibis* 160:681-687.
- Ennen, JR, Agha, M, Sweat, SC, Matamoros, WA, Lovich, JE, Iverson, JB, Rhodin, AGJ, Thomson, RC, & **Hoagstrom CW**. (2021). A watershed moment: focusing in on sub-basins to focus the geography of turtle conservation across the globe. *Biological Conservation* 253:108925.
- Ennen, JR, Agha, M, Sweat, SC, Matamoros, WA, Lovich, JE, Rhodin, AGJ, Iverson, JB, & **Hoagstrom CW**. (2020). Turtle biogeography: Global regionalization and conservation priorities. *Biological Conservation* 241:108323.
- Ennen, JR, Matamoros, WA, Agha, M, Lovich, JE, Sweat, S, **Hoagstrom, CW**. (2017). Hierarchical, quantitative biogeographic provinces for all North American turtles and their contribution to the biogeography of turtles and the continent. *Herpetological Monographs* 31:142-168.
- Flowers D, Price-Sturgeon C, Rollin A, Schmidt D, Banford M, Collard C, Dearden M, Deem S, Dubose R, Faulkner M, Haney S, Hipolito K, Hughes H, Hunnel D, Johnson H, Mercer K, Miller C, Moran D, Pressley S, Pytlewski S, Sorenson G, & White A.** (2021). Investigating the effects of ocean acidification on adult oyster (*Crassostrea virginica*) shells. *Ergo*, 14-28.
- Hoagstrom, CW**, Bestgen, KR, Propst, DL, & Williams, JE. (2020). Searching for common ground between life and extinction. Pages 407-418 in DL Propst, JE Williams, KR Bestgen, CW Hoagstrom (eds). *Standing Between Life and Extinction*. University of Chicago Press.
- Hoagstrom, CW**, & Echelle, AA. (2022). Biogeography of the *Macrhybopsis aestivalis* complex (Teleostei: Cyprinidae): emphasis on speciation and ancient heterospecific mitochondrial transfer. *Environmental Biology of Fishes*, 105:261-287.
- Hoagstrom, CW**, Houston, D, & Mercado-Silva, N. (2020). Biodiversity, biogeography, and conservation of North American desert fishes. Pages 36-67 in DL Propst, JE Williams, KR Bestgen, CW Hoagstrom (editors). *Standing Between Life and Extinction*. University of Chicago Press.
- Hoagstrom, CW**, & Osborne, MJ.(2021). Biogeography of *Cyprinodon* Across the Great Plains-Chihuahuan Desert Region and Adjacent Areas. *Desert Fishes Council Special Publication* 2021:20-76.
- Hoagstrom, CW**, Xiang, L, Lewis-Rogers, N, Connors, PK, Sessions-Robinson, A, & **Mull, JF** (2019). A quantitative simulation of coevolution with mutation using playing cards. *American Biology Teacher* 81:127-132.
- Jackson, Josephine D'Urban, M. Bruford, T. Székely, J. DaCosta, M. Sorenson, S. Edwards, I. Russo, K. Maher, M. Cruz-Lopez, D. Galindo-Espinosa, A. DeSucre-Medrano, **J.F. Cavitt**, R. Pruner, A. Morales, O. Gonzalez, T. Burke, & C. Küpper. (2020). Population differentiation and historical demography of the threatened snowy plover *Charadrius nivosus*. *Conservation Genetics* 21:387-404.
- Jimenez, A, Schmalz, J**, Wright, MN, & **Skopec, MM**. (2020) Sagebrush characteristics influencing foraging patterns of pygmy rabbits. *Journal of Wildlife Management*. 84: 1306-1314.
- Kaya, E., Newley, A., **Yesilyurt, E.**, & Deniz, H. (2020). Measuring computational thinking teaching efficacy beliefs of preservice elementary teachers. *Journal of College of Science Teaching*, 49(6), 55-64.
- Leyte-Manrique, A., Hernández-Salinas, U., Ramírez-Bautista, A., Mata-Silva, V., & **Marshall, J.C.** (2017) Habitat use in eight populations of *Sceloporus grammicus* (Squamata: Phrynosomatidae) from the Mexican Plateau. *Integrative Zoology* 12:198-210
- Lois NA, Balza U, **Brasso R**, Dodino S, Pütz K, Polito MJ, Riccialdelli L, Ciancio J, Quillfeldt P, Mahler B, Raya Rey A. (2022). Mercury and stable isotopes portray colony-specific foraging grounds in southern rockhopper penguins over the Patagonian Shelf. *Marine Pollution Bulletin*, in press.

- MacGuigan, DJ, **Hoagstrom, CW**, Domisch, S, Hulseay, CD, & Near, TJ. (2021). Integrative ichthyological species delimitation: reconciling genetic, phenotypic, environmental, and biogeographic evidence in the Greenthroat Darter complex (Percidae: Etheostomatinae). *Zoologica Scripta* 50:707-733.
- Marshall, J.C.**, Bastiaans, E., Caccone, A., Camargo, A., Morando, M., Niemiller, M.L., Pabijan, M., Russello, M.A., Sinervo, B., Sites, J.W., Jr, Vences, M., Werneck, F.P., Wiens, J.J., & Steinfartz S. (2018) Mechanisms of speciation in reptiles and amphibians: A synopsis. *Peer J Prepr.* 6:e27279v1
- McCormick, A, Robertson MD, **Brasso R**, & Midway SR. (2020). Mercury concentrations in store bought shrimp. *Food Science and Nutrition* 8: 731-3737.
- Meyers, R.A.** (2019). Comparative anatomy of the postural mechanisms of the forelimbs of birds and mammals. *Journal of Ornithology* 160(3): 869-882.
- Molina, D., Cavitt, J.F.**, Carmona, R. & Cruz-Nieto, M. (2017). Non-breeding distribution, abundance and population structure of American Avocet (*Recurvirostra americana*, Gmelin 1789) in Marismas Nacionales, México. *Mexican Journal of Ornithology* 19(1):22-32.
- Mull, J.F.** & S. Zeveloff. (2021). Consumption of insect and plant exudates by mouse lemurs. *Frontiers in Ecology and Environment* 19: 282.
- Orr, TJ, Kitanovic, S, Schramm, KM, **Skopec, MM**, Wilderman, PR, Halpert JR, & Dearing, MD. (2020) Strategies in herbivory by mammals revisited: The role of liver metabolism in a juniper specialist, (*Neotoma stephensi*) and a generalist (*Neotoma albigula*). *Molecular Ecology.* 29: 1674-1683.
- Osborne MJ, Portnoy DS, Fields AT, Bean MG, **Hoagstrom CW**, & Conway KW. (2021). Under the radar: genetic assessment of Rio Grande Shiner (*Notropis jemezianus*) and Speckled Chub (*Macrhybopsis aestivalis*), two Rio Grande basin endemic cyprinids that have experienced recent range contractions. *Conservation Genetics* 22:187-204.
- Padilla N, Kendrick J, Evans G, Arbon J, Catalan C, & White A** (2018) Double-crested cormorants respond to fish stocking of rainbow trout in suburban ponds in northern Utah. *Utah Academy of Sciences, Arts, & Letters* 95, 31-42.
- Patel, B.B., Sharma, A.D., Mammadova, N., **Sandquist, E.** Uz, M., Mallapragada, S.K. & Sakaguchi, D.S. (2018) Nanoengineered biomaterials for retinal repair. In M. Mozafari, J. Rajadas, and D. Kaplan (eds.), *Advances in Nanoengineered Biomaterials for Regenerative Medicine*, (215-64). Elsevier. (Invited chapter)
- Ramírez-Bautista, A.; Sites, J.W. Jr.; **Marshall, J.C.**; Cruz-Elizalde, R.; Díaz-Marín, C.A.; Hernández-Salinas, U.; Berriozabal-Islas, C.; García-Rosales, A. (2021) Reproduction and sexual dimorphism in the viviparous lizard *Sceloporus palaciosi* (Squamata: Phrynosomatidae) from the Trans-Mexican Volcanic Belt, Mexico. *Acta Zoologica* 102:63 -76
- Ross, C.D. & Meyers, R.A.** (2022). Immunohistochemistry of kangaroo rat hindlimb muscles. *Anatomical Record* 305(6): 1435-1447 (<https://doi.org/10.1002/ar.24791>)
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- Sandquist, E.**, Petersen, S. C., & Smith, C. J. (2017). 2017 Midwest zebrafish meeting report. *Zebrafish* 14(6): 606-607.
- Sandquist, E.S.** & Sakaguchi, D.S. (2019) Adult neural stem cell plasticity. *Neural Regeneration Research* 14(2): 256-7. (Invited perspective)
- Schutt D, **Brasso RL**, Vajda AM, & Wunder MB. (2021). Comparison of feather mercury concentrations in live-caught vs. found-dead chick carcasses of Gentoo penguins (*Pygoscelis papua*). *Polar Biology* 44: 1955-60.
- Skopec, MM**, Adams, RP, & Muir, JP. (2019) Terpenes may serve as feeding deterrents and foraging cues for mammalian herbivores. *Journal of Chemical Ecology* 45(11-12): 993-1003.
- Skopec, MM**, Dearing, MD, & Halpert, JR. (2022) Mammalian cytochrome P450 biodiversity: Physiological importance, function and protein and genomic structures of cytochromes P4502B in multiple species of woodrats with different dietary preferences. *Advances in Pharmacology.* 95: 107-129.
- Skopec, MM**, Lewinsohn, J., **Sandoval, T.**, Wirick, C., Murray, S., Pence, V. & Whitham, L. (2017), Managed grazing is an effective strategy to restore habitat for the endangered autumn buttercup (*Ranunculus aestivalis*). *Restoration Ecology* 26(4):629-6354 doi:10.1111/rec.12633
- Strand, M, J. Norenburg, J.E. Alfaya, F.A. Fernandez-Alvarez, H.S. Andersson, S.C.S. Andrade, T. Bartholomaeus, P. Beckers, G. Bigatti, I. Cherneva, A. Chernyshev, & **B.M. Chung** et al, (2019) Nemertean taxonomy – Implementing changes in the higher ranks, dismissing *Anopla* and *Enopla*. *Zoologica Scripta* 48(1):118-19.

- Truong, A**, Sondossi, M. & **Clark, J.B.** (2017). Genetic identification of *Wolbachia* from Great Salt Lake brine flies. *Symbiosis* 72:95-102.
- Uz, M., Hondred, J.A., Donta, M., Jung, J., Kozik, E., **Sandquist, E.**, Sakaguchi, D.S., Claussen, J.C., & Mallapragada, S.K. (2019) Determination of electrical stimuli parameters to transdifferentiate genetically engineered mesenchymal stem cells into neuronal or glial lineages. *Regenerative Engineering and Translational Medicine* 6(1): 18-28.
- Walker, A.M. & Meyers, R.A.** (2019). The Anatomy and histochemistry of flight hindlimb posture in birds. II. The flexed hindlimb posture of perching birds. *Journal of Anatomy* 234: 668-678.
- Wollenberg Valero, K.C.; **Marshall, J.C.**; Bastiaans, E.; Caccone, A.; Camargo, A.; Morando, M.; Niemiller, M.L.; Pabijan, M.; Russello, M.A.; Sinervo, B.; Jack W. Sites, J.W. Jr.; Werneck, F.P.; Wiens, J.J.; & Steinfartz S. (2019) Patterns, Mechanisms and Genetics of Speciation in Reptiles and Amphibians. *Genes* 10:646
- Yesilyurt, E.** (2022). Investigating elementary preservice teachers' beliefs about teaching and learning science. *Journal of College Science Teaching*, 51(5).
- Yesilyurt, E.**, Deniz, H. & Kaya, E. (2021) Exploring sources of engineering teaching self-efficacy for pre-service elementary teachers. *Int'l J STEM Ed* 8: 42 <https://doi.org/10.1186/s40594-021-00299-8>
- Zarn, AM, Valle CA, **Brasso R**, Fetzner WD, & Emslie SD. (2020). Stable isotope and mercury analysis of the Galapagos Islands seabird community. *Marine Ornithology* 48: 71-80.

Mentoring Activities

Mentoring of junior faculty historically occurs through collaborations and informal activities. Senior faculty assist junior faculty assigned to teach common courses in several ways. Commonly, senior faculty will share materials, strategies, and approaches with junior faculty. They will also often discuss teaching successes and failures as collaborators. It is routine for faculty teaching shared courses to work together and coordinate for perpetual course revision and improvement, and junior faculty are a part of this process. All faculty have more freedom in development of specialized, upper-division courses. However, in these cases, support remains available from senior faculty for help in courses design and pedagogy.

In addition, there is a formal process of review for tenure and promotion. The chair has primary responsibility to guide junior faculty through this process, but all senior faculty are supportive and provide assistance as needed or requested. All Zoology faculty have received promotion and tenure on schedule through the period of the last several program reviews. The chair also meets with each faculty member annually as part of their annual review, and information concerning progress and support is passed on to junior faculty at this time as well.

Since the last Program Review, the chair has established a more formal mentoring process with the newest hire in Biology Teaching Education (Ezgi Yesilyurt). A committee was assembled, consisting of John Mull, Ron Meyers (Chair), and Adam Johnston (Director, Center for Science & Math Education). The three of us met with Ezgi approximately every six months for the first 2 years of her appointment, and discussed the requirements for tenure and promotion, and made sure she had all questions answered. These efforts will continue with upcoming hires.

The Zoology Department has a long history of mentoring undergraduate students. This can take the form of students enrolling in Readings in Zoology (Zool 4830) and Problems in Zoology (Zool 4800), in which students are guided in the formal reading of scientific literature and research. Often, faculty will begin students in Readings to establish a base knowledge of relevant literature, and then subsequently move the students into Problems where they begin to conduct original research. Dedicated students often move on to a capstone Thesis (Zool 4970), which requires a proposal, a thesis committee, document, (the Thesis) and oral presentation. We typically have a few students complete a thesis each year, but this has been curtailed by the COVID pandemic, which has negatively-impacted faculty-student research between 2020 and 2022. Many students are encouraged to produce a tangible product from their research experience, and this can take the form of a published article, a presentation at a national/international conference, or a presentation at Weber State's Annual Undergraduate Research Symposium. These presentations (and publications) also

require mentoring, and our faculty spend time making sure student presentations are quality work. Mentoring also takes the form of assisting students in grant-writing, and many students will apply for undergraduate research grants through the Office of Undergraduate Research (OUR). Zoology students have a nearly perfect record of obtaining funding through OUR.

It should also be noted that faculty are only given 0.25 credits for each hour of research that students register for, and that these extra hours are not counted as part of our teaching load (i.e., we mentor students in addition to our full teaching responsibilities).

Not all students mentored complete a project/give presentations, so a list of mentored students is much larger than the snapshot presented below.

List of Zoology Student Peer-Reviewed Publications 2017-2022 (Faculty mentor in **bold**, student in **bolded italic**)

- Flowers D, Price-Sturgeon C, Rollin A, Schmidt D, Banford M, Collard C, Dearden M, Deem S, Dubose R, Faulkner M, Haney S, Hipolito K, Hughes H, Hunnel D, Johnson H, Mercer K, Miller C, Moran D, Pressley S, Pytlewski S, Sorenson G, White A.** (2021). Investigating the effects of ocean acidification on adult oyster (*Crassostrea virginica*) shells. *Ergo*, 14-28. [Brasso]
- Jimenez, A, Schmalz, J,** Wright, MN, **Skopec, MM.** (2020) Sagebrush characteristics influencing foraging patterns of pygmy rabbits. *Journal of Wildlife Management*. 84: 1306-1314. Doi: 10.1002/jwmg.21923
- Molina, D., Cavitt, JF,** Carmona, R. and M. Cruz-Nieto. (2017). Non-breeding distribution, abundance and population structure of American Avocet (*Recurvirostra americana*, Gmelin 1789) in Marismas Nacionales, México. *Mexican Journal of Ornithology* 19(1):22-32.
- Padilla, N., Kendrick J., Evans, G., Arbon, J., Catalan C, & A. White** (2018) Double-crested cormorants respond to fish stocking of rainbow trout in suburban ponds in northern Utah. *Utah Academy of Sciences, Arts, & Letters* 95, 31-42. [Hoagstrom]
- Ross, C.D. and Meyers, R.A.** (2022). Immunohistochemistry of kangaroo rat hindlimb muscles. *Anatomical Record* 305(6): 1435-1447 (<https://doi.org/10.1002/ar.24791>)
- Skopec, M., Lewinsohn, J., Sandoval, T., Wirick, C., Murray, S., Pence, V. & L. Whitham** (2017), Managed grazing is an effective strategy to restore habitat for the endangered autumn buttercup (*Ranunculus aestivalis*). *Restoration Ecology*. 26(4): 629-635 doi:10.1111/rec.12633
- Truong A,** M Sondossi, and **JB Clark.** (2017). Genetic identification of *Wolbachia* from Great Salt Lake brine flies. *Symbiosis* 72:95-102.
- Walker, A.M. and R.A. Meyers.** (2019). The anatomy and histochemistry of flight hindlimb posture in birds. II. The flexed hindlimb posture of perching birds. *Journal of Anatomy* 234: 668-678.

List of Zoology Student Theses 2017-2022

- Goodwin, C. (2020) Longer term caching and building behaviors of wild caught woodrats and the prey instinct of lab raised woodrats [Skopec]
- Mathews, A. (2020) Anatomy and histochemistry of the Hairy Woodpecker tail apparatus [Meyers]
- Thomas, K. (2020) Milkweed host preferences in oviposition of monarch butterflies (*Danaus plexippus*) [Mull]
- Ross, C. (2021) Anatomy and muscle fiber types of the kangaroo rat hindlimb muscles [Meyers]

List of Zoology student Presentations at National and International Conferences 2017-2022 (Faculty mentor in **bold**, student in **bolded italic**)

- Alton, B.D.** (2022) Characterization of Metformin's Repression of Chemokine Production by Cancer Cells [4th International Conference on Cytokines in Cancer in Crete, Greece] [Trask]
- Ashfaq, A., Malan, G., DuBose, R., Stevens, R., Palmere, L., R. Okazaki, & B.M. Chung** (2018) Examination of the invertebrate tachykinin receptor gene. [9th International Meeting on Nemertean Biology, Sylt, Germany]
- Batis, L., Wilkinson, J., Garrett, P., Friedel, K., Saavedra, J., Payne, K., Tonks, B. & Sandquist, E.** (2021) The role of MMP2 in zebrafish retinal regeneration. Society for Neuroscience. Virtual.
- Bedolla, O and J Clark.** (2017). DNA Barcoding of Great Salt Lake invertebrates. 7TH INTERNATIONAL BARCODE OF LIFE CONFERENCE, Kruger National Park, South Africa
- Bedoya-Wilkinson, J., Hansen, B., Slagowski, B., Peck, D. Price, C., & M. Merrill** (2019) Predatory interrelations in Weber & Davis County Streams [Annual Meeting of the Desert Fishes Council] [Hoagstrom]

- Bell, A., Anderson, Z., Faulkner, M., Nilson, J., & L Stoneham** (2019) Rainbow versus cutthroat trout effects on predatory invertebrate assemblages. Annual Meeting of the Desert Fishes Council [**Hoagstrom**]
- Carter, R., G. Beatie, G. & B.M. Chung** (2019) Novel and economical shoulder model for bursae injections. [Human Anatomy and Physiology Society Annual Meeting, Portland, OR.]
- DeJong, J. and N. Berthelemy** (2018) Effects of Glyphosate and Roundup on the Brine Shrimp *Artemia*- Survival and Physiological Responses. [Society for Integrative and Comparative Biology, San Francisco]
- DuBose, R., Ashfaq, A., Malan, A., R.K. Okazaki, & B.M. Chung** (2018) Histologic analysis of nemertean osmotic stress. [9th International Meeting on Nemertean Biology, Sylt, Germany]
- Friedel, K., Odenwalder, T., & B.M. Chung** (2019) Use of lasers to identify delicate structures in the human anatomy laboratory [Human Anatomy and Physiology Society Annual Meeting, Portland, OR.]
- Geilmann, S., LeeMaster, M. & B.M. Chung** (2019) Using mannequins to aid in teaching the human anatomy laboratory. [Human Anatomy and Physiology Society Annual Meeting, Portland, OR.]
- Goodwin, C** (2019) Caching and building behaviors of woodrats in captivity during longer term studies [American Society of Mammalogists Annual Meeting] [**Skopec**]
- Goodwin, C** (2021) The nose knows: Prey instinct of lab raised woodrats" [American Society of Mammalogists Annual Meeting] [**Skopec**]
- Hansen, B., Bell, A., Bedoya-Wilkinson, J., & Jensen, J.** (2019) Stonefly assemblages versus trout in low-order creeks along the northern Wasatch Front. [Annual Meeting of the Desert Fishes Council] [**Hoagstrom**]
- Haney, S. & J. Clark** (2019). DNA barcoding of invertebrates from the Great Salt Lake ecosystem. Annual Meeting of AAAS-Pacific Division, Ashland, OR, June 18-21.
- Haney S. & J. Clark** (2017). Invertebrate diversity in Great Salt Lake revealed by DNA barcoding. Annual Meeting of AAAS-Pacific Division, Waimea, HI, June 19-23.
- Malan, A. Ashfaq, A., DuBose, R., Naveed, S., Peterson, K., Palmere, L., Amlaw, N., Okazaki, R., & B.M. Chung** (2018) Role of Ca⁺⁺ and cAMP on nemertean heat-shock gene expression following environmental stress. [9th International Meeting on Nemertean Biology, Sylt, Germany]
- Mathews, A., Ross, C. & B.M. Chung** (2019) How painted bones aid undergraduate students in learning the human skeletal system." [Human Anatomy and Physiology Society Annual Meeting, Portland, OR.]
- Odenwalder, T., Friedel, K. & B.M. Chung** (2019) A potentially lower-cost alternative to cadaver immersion tanks for long-term cadaver storage." T. [Human Anatomy and Physiology Society Annual Meeting, Portland, OR.]
- Ross, C.D., and R.A. Meyers.** 2021. Anatomy and muscle fiber types of kangaroo rat hindlimb muscles. [Society for Integrative and Comparative Biology, Virtual Meeting.]
- Sorbonne M and J Clark.** (2022). DNA Barcoding of Parasites Associated with Great Salt Lake Brine Shrimp. [INTERNATIONAL FORUM ON RESEARCH EXCELLENCE, Alexandria, VA]
- Thomas, K. and J.F. Mull.** (2020) Oviposition host preference in monarch butterflies (*Danaus plexippus*) and its impact on offspring survival. [Poster presentation at the virtual Annual Meeting of the Ecological Society of America.]
- Wilko T and J Clark.** (2019). DNA barcoding of economically important insects. [SIGMA XI ANNUAL MEETING AND INTERNATIONAL RESEARCH CONFERENCE, Madison, WI]

List of Zoology Student Presentations at WSU Undergraduate Symposium 2017-2022 (Faculty mentor in **bold**, student in **bolded italic**)

- Arbon, J. & Catalan, C.** (2018) Cormorants: where are they after fish stocking in suburban ponds in northern Utah [**Hoagstrom**]
- Clunas, G., Haslam J., & T Johnson** (2018) Cormorant visitations at Farmington pond [**Hoagstrom**]
- Dall, B. & B.M. Chung.** (2022) Improving anatomic instruction and comprehension of female reproductive structures
- Faulkner, F.** (2020) Bioaccumulation of mercury (Hg) by western spotted orb weaver spiders at Antelope Island State Park. [**Brasso**]
- Flowers, D.** (2021) Mercury concentrations in Bluegill (*Lepomis macrochirus*) and Largemouth Bass (*Micropterus salmoides*) in local fishing ponds along the Wasatch Front. [**Brasso**]
- Friedel, K., Whitmore, K., Saavedra, J., Stocks, C., Garrett, P., Morales, J., & Sandquist, E.** (2020) The role of MMP2 for retinal regeneration in zebrafish.
- Hansen, B., Bell, A., Bedoya-Wilkinson, J., & C Jensen** (2019) Stonefly assemblages versus trout in low-order creeks along the northern Wasatch Front. [**Hoagstrom**]
- Huffcutt, P.** (2020). Effects of *Pogonomyrmex occidentalis* on neighboring sagebrush arthropod communities. [**Mull**]
- Mathews, A.** (2018). Anatomy and histochemistry of the Hairy Woodpecker tail apparatus. (poster) [**Meyers**]
- Mathews, A.** (2019). Anatomy and histochemistry of the Hairy Woodpecker tail apparatus. (ppt) [**Meyers**]
- Padilla, N., White, A., Isaacson, K., Mayer, G., & Friedel, K.** (2019) Fish stocking pattern versus abundance of double-crested cormorants at suburban ponds in northern Utah [**Hoagstrom**]

- Peck, D., and Anderson, M.** (2019) Captive foraging behavior of tiger salamanders (*Ambystoma tigrinum*) in relation to the natural habitat. [Mull]
- Pickett, S.** (2022). Proximo-distal fiber type distribution in the limb muscles of birds. [Meyers]
- Riggs, B.** (2019) Oxidative stress in *Artemia*. [Berthelemy]
- Ross, C.** (2019). Anatomy and muscle fiber types of the kangaroo rat hindlimb muscles. (poster) [Meyers]
- Stoneham, L.** (2020): Examining spatial and temporal variation in mercury (Hg) concentrations in brine flies at Antelope Island [Brasso]
- Thomas, K.** (2018). Fiber type distribution in Golden-collared Manakins (*Manacus vitellinus*). (poster) [Meyers]
- Urry, S. & Gorges, A.** (2022) Foraging pattern in terrestrial insectivores among terrestrial & aquatic food webs [Hoagstrom]
- Vance, B.** (2019) Use of gambel oak acorns as nesting sites for *Temnothorax* sp. ants. [Mull]
- Whitmore, K.** (2022) Microhabitat conditions in songbird nest boxes [Brasso]
- Whitmore, K. and Sanford, M** (2022): Examining spatial variation in mercury concentrations in brine flies and western spotted orb weaver spiders from Antelope Island State Park [Brasso]

List of Zoology Student Presentations at other venues 2017-2022 (Faculty mentor in **bold**, student in **bolded italic**)

- Alton, B.D.** (2022) Characterization of metformin's repression of chemokine production by cancer cells [Ogden Surgical-Medical Society]. [Trask]
- Alton, B.D.** (2022) Characterization of metformin's repression of chemokine production by cancer cells [Utah Academy of Science Arts & Letters Conference] [Trask]
- Batis, L., Wilkinson, J., Garrett, P. Payne, K., Tonks, B. & Sandquist, E.** (2021) Matrix metalloprotease 2 in regeneration of the zebrafish retina. [Utah Conference on Undergraduate Research]
- Cresswell, G.** (2018) Triple-negative breast cancer metastasis: inhibition through anti-hyperglycemia drugs. [Ogden Surgical-Medical Society]. [Trask]
- Friedel, K., Whitmore, K., Saavedra, J., Stocks, C., Garrett, P., Morales, J., & Sandquist, E.** (2020) The role of MMP2 for retinal regeneration in zebrafish. [Utah Conference on Undergraduate Research]
- Hansen, B., Bell, A., Bedoya-Wilkinson, J., & C Jensen** (2019) Stonefly assemblages versus abundance of trout in low-order creeks along the northern Wasatch Front. [Utah Chapter of the American Fisheries Society] [Hoagstrom]
- Isaacs, D.** (HS Student) (2022) Delivery of intracellular calcium using liposomes and its impact on cancer cell viability. [Regional Ritchey Science Fair and ISEF in Atlanta] [Trask]
- Mathews, A.** (2019) Anatomy and histochemistry of the Hairy Woodpecker tail apparatus. [Utah Conference on Undergraduate Research] [Meyers]
- O'Donnell, H. and Smith, C.** (2019) Caching behavior of woodrats (*Neotoma lepida* and *Neotoma bryanti*) through maturity [Utah Conference on Undergraduate Research] [Skopec]
- Padilla, N., White, A., Isaacson, K., Mayer, G. Friedel, K.** (2019) Fish stocking pattern versus abundance of double-crested cormorants at suburban ponds in northern Utah [Utah Academy of Sciences, Arts & Letters] [Hoagstrom]
- Randhahn, M.** (HS Student) (2022) Alcohol extracts of *Centella* sp. contain cytotoxic compounds. [SLC Regional Science Fair and ISEF in Atlanta] [Trask]
- Ross, C.** (2019) Anatomy and muscle fiber types of the kangaroo rat hindlimb muscles. [Utah Conference on Undergraduate Research] [Meyers]
- Sandquist, E., Friedel, K., Essner, J.J., Sakaguchi, D.S.** (2019) Matrix metalloproteinases in the regenerative zebrafish retina. Metalloproteases Gordon Research Conference. Lucca, Italy.
- Stoneham, L. & M. Faulkner** (2019): Mercury exposure in Gentoo penguin (*Pygoscelis papua*) chicks on sub-Antarctic and Antarctic islands. Utah Conference on Undergraduate Research [Brasso]
- Tonks, B., Batis, L., Payne, K., MacDonald, M., & Sandquist, E.** (2022) Role of MMP2 for retinal regeneration in zebrafish. [Utah Conference on Undergraduate Research]

Diversity of Faculty

Diversity of faculty in the Department of Zoology is summarized in the “Faculty Profile” (below) and in diversity of expertise indicated in the Faculty description above (section E). In short, when hired, faculty members were selected to fulfill diverse roles and in all cases they continue to serve in diverse capacities with regard to courses taught as well as with regard to research emphases and service activities. The faculty includes individuals with notable expertise in all levels of biological organization (from molecules to ecosystems) and in many major groups of animals. All of the Zoology faculty are from different PhD institutions, which in itself provides a diversity of research and teaching philosophies.

For tenured and tenure-track faculty, gender diversity is slightly in favor of males (7:6). Our single full-time contract faculty is male. For adjunct faculty, gender diversity is also slightly in favor of females (5:4).

For tenured and tenure-track faculty, ethnicity is skewed with predominantly individuals of Caucasian ancestry ($n = 11$), with one faculty having Asian ancestry and another originally from Asia. All adjunct faculty but one (Asian ancestry) are Caucasian. For an increase in faculty ethnicity diversity, there needs to be an increase in diversity in PhD-granting institutions (a kind of trickle-up effect). The COVID-19 pandemic certainly impacted science students in graduate school across the board.

Ongoing Review and Professional Development

Tenure-track faculty are reviewed, as part of the tenure-and-promotion process, in their third, sixth, and eleventh years. Post-tenure review occurs every five years after tenure is granted. Fully-promoted professors can also apply for performance compensation every five years, which also entails a review process.

In the Zoology Department (and College of Science), tenured and tenure-track faculty submit an annual report of their activities including goals for the upcoming year. This includes a meeting with the department chair as well as an overall review of performance by the Dean of the College. These annual reports are used as part of the post-tenure review mentioned above.

There are a variety of training opportunities on campus and many committee-led endeavors are also related to topics of professionalism. Further, faculty members maintain active connections with professional, off-campus organizations that pertain to their individual areas of interest. These groups are important sources of information and training opportunities that keep each person abreast of their own field.

Professional development is a key justification for ongoing research within the department because active research programs ensure that each zoology professor is engaged and continuing to grow within their discipline.

Use and impact of high impact educational experiences

The Zoology Department has a long history of utilizing high-impact educational practices, including, but not limited to undergraduate research. The table below shows the breadth of the HIEEs within the department's curriculum.

Courses	Zoology Department use of High Impact Educational Experiences											
	Supplemental Instruction ¹	Research ²	Writing ³	Presentations ⁴	In-Class Discussion ⁵	Evidence-Based Learning ⁶	Community Engagement ⁷	Project-based Learning ⁸	Techniques ⁹	Team-based-Learning ¹⁰	Internship ¹¹	Pre-Professional/Career Development
1010 LS Animal Biology			✓				✓	✓		✓		
1020 LS Human Biology	✓	✓	✓			✓		✓		✓		
1030 LS The Nature of Sex						✓						
1110 LS Principles of Zoology	✓	✓	✓			✓		✓	✓	✓		
2220 Diversity of Animals	✓	✓	✓			✓		✓		✓		
3200 Cell Biology	✓	✓	✓	✓	✓	✓		✓	✓	✓		
3300 Genetics	✓	✓	✓		✓	✓		✓	✓	✓		✓
3450 Ecology		✓	✓	✓	✓	✓	✓	✓	✓	✓		
3600 Comparative Physiology	✓	✓	✓	✓	✓			✓		✓		
3720 Evolution			✓		✓	✓				✓		
4990 Seminar				✓	✓							
3470 Zoogeography			✓	✓						✓		
3500 Conservation Biology			✓	✓		✓				✓		
3730 Population Biology			✓	✓	✓	✓						
4050 Comparative Vertebrate Anatomy			✓	✓	✓				✓			
4100 Vertebrate Embryology			✓	✓	✓							
4120 Histology			✓	✓	✓	✓				✓		✓
4210 Advanced Human Physiology		✓	✓			✓		✓		✓		
4220 Endocrinology		✓	✓			✓		✓		✓		
4300 Molecular Genetics		✓	✓	✓	✓	✓		✓	✓	✓		
4350 Animal Behavior		✓	✓	✓	✓				✓	✓		
4470 Wildlife Ecology and Management			✓	✓				✓		✓		
4480 Aquatic Ecology		✓	✓	✓				✓		✓		
4490 Marine Ecology		✓	✓		✓	✓		✓	✓	✓		
4640 Entomology				✓				✓	✓			
4650 Ichthyology		✓	✓	✓		✓		✓	✓	✓		
4660 Herpetology			✓	✓				✓	✓	✓		✓
4670 Ornithology		✓							✓			
4680 Mammalogy		✓	✓	✓					✓	✓		

Courses	Zoology Department use of High Impact Educational Experiences											
	Supplemental Instruction ¹	Research ²	Writing ³	Presentations ⁴	In-Class Discussion ⁵	Evidence-Based Learning ⁶	Community Engagement ⁷	Project-based Learning ⁸	Techniques ⁹	Team-based-Learning ¹⁰	Internship ¹¹	Pre-Professional/Career Development
3099 Teaching the Human Anatomy Laboratory			✓	✓		✓	✓	✓		✓		✓
3100 Advanced Human Anatomy			✓	✓		✓	✓	✓		✓		✓
4890 Cooperative Work Experience											✓	✓
2100 Human Anatomy	✓					✓				✓		
2200 LS Human Physiology	✓		✓			✓		✓				

-
- ¹Supplemental Instruction – Advanced/experience student(s) hold regular meetings
- ² Research – In-class research typically occurs in the laboratory, and includes data collection, hypothesis testing, exposure to literature and writing
- ³ Writing – Courses may have lab reports/manuscripts; written homework; written exam questions
- ⁴ Presentations – Students prepare and present to the class materials related to: research, discussion, and literature
- ⁵ Discussion – Students read and discuss scientific literature
- ⁶ Evidence-Based Learning – Classes utilize learning approaches that are “evidence-based”
- ⁷ Community Engagement – e.g., student projects uploaded to public photo site; students lead tours of lab to local school and community groups
- ⁸ Project-based Learning – Students engage in a project as a class, in small groups, or individually
- ⁹ Techniques – Students learn and use scientific methodologies/techniques such as specimen cataloging, identifying animals, experimental techniques
- ¹⁰ Team-based Learning – Students work in groups, collaborating on research, assignments, projects, including peer-review
- ¹¹ Students use work, volunteer, internship, and externship experiences for “Zoology experience” credit

Lab Skills

The variety of classes in the Zoology department provides the opportunity for students to learn and master a number of classic and modern laboratory skills. These are quite diverse and are elaborated in the table below. Hands-on techniques require repeated exposure and training to facilitate both muscle memory and time-sensitive practices. Techniques are all introduced in the introductory sequence of Zool 1110 and 2220 and are then repeated and expanded upon in the upper-level required and elective classes. As a first iteration of a lab skills table, we will need to review this as a department periodically and provide updated information.

		Nature of Science ¹	Scientific Literacy ²	Data collection ³	Techniques ⁴	Quantitative Skills ⁵
Required Introductory Sequence	1110	✓	✓	✓	✓	✓
	2220	✓	✓	✓	✓	✓

Required Upper-Division Courses with Labs	3200	✓	✓	✓	✓	✓
	3300	✓	✓	✓	✓	✓
	3450		✓	✓		✓
	3600	✓	✓	✓		✓

**Required Classes:
Totals**

5 6 6 4 6

Electives (Select 4)	4100				✓	
	4120		✓		✓	
	4300		✓	✓	✓	✓
	4350	✓	✓	✓		✓
	4480			✓	✓	
	4500				✓	
	4640			✓	✓	
	4650		✓	✓	✓	
	4660			✓	✓	
	4680			✓	✓	✓

Evidence of Effective Instruction

¹ Nature of science includes hypothesis generation, experimental design, and iteration of the scientific method.

² Scientific literacy includes reading and writing scientific articles, presenting powerpoints and posters.

³ Data collection includes animal observation and collection, characterization, as well as DNA and protein quantification.

⁴ Techniques include microscopy, animal identification, dissection, phylogenetics, histology, use of micropipettes, and DNA cloning.

⁵ Quantitative skills include bioinformatics, modeling, graphing, and statistical analysis.

i. Regular Faculty

Faculty are reviewed annually and meet with the Department chair regarding that review. Tenured faculty submit student evaluations from 2 classes per year, whereas non-tenured faculty must submit evaluations from every class they teach. These evaluations are included with the Annual Reports submitted by all faculty (see above). Assessment data now being generated in the Department provides another means to validate effective instruction. All of the general-education courses in the Department have been assessed multiple times and have met the thresholds of learning for each learning outcome (often exceeding such thresholds substantially). These data corroborate the information from student evaluations.

Graduate surveys provide another means to garner student input on the effectiveness of instruction. Available survey data (below) support the conclusion that teaching is effective to achieve learning outcomes emphasized within the Department.

ii. Adjunct Faculty

Adjunct faculty are evaluated by students for their classes, and these are reviewed by the chair. The department chair also corresponds periodically with the adjunct faculty concerning their teaching approach. Although student evaluation scores for adjunct professors tend to be lower than for tenured faculty, they generally fall within the range of 3 (below average) to 5 (above average). Reasons for lower scores include less experienced teachers, teaching assignments of largely introductory courses (which tend to have less experienced students), and many adjunct-taught courses are scheduled at non-traditional hours, such as in the evenings in which students may be less engaged due to having worked all day prior to class. Adjunct faculty do not have a formal review process (unlike regular faculty), although the College of Science is implementing a college-wide assessment/evaluation of adjunct faculty that will include a classroom visit. The chair determines the teaching schedule for adjunct faculty members and oversees their recruitment, hiring, ongoing professional development and regular evaluation. However, adjunct faculty members are appointed by the college academic dean for a specific period of time (based on a recommendation by the chair). Adjunct faculty in Zoology are hired on a semester-by-semester basis. Hiring is based on qualification, ability, and need.

Standard F – Program Support

Support Staff, Administration, Facilities, Equipment, and Library

Adequacy of Staff (Include evidence of ongoing Staff Development)

The Department of Zoology includes a full-time professional staff person (Laboratory Manager) and a full-time classified staff member (Administrative Specialist; see table below). Each has excellent credentials and is responsible for diverse, critical activities.

The Laboratory Manager (Susan Gurr) is responsible for ensuring lab rooms are properly equipped and maintained, that lab supplies are always on hand, that live animals in the Department are properly cared for, and that all classroom technology is maintained and properly serviced. Susan also oversees the live-animal facility in collaboration with Dr. Skopec. This facility is used for research and also to house animals used in course laboratories. Susan assists all faculty members and students using this facility. She also supervises part-time (student) lab assistants who help her with all of these activities.

Susan handles purchasing for laboratory supplies. She also manages budgetary paperwork associated with purchasing as an aid to the chair.

Susan also organizes visits and tours from community organizations, such as schools and clubs. She is the advisor for the Zoology Club, which is involved in many such activities.

The Administrative Specialist (Monica Linford, through 2017, Robin Osterhoudt, 2018-2019 & Megan Nelson, 2019-2022) is the interface for students visiting, calling, or emailing the Department for information or for clerical assistance. The department admin can answer a majority of questions typically asked by students and direct them to proper individuals or resources as appropriate. The admin helps students with various clerical needs of all kinds. She also supervises a student office assistant, who also helps with these tasks.

The admin handles a variety of clerical duties and assists the chair with important tasks such as course scheduling, textbook ordering, purchasing office supplies, tracking course enrollment, and tracking applications for graduation. Her responsibilities increasingly include contacting students for a suite of campus-wide initiatives intended to increase student success and retention.

As part of efforts to strengthen the image of the Department and awareness of department activities, the admin is the leader in planning a number of activities. These include the welcome social for new Zoology majors, the departmental newsletter, and the departmental awards ceremony & banquet.

Staff members keep up with upgrades and changes to relevant university procedures and software. When training is necessary or desired, staff members are encouraged to take advantage. In many cases, staff members act as a liaison between training opportunities, faculty members, and the chair. Staff members are also encouraged to take advantage of other university support services at their disposal.

Adequacy of Administrative Support

Administration for the Department of Zoology includes the chair (Ron Meyers 2019-present; Christopher Hoagstrom 2017-2019), the Dean of the College of Science (Andrea Easter-Pilcher), the Associate Dean (Barb Trask) and the WSU Provost (Ravi Krovi). The Chair oversees routine personnel, budgetary, and curricular issues. The Dean works closely with all department chairs in terms of budgetary and policy issues. She also provides direction with regard to strategic planning, student recruitment, advising, and retention. The Provost and Dean also sometimes provide support for various expenses when funding is available.

Funding and expenditures for the Department have remained relatively stable over the last five years (see table below). Some course fees were increased for the first time in many years during course-fee renewal for 2019.

This provides much needed funding to help with the cost of purchasing consumable laboratory supplies and maintaining and replacing equipment.

Zoology					
Funding	'17-18	'18-19	'19-20	'20-21	'21-22
Appropriated Fund	1,381,654	1,498,458	1,511,090	1,600,474	1,350,041
Other: IW Funding from CE	139,570	148,940	169,500	177,700	150,265
Special Legislative Appropriation					
Grants or Contracts					
Special Fees/Differential Tuition	58,726	45,640	26,591	39,970	38,049
Total	1,579,950	1,693,038	1,707,181	1,818,144	1,538,355

Student FTE Total	326.0	324.9	347.2	327.3	288.1
Cost per FTE	4,846.47	5,210.95	4,917.00	5,554.98	5,339.04

The College of Science provides additional support staff including Science Advisors (Monica Linford & Emily Romo-Hendrix) who guide students taking general-education courses and direct students to the department advisors as needed, and a liaison in the university's Development Office (Beth Orgeron), who is instrumental in obtaining donations and gifts. The College of Science has a Computer Specialist (Nic Meldrum) to assist with various computing needs and an Instructional Designer (Tim Maw) to assist faculty with online (Canvas) teaching. The College of Science Public Relations and Outreach Coordinator (Ali Miller) is available to help with website maintenance and other outreach activities.

Student workers are also integral to departmental support. Student employees benefit by being able to find employment in the Department of Zoology. Students performing discipline-related tasks (e.g., tutors, lab assistants) develop valuable skills. However, even for students in more general tasks, there are benefits:

- All student employees gain the benefit of convenience, by being able to work in proximity to their classrooms and other university resources. We expected this to improve their quality of life, which should indirectly improve their performance and ability to persist within the Zoology program.
- All student employees gain better familiarity with Zoology faculty and staff, which empowers them to understand the university, curriculum, research, etc.
- Not surprisingly, data from WSU Student Affairs show a strong relation of employment on campus with persistence to graduation.

In addition, student employees commonly act as ambassadors for the Department.

Other zoology students (non-employees) also benefit from student employees. First, we hire tutors and supplemental instructors (SIs) to improve teaching effectiveness and provide guided study opportunities for students. Second, office and laboratory assistants provide additional access points for students to connect with the Department and gain assistance when needed.

Faculty and staff benefit from student employees as assistants and collaborators for varied tasks conducted within the Department. University- and College-level administrations continually task departments with new and more complicated responsibilities, including higher demands on paperwork and accounting for a variety of departmental procedures. However, reductions in other duties or additional pay or opportunities for advancement rarely (if ever) accompany these cumulative, increasing demands.

Further, student employees strengthen morale by providing companionship and collegiality, as well as fresh, youthful perspectives that should be the hallmark of the college environment. Departmental staff appreciate having help and having someone to delegate to for various tasks. Faculty appreciate having additional assistance as needed and not having to place so many requests upon just the Administrative Specialist or Lab Manager. Overall, the Department runs much more smoothly and at a lower level of stress with the help of student employees.

List of Paid Zoology-Student Positions:

ZOOLOGY OFFICE ASSISTANT (FULLY FUNDED BY DEPARTMENT)

In addition to providing an extra set of hands to keep the department running smoothly, the Zoology Office Assistant is available to run errands so that the Administrative Specialist does not have to leave the front desk when something needs to be picked up elsewhere on campus. The Zoology Office Assistant provides extra support to faculty in making scans and copies, helps with special events such as major fest or annual awards. The Zoology Office Assistant is a smiling face at the front desk or on the phone when the Zoology Administrative Specialist needs to step away. The Zoology Office Assistant oversees office inventory and alerts the Administrative Specialist when supplies are running low. The assistant provides an extra pair of eyes for quality control on items such as room schedules and classroom schedules--those tasks that are repetitive and can prove difficult to spot errors when one has been looking at the documents too long. The assistant also provides an extra hand to the Zoology Lab Manager if the needs of the lab or special COS events require extra help. The is position was regularly staffed prior this review period and from 2017-2019, but COVID-19 and the switch to online and remote instruction forced a cutback on office staff. This position has not been re-filled as of this writing (Fall 2022).

ZOOLOGY LAB ASSISTANT (FULLY FUNDED BY DEPARTMENT)

The Zoology Lab Assistant helps with the set-up labs for a variety of classes, which includes setting out specimens, displays, and materials for experiments. The Lab Assistant helps with Human Physiology labs, by making solutions, preparing dissections, and setting up instrumentation. The assistant also helps with Cell Biology and Genetics labs, which also involves making solutions, taking care of the fruit fly colony, and setting up instrumentation. The Lab Assistant can also help with any other labs that are in need, wash glassware, and perform other general lab duties as requested.

The Zoology Lab Assistant helps the lab manager take care of live animals in the Department of Zoology, which include a number of fish tanks, a variety of reptiles, and rodents. The Lab Assistant helps maintain the animal facility by cleaning the facility and monitoring equipment. The Lab Assistant records animal care and maintenance activities on daily log.

JOB TITLE: ZOOLOGY EDUCATION ASSISTANT (FUNDED BY 50/50 PROGRAM)

The Zoology Education Assistant is in contact with a number of secondary schools in Box Elder, Weber, and Davis counties. He or she visits classrooms upon request and presents information according to their interests. Some examples include teaching a 3rd grade class about moths and butterflies, a 2nd grade class about Habitats and Adaptations, and a different 3rd grade class about Bones and Joints. These presentations include a power point presentation and hands-on displays. The Education Assistant recruits other Zoology student to help as needed. These included (but are not limited to) Zoology Club members and Lab Instructors/Teaching Assistants for Human Anatomy or Human Physiology. The Education Assistant also gives tours and presentations around the Department of Zoology when schools visit WSU. He or she also helps the Lab Assistant with laboratory preparation and animal care as needed. These activities were highly curtailed from 2020-2022 at the height of the COVID-19 pandemic.

JOB TITLE: STUDENT RESEARCH AIDE (FUNDED BY 50/50 PROGRAM)

The Student Research Aide provides support in the Molecular Research (DNA) Lab. This laboratory is focused on faculty and student research that involves characterization of DNA, RNA, and proteins by preparing solutions, stocking supplies, autoclaving, maintaining equipment and instruments, washing glassware, and assisting with faculty research projects. He or she also helps in the Organismal lab, helps the Lab Assistant and the Zoology Education Assistant with laboratory preparation, animal care, and outreach events.

JOB TITLE: SUPPLEMENTAL INSTRUCTORS (FUNDED BY SI PROGRAM)

The Supplemental Instruction Program provides Supplemental Instructors (SIs) (<https://www.weber.edu/SupplementalInstruction>) for a number of lower division, higher enrollment courses at no charge to the department. Supplemental Instructors are becoming less frequently used in the department (and across campus) as student participation in their review sessions has waned.

Zoology courses with SIs: ZOOL 1010, 1020, 1110, 2100, 2200, 3200

JOB TITLE: ZOOLOGY COURSE TUTORS FOR DIFFICULT COURSES LACKING SIS (FULLY FUNDED BY DEPARTMENT)

Unfortunately, SIs are not available for all Zoology courses. In the interest of student success, we determined as a department to hire tutors that follow the same basic format as SIs for our more difficult courses lacking SIs. Initially, this was focused on Cell Biology (ZOOL 3200) and Genetics (ZOOL 3300), which are two of the more difficult courses in Zoology, but had never qualified for an SI. Eventually, Dr. Jon Clark was able to procure an SI for Zoology 3200 (see above), but the hiring of a tutor has continued for Genetics and has also been used for Comparative Physiology (ZOOL 3600).

Adequacy of Facilities and Equipment

The Zoology Department has priority access to five laboratory classrooms (two shared with Microbiology) and two laboratory preparation areas, all located on the 4th floor of Tracy Hall, adjacent to the area where the main Department office is located.

The Department is the primary user of one classroom in Lind Lecture Hall (LL 130). Zoology maintains the facilities in LL 130, including a projector connected to a computer and other audio-visual equipment. Because of its room capacity (105), our larger-enrollment lecture courses are held in this room. When needed, larger lecture classrooms are solicited elsewhere on campus.

The Department has a dedicated teaching laboratory for Human Anatomy (Zool 2100) on the first floor of Tracy Hall (TY112). Laboratory sections for Human Anatomy run continuously on Tuesday, Wednesday, and Thursday, with lab sections scheduled from 8 or 8:30 am to 4 or 4:30 pm. Students receive sophisticated anatomical training on cadavers that are in various stages of dissection, and on skeletons and anatomical models.

Models and specimens for laboratories are housed in cabinets and shelves in laboratory classrooms. The Prep room houses cabinets for chemicals, glassware, and flammables. Individual faculty members maintain fairly extensive collections of animal specimens within their area of expertise including mammals, birds, reptiles, amphibians, fishes, and insects. Our extensive bird and mammal collection is held in the Zoology Collection room (TY431). Field equipment for a number of faculty is stored in Lind Lecture Hall.

An Interdisciplinary Microscopy Lab (TY429) houses a tissue processing unit, a microtome and freezing microtome for preparing histological specimens, and a Confocal Microscope that is shared by number of departments. One ultracold (-80° C) freezer and a number of chest freezers also belong to the department and are located in a shared equipment room (TY453).

The Department has an animal care and research facility on the first floor of Tracy Hall. It provides students and faculty with opportunity to conduct animal research following scientific, humane, and ethical principles. The facility includes three animal-housing rooms and a cage-wash area. One animal-housing room has an air-handling unit for 70 individually ventilated cages and a ventilated cabinet that allows multiple species to be held within one room and complies with housing standards required for USDA-covered species.

The Department also houses a DNA Laboratory on the fourth floor of Tracy Hall (TY435), which serves as a hi-tech teaching laboratory for Cell Biology (Zool 3200) and Research Applications in Genetics (Zool 4300) labs. The laboratory also facilitates student research projects in molecular genetics. The DNA laboratory was largely funded initially through a National Science Foundation instrumentation grant with matching university funding. Thereafter, the Department and College have provided supplies and occasional equipment upgrades. This vital facility is a focal point for research and teaching of several faculty members.

Department faculty members not directly affiliated with the DNA lab are provided small research laboratory spaces on the fourth floor of Tracy Hall where they house laboratory and field equipment along with computer facilities and workspaces for student researchers. These laboratories have been outfitted over the years via equipment and funding sometimes available in the department, “startup” funds available to new faculty in some cases, grants received by faculty (internal and external), and excess or donated equipment from elsewhere. Each faculty member has been responsible for outfitting their own research space.

Department faculty members are also each provided an office space. Most offices are on the fourth floor of Tracy Hall, but one is on the third floor. The College of Science provides each individual with a new office computer every five-to-seven years.

Adequacy of Library Resources

The Library’s holdings are adequate to support the Zoology mission. There is money budgeted to buy new books annually and the availability of online journals is relatively good. The interlibrary loan staff effectively and rapidly fulfills requests for resources not available on campus. The Library’s science representative (Miranda Kispert) works closely with the Department to efficiently use resources available for subscriptions to biological resources, cancelling subscriptions that are little used and using “freed-up” resources to subscribe to other journals value more highly by Department faculty members. Miranda also sometimes provides library training for students and faculty members.

Standard G - Relationships with External Communities

Description of Role in External Communities

RELATIONSHIPS WITH PRIMARY & SECONDARY SCHOOLS

Department faculty and staff members support regional primary and secondary schools. The list that follows summarizes many interactions with schools, although it is not necessarily all-inclusive. Interactions were severely limited during the height of the COVID-19 pandemic, 2020-2021.

Zoology Service to Primary & Secondary Schools or other Community by Faculty or Mentored Students 2017-2022

School	Service	Faculty Member	Year(s)
Bonneville HS	Anatomy lab Tour	Chung	2022
Ben Lomand HS	Latinos in Action: Multicultural Advancement of Science	Marshall	2020
Big Cottonwood Canyon, Community Snow Shoe Activity	Multicultural Advancement of Science	Marshall	2020
Brigham City Fire and EMT	Anatomy lab Tour	Chung	2022
DaVinci Academy	Anatomy lab Tour	Chung	2022
Fremont HS	Nest Box Trail @ Swanson's N. Fork Environmental Center	Brasso	2020
Fremont HS	Anatomy Lab Tour	Chung	2020
Great Salt Lake Coastal Cleanup	Zoology Club		2017
Harvest Moon Festival, Ogden Nature Center	Zoology Club		2017
Int'l Science and Engineering Fair	Judge	Yesilyurt	2021-22
Melba Lehner Children's School	Neuroscience Demo	Sandquist	2019
Morgan HS	Anatomy lab Tour	Chung	2021-22
Northern Utah Allied Health Education Center Health Occupation Students of America (NUAHEC-HOSA)	Anatomy lab Tour	Chung	2020-22
NUAMES HS	Mentored Science Fair Student	Trask	2021-22
Ogden Surgical Medical Society	Anatomy lab Tour	Chung	2020
Parkside Elementary	Visit by Outreach Students	Madison Hartmann, Madeleine Sorbonne	2017-22
Pioneer Elm Elementary	Visit by Outreach Students	Madison Hartmann, Madeleine Sorbonne	2017-22
Ritchey Science and Engineering Fair	Judge; Exec Comm; Faculty Planning	Mull	2017-22
Ritchey Science and Engineering Fair	Zoology "Captain" (organizes judges)	Susan Gurr	2017-22
Ritchey Science and Engineering Fair	Judge	Berthélémy	2018-21
Ritchey Science and Engineering Fair	Anatomy Lab Tour	Chung	2022
Saint Joseph's Catholic School	Expert for HS student	Brasso	2019
Saint Joseph's Catholic Schools	Mentored Science Fair Student	Trask	2021-22
SLC March for Science	Multicultural Advancement of Science	Marshall	2017

Zoology Service to Primary & Secondary Schools or other Community by Faculty or Mentored Students 2017-2022

School	Service	Faculty Member	Year(s)
Taylor Canyon Social Distance Hike	Multicultural Advancement of Science	Marshall	2020
Teacher Twilight Series	Anatomy Lab Tour	Chung	2022
Teacher Twilight Series	Zebrafish in Research	Sandquist	2018
Twin Rivers HS	Anatomy lab Tour	Chung	2020-22
Uintah Elementary	Judge, 6 th Grade Science Fair	Sandquist	2018
Venture Academy	Visit by Outreach Students	Madison Hartmann, Madeleine Sorbonne	2017-22
Venture Academy	Board of Directors	Hoagstrom	2018-22
Venture Academy	Visit by Outreach Student	Madison Hartmann	2017-19
Westlake JHS	Multicultural Advancement of Science	Marshall	2017; 2022
Weber HS	Anatomy lab Tour	Chung	2022
Weber Innovations HS	Anatomy lab Tour	Chung	2021-22
WSU COS Open House	Anatomy lab Tour	Chung	2022
WSU Weberstock	Multicultural Advancement of Science	Marshall	2022
WSU COS Open House	Multicultural Advancement of Science	Marshall	2019; 2022
WSU Club Carnival	Multicultural Advancement of Science	Marshall	2017
WSU Latinos in Action Conference	Multicultural Advancement of Science	Marshall	2017
WSU Purple Carpet Event	Anatomy lab Tour	Chung	2022
WSU Dance 2300	Muscle Demonstration	Chung	2020; 2022
WSU Physician Asst Program Team	Anatomy lab Tour	Chung	2022
WSU Pre School	Halloween Skeleton Demo	Chung	2021
WSU Vocal Pedagogy	Vocal Anatomy Demo	Chung	2019; 2022

PROFESSIONAL SERVICE BY FACULTY MEMBERS

Faculty members are regularly involved in organizations and events with links to biology and education. Many common activities are listed below, but this list is not necessarily all-inclusive. Interactions were severely limited during the height of the COVID-19 pandemic, 2020-2021.

External Professional Engagement by Zoology Faculty or their Mentored Students, 2017-2022		
Organization	Faculty	Year(s)
<i>Animals</i> , MDPI open access journal, Editorial Board Member	Hoagstrom	2018-21
Antelope Island State Park Spider Festival co-organizer	Mull	2017-22
Association of Field Ornithologists, Communications Committee	Brasso	2020-22
Bear River Migratory Bird Refuge Board of Directors member, US Fish & Wildlife Service	Cavitt	2017-18
Brown University Research collaborator	Meyers	2017-22
Council for Undergraduate Research, Biology Division Councilor	Sandquist	2020-22
Desert Fishes Council, member secretary	Hoagstrom	2018-19
Desert Fishes Council, program director	Hoagstrom	2020
International Society for Salt Lake Research, Board of Directors	Clark	2018-21
National Association for Research in Science Teaching, Research Committee	Yesilyurt	2022
<i>Nomina Anatomica Avium</i> , 3 rd edition, editor in chief	Meyers	2017-22
North American Congress for Conservation Biology, Toronto, Mentor Match	Mull	2020-21
North American Ornithologists Conference, Marketing & Communications Committee	Brasso	2020-21
Northeastern Nat Hist Conference, Virtual Planning Committee	Brasso	2021
Ogden Nature Center Volunteer	Berthélémy	2012-15
Ogden Regional Hospital Institutional Review Board	Hoagstrom	2012-16
Sigma XI Board of Directors	Clark	2017-18
Sigma XI Northwest Region Director	Clark	2017-18
University of Utah Research collaborator	Skopec	2012-17
Utah Division of Wildlife Resources Northern Region Regional Advisory Committee, chair	Cavitt	2017-18
Working Group in Avian Morphology, vice chair	Meyers	2017-22

EXTERNAL COMMUNITY INVOLVEMENT FINANCIAL CONTRIBUTIONS TO THE DEPARTMENT OF ZOOLOGY

The Department of Zoology is fortunate to receive routine donations from several private sources (see table below). These donations provide dedicated funds and scholarships for Zoology students.

External Community Involvement Financial Contributions to the Department of Zoology

Organization	Type
Dr. Earl W. Smart Memorial Fund	Endowment
Orson Whitney Young Memorial Scholarship	Endowment
Zoology Department Gift Fund	Donation
Dr. Kent M. Van de Graaff Pre-medical Application Award Fund	Donation
Zoology Scholarship Fund	Donation
Anatomy Lab Instructor Award	Donation
Ashley Austin Zoology Research Program and Endowment Fund	Donation

Summary of External Advisory Committee Minutes

The Zoology Department no longer has an external advisory committee

Community and graduate Success

See page 11 above

Standard H – Program Summary

Results of Previous Program Reviews – in the last program review (2016-2017), a few concerns were raised, and a number of recommendations were suggested. These are addressed below. During the five years since the last review, there has been a change in the department chair and the COVID-19 pandemic had a widespread effect on departmental activities.

Recommendation Identified	Action Taken	Progress
<p>“The review team recommends that already planned faculty discussions about skills and techniques taught in labs take place to ensure content diversity and prevent overlap.”</p>	<p>Previous 5 Year Program Review:</p>	<p>Rather than worry about overlapping skills. the department is evaluating the lab activities currently taught (see lab skills on page 28) throughout the major (beginning with introductory classes and on to upper-division classes). A faculty discussion of these skill will help us fine tune which skill are taught and which, if any, need to be added. Many skills (e.g., scientific literacy) are introduced early on and then later classes have higher expectations of student abilities</p>
	<p>Year 1 Action Taken:</p>	
	<p>Year 2 Action Taken:</p>	
	<p>Year 3 Action Taken:</p>	
	<p>Year 4 Action Taken:</p>	
<p>“Zoology faculty are encouraged to pursue an introductory one-semester majors course such as BIOL 1610/1615 at other USHE schools.”</p>		<p>Although a one-semester biology class was considered, the three Life Science departments decided to implement an A.S. degree in Biology, which started in 2019-</p>

		2020. Information about that program can be found on page 10.
<p>“The review team recommends the department hold a discussion to clean up the majors curriculum map to more accurately reflect the development of topics during a typical four years of coursework keeping in mind that not every class needs to map onto every outcome for assessment purposes.”</p>	Previous 5 Year Program Review:	A revised curriculum map has been developed with supporting rationale (see page 6).
	Year 1 Action Taken:	
	Year 2 Action Taken:	
	Year 3 Action Taken:	
	Year 4 Action Taken:	
<p>“For core concepts, adopting an outside standardized exam similar to the Majors Field Tests could be used to standardize assessment even though the program emphasis on zoology could create understandable issues with scores relative to peer institutions.”</p>	Action Taken	As described above (Assessment of Graduating Students, page 12), an exam would be useful – the source and time to administer it are both ongoing problems that need to be solved. We would welcome recommendations.
	Previous 5 Year Program Review:	
	Year 1 Action Taken:	
	Year 2 Action Taken:	
	Year 3 Action Taken:	
	Year 4 Action Taken:	

<p>“Creating an assessment committee of three Zoology faculty tasked with learning from Weber programs with more developed assessment in place and then proposing a department-wide assessment plan would help to jump start things.”</p>	<p>Previous 5 Year Program Review:</p>	<p>The Department now has more experience with class assessment and feedback from the assessment review team has helped.</p>
	<p>Year 1 Action Taken:</p>	
	<p>Year 2 Action Taken:</p>	
	<p>Year 3 Action Taken:</p>	
	<p>Year 4 Action Taken:</p>	
<p>“End of year department discussions regarding assessment data and appropriate changes to curricula if needed will help close the loop.”</p>	<p>Previous 5 Year Program Review:</p>	<p>Agreed, department-wide discussions do need to happen and we have done so with the initiation of the new Lab skills evaluation.</p>
	<p>Year 1 Action Taken:</p>	
	<p>Year 2 Action Taken:</p>	
	<p>Year 3 Action Taken:</p>	
	<p>Year 4 Action taken:</p>	
<p>“Add an advisement survey before the start of the senior year or before graduation. Seek funding from the provost office for a dedicated academic advisor to improve the availability to students.”</p>	<p>Previous 5 Year Program Review:</p>	<p>In the second semester major’s class, Zoology 2220 (Diversity of Animals), faculty review the advising sheet to direct students to specific advisors as they head into their upper-division classes. Speakers are also brought in to give presentation on a variety of career opportunities. A follow-up</p>

		survey at the end of this class can help focus student awareness of advising opportunities in the department. Since students do not take specific classes in a specific order, it would be challenging to determine a class or a time for such a survey (but the department can discuss options).
	Year 1 Action Taken:	A dedicated staff pre-professional advisor has been in place since summer 2020.
	Year 2 Action Taken:	
	Year 3 Action Taken:	
	Year 4 Action Taken:	
“We suggest targeted advertising of positions in the future to increase the diversity of the pool of applicants.”	Current 5 Year Program Review:	Moving forward, new faculty openings will target diversity; the new diversity office can help.
	Year 1 Action Taken:	
	Year 2 Action Taken:	
	Year 3 Action Taken:	
	Year 4 Action taken:	

Action Plan for Ongoing Assessment Based on Current Self Study Findings

<p>“The lab manager is exceptionally capable of performing job duties but it is clear that the job requirements are more appropriate for 1½ or 2 equivalent positions. Funding for at least another 50% lab manager is needed.”</p>	Current 5 Year Program Review:	Funding for student worker has helped the lab manager perform her duties
	Year 1 Action Taken:	
	Year 2 Action Taken:	
	Year 3 Action Taken:	
	Year 4 Action Taken:	
<p>“Establish more formal and long-term partnerships if you continue your external advisory committee and/or establish a more formal pre-professional advisory committee for student graduates.”</p>	Current 5 Year Program Review:	The Department decided to terminate the advisory committee. A variety of faculty have colleagues and connections to facilitate student opportunities (e.g., Utah Division of Wildlife, Northern Utah Animal Rehabilitation), and these can offer targeted recommendations for students (& faculty) seeking collaborations.
	Year 1 Action Taken:	
	Year 2 Action Taken:	
	Year 3 Action Taken:	
	Year 4 Action Taken:	

APPENDICES

Appendix A: Student and Faculty Statistical Summary

(Note: Data provided by Institutional Effectiveness. This is an extract from the Program Review Dashboard and shows what will be sent to the Boards of Trustees and Regents)

Zoology	2017- 2018	2018- 2019	2019- 2020	2020- 2021	2021- 2022
Student Credit Hours Total ⁶	9,780	9,747	10,416	9,819	8,644
Student FTE Total ⁷	326.0	324.9	347.2	327.3	288.1
Student Majors ⁸	340	352	412	413	386
Second Major or Concentration	59	60	56	55	45
Minors	25	33	26	30	35
Program Graduates ⁹					
Associate Degree	0	0	0	0	0
Bachelor Degree	46	37	36	32	60
Student Demographic Profile ¹⁰					
Female	218	216	276	273	253
Male	122	136	136	140	133
Faculty FTE Total ¹¹	16.86	15.1	16.37	16.29	N/A
Adjunct FTE	4.28	4.48	5	5.4	N/A
Contract FTE	12.58	10.62	11.37	10.89	N/A
Student/Faculty Ratio ¹²	19.34	21.52	21.21	20.09	N/A

⁶ **Student Credit Hours Total** represents the total department-related credit hours for all students per academic year. Includes only students reported in Banner system as registered for credit at the time of data downloads.

⁷ **Student FTE Total** is the Student Credit Hours Total divided by 30 for undergraduate and by 20 for graduate.

⁸ **Student Majors** is a snapshot taken from self-report data by students in their Banner profile as of the third week of the Fall term for the academic year. Only 1st majors count for official reporting.

⁹ **Program Graduates** includes only those students who completed all graduation requirements by end of Spring semester for the academic year of interest. Students who do not meet this requirement are included in the academic year in which all requirements are met. Summer is the first term in each academic year.

¹⁰ **Program Graduates** includes only those students who completed all graduation requirements by end of Spring semester for the academic year of interest. Students who do not meet this requirement are included in the academic year in which all requirements are met. Summer is the first term in each academic year.

¹¹ **Faculty FTE** is the aggregate of contract and adjunct instructors during the fiscal year. **Contract FTE** includes instructional-related services done by "salaried" employees as part of their contractual commitments. **Adjunct FTE** includes instructional-related wages that are considered temporary or part-time basis. Adjunct wages include services provided at the Davis campus, along with on-line and Continuing Education courses.

¹² **Student/Faculty Ratio** is the Student FTE Total divided by the Faculty FTE Total.

Appendix B:

Faculty (current academic year)

	Tenure and tenure-track	Contract	Adjunct
Number of faculty with Doctoral degrees	13	-	4
Number of faculty with Master's degrees	-	1	5
Number of faculty with Bachelor's degrees			
Other Faculty			
Total	13	1	9

Contract/Adjunct Faculty Profile

Name	Rank	Tenure Status	Highest Degree	Years of Teaching 2017-2022	Areas of Expertise
Brooks, Nicole		N/A	MS	3	Biology
Gurr, Susan		N/A	MS	5	Biology
Hoffman, Rosemary		N/A	PhD	3	Biology
Okazaki, Robert		N/A	PhD	1	Invert Physiology
Pendleton, Maya		N/A	MS	1	Ecology
Pilcher, Brian		N/A	MS	1	Ecology
Prothero, Walter		N/A	MS	5	Biology
Robinson, Ami Sessions		N/A	PhD	5	Biology
Spainhower, Kyle		N/A	MS	1	Functional Anatomy
Zeveloff, Samuel		N/A	PhD	4	Mammalogy

Summary Information (as needed)

Appendix C: Staff Profile

Name	Job Title	Years of Employment	Areas of Expertise
Susan Gurr	Lab Manager	18	Lab Management
Megan Nelson	Admin Specialist	3	Office Admin
Robin Osterhout	Admin Specialist	2	Office Admin

Summary Information (as needed)

Appendix D: Financial Analysis Summary
 (This information will be provided by the Office of Institutional Effectiveness)

Zoology					
Funding	17-18	18-19	19-20	20-21	21-22
Appropriated Fund	1,381,654	1,498,458	1,511,090	1,600,474	1,350,041
Other: IW Funding from CE	139,570	148,940	169,500	177,700	150,265
Special Legislative Appropriation					
Grants or Contracts					
Special Fees/Differential Tuition	58,726	45,640	26,591	39,970	38,049
Total	1,579,950	1,693,038	1,707,181	1,818,144	1,538,355

Student FTE Total	326.0	324.9	347.2	327.3	288.1
Cost per FTE	4,846.47	5,210.95	4,917.00	5,554.98	5,339.04

Note – with this information and the student information, we will calculate a ‘cost per fte’ as part of the financial summary

Summary Information (as needed)

Appendix E: External Community Involvement Names and Organizations

See Standard G on page 34.

Appendix F: Site Visit Team (both internal and external members)

Name	Position	Affiliation
Dr. Mark Stevenson	Anthropology Professor	Weber State University
Dr. Kimberly Bates	Biology Professor	Winona State University

Appendix G: Evidence of Learning Courses within the Major

(use as a supplement to your five-year summary, if needed. Be sure to delete the sample text before using)

A sample of some zoology major courses from our latest Assessment report is included below.

Course: ZOOL 3200 Cell Biology Fall 2021

Program Learning Goal or Outcome	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results and Closing the Loop
Learning Outcome 1: Evolution	Method 1: 3 exam questions Method 2: Students interpret the results of a primary research article on evolution.	Method 1: Class average >72% Method 2: Class average >72%	Method 1: Class average: 87% Method 1: Class average: 74%	Students are able to discuss how evolutionary forces have shaped animals' physiology	Continue use of assessments. Low number of assessment methods indicates this is an area I should work to emphasize in the future.
Learning Outcome 2: Cellular Organization	Method 1: 125 exam questions	Method 1: Class average >72%	Method 1: Class average: 84%	Students are able to collect, analyze and/or discuss data about cellular function	Continue use of assessments.
Learning Outcome 3: Genetics	Method 1: 35 exam questions	Method 1: Class average >72%	Method 1: Class average: 82%	Students are able to are able to collect, analyze and/or discuss data on how genetic changes/differences alter the physiology of animals	Continue use of assessments.
Learning Outcome 4: Ecosystems	Not assessed.				
Learning Outcome 5: Structure and function	Method 1: 27 exam questions	Method 1: Class average >72%	Method 1: Class average: 83%	Students are able to collect, analyze and/or discuss data on how differences in protein expression lead to	Continue use of assessments. Added second method of assessment F21.

Program Learning Goal or Outcome	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results and Closing the Loop
				differences in cellular function which lead to differences in physiology.	
Learning Outcome 6: Systems regulation	Method 1: 35 exam questions	Method 1: Class average >72%	Method 1: Class average: 90%	Students are able to collect, analyze and/or discuss data on how animals maintain homeostasis despite changes in their internal or external environments.	Continue use of assessments
Learning Outcome 7: The process of science	Method 1: 15 exam questions Method 2: Multi-week lab activity.	Method 1: Class average >72% Method 2: Class average >72%	Method 1: Class average: 95% Method 2: Class average: 92%	Students are able to generate as well as test hypotheses. Students are able to collect and evaluate data as well interpret and evaluate already collected data.	Continue use of assessments
Learning Outcome 8: Quantitative reasoning	Method 1: Lab activity done in groups determining the effects of cell type on proliferation. Students must create graphs representing the data collected in a lab report. Graded via rubrics. Method 2: Students interpreted figures from a primary	Method 1: Class average >72% Method 2: Class average >72%	Method 1: Class average: 90% Method 2: Class average: 79%	Students are able to analyze physiological data statistically and display data graphically.	Continue use of assessments

Program Learning Goal or Outcome	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results and Closing the Loop
	research article by answering essay questions which were graded with a rubric.				
Learning Outcome 9: Communication	<p>Method 1: Multi-week lab researching the effects of cell on proliferation. Students write a lab report graded via rubric.</p> <p>Method 2: Lab notebooks were completed for every experiment and graded 3 times by a rubric.</p> <p>Method 3: Group presentations on the findings of a figure from primary literature.</p>	<p>Method 1: Class average >72%</p> <p>Method 2: Class average >72%</p> <p>Method 3: Class average >72%</p>	<p>Method 1: Class average: 92%</p> <p>Method 2: Class average: 88%</p> <p>Method 3: Class average: 92%</p>	Students can effectively communicate scientific information at different levels and can work collaboratively.	Continue use of assessments.
Learning Outcome 10: Science and society	Not assessed				

*Direct and indirect: at least one measure per objective must be a direct measure.

Course: ZOOL 3300, Genetics Semesters taught: Fall 2019, Spring 2020, Spring 202

Evidence of Learning: Courses within the Major						
Measurable Learning Outcome	Method of Measurement*	Target Performance	Actual Performance	Interpretation of Findings	Action Plan/Use of Results	“Closing the Loop”
Learning Outcome: Evolution	Method 1: 596 exam questions Method 2: Students identify a topic related to human evolution and adaptation and summarize a research paper on this topic. Summary is graded via a rubric.	Method 1: Class average >70% Method 2: Class average >70%	Method 1: Class average: 81% Method 2: Class average 81%	Students understand the genetic basis of evolution. Student evolution summary is effective in exploring genetics in more detail.	Continue use of these assessments.	This assessment covers in-person, hybrid, and online versions of this course. Furthermore, exams were given in multiple choice format, essay/short answer on paper, and as take-home assignments. The results are consistent across modalities.
Learning Outcome: Cellular Organization	Method 1: 254 exam questions	Method 1: Class average >70%	Method 1: Class average: 80%	Students are mastering the relationship between cells and genetics.	Continue use of assessment.	See comments above.

Evidence of Learning: Courses within the Major						
Measurable Learning Outcome	Method of Measurement*	Target Performance	Actual Performance	Interpretation of Findings	Action Plan/Use of Results	“Closing the Loop”
Learning Outcome: Genetics	Method 1: 236 exam questions Method 2: Students work in groups on seven laboratory exercises and work collaboratively to collect, analyze and present their data in a laboratory report. Report is graded via a rubric.	Method 1: Class average >70% Method 2: Class average >70%	Method 1: Class average: 78% Method 2: Class average 82%	Exam scores demonstrate student mastery of basic genetic principles. Laboratory exercises and lab report provide deeper understanding of the breadth of genetics.	Continue use of these three assessments.	This is obviously the major focus of this course and is addressed by two assessment methods. Over this period students performed above average.
Learning Outcome: Ecosystems	Not assessed	–	–	–	–	
Learning Outcome: Structure and function	Method 1: 280 exam questions	Method 1: Class average >70%	Method 1: Class average: 82%	Coverage of this topic and student performance are above average.	Continue use of this assessment.	This is a focus of this course and over this period students performed above average.

<p>Learning Outcome: The process of science</p>	<p>Method 1: 642 exam questions</p> <p>Method 2: Students identify a topic related to human evolution and adaptation and summarize a research paper on this topic. Summary is graded via a rubric.</p> <p>Method 3: Students work in groups on seven laboratory exercises and work collaboratively to collect, analyze and present their data in a laboratory report. Report is graded via a rubric.</p>	<p>Method 1: Class average >70%</p> <p>Method 2: Class average >70%</p> <p>Method 3: Class average >70%</p>	<p>Method 1: Class average: 74%</p> <p>Method 2: Class average: 81%</p> <p>Method 3: Class average: 82%</p>	<p>Students can recognize how scientific principles have been used to study genetics.</p> <p>Evolution report exposes students to a variety of published research papers in genetics.</p> <p>For lab reports, students gain insight into collecting and presenting genetic data, as well as providing context for their findings.</p>	<p>Continue use of these three assessments.</p>	<p>This is a major focus of this course and is addressed by three assessment methods. Each assessment showed above average performance, but performance seems better for those activities emphasizing real-life applications</p>
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<p>Learning Outcome: Quantitative reasoning</p>	<p>Method 1: 2156 exam questions</p> <p>Method 2: Students work in groups on seven laboratory exercises and work collaboratively to collect, analyze and present their data in a laboratory report. Report is graded via a rubric.</p>	<p>Method 1: Class average >70%</p> <p>Method 2: Class average >70%</p>	<p>Method 1: Class average: 76%</p> <p>Method 2: Class average 82%</p>	<p>Quantitative analysis remains challenging for students.</p> <p>As measured by exam questions, students are performing slightly above the threshold for competency. Students do much better in the lab report, which assess real-life applications.</p>	<p>Continue use of assessments.</p> <p>If online learning is done again, need to adjust teaching strategy to improve Method 1 outcomes.</p>	<p>Covering quantitative applications in the life sciences is always challenging, owing to differences in student preparation. Using two assessment methods students performed above average.</p>
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<p>Learning Outcome: Communication</p>	<p>Method 1: 390 exam questions.</p> <p>Method 2: Students work in groups on seven laboratory exercises and work collaboratively to collect, analyze and present their data in a laboratory report. Report is graded via a rubric.</p>	<p>Method 1: Class average: >70%</p> <p>Method 2: Class average >70%</p>	<p>Method 1: Class average: 74%</p> <p>Method 2: Class average: 82%</p>	<p>Students can effectively communicate scientific information at different levels.</p> <p>Students perform well in activities measuring real-life applications.</p>	<p>Continue use of assessments.</p> <p>Lab and group activities are worthwhile in achieving competency in this core concept.</p>	<p>Using three assessment methods students performed above average over three semesters.</p>
<p>Learning Outcome: Science and society</p>	<p>Not assessed</p>	<p>–</p>	<p>–</p>	<p>–</p>	<p>–</p>	<p></p>

*Direct and indirect: at least one measure per objective must be a direct measure.

Course: Zool 3600 Comparative Physiology Semesters taught: Fall 19, Spr 20, Fall 20, Spr 21

		Evidence of Learning: Courses within the Major				
Measurable Learning Outcome	Method of Measurement*	Target Performance	Actual Performance	Interpretation of Findings	Action Plan/Use of Results	“Closing the Loop”
Learning Outcome: Evolution	Method 1: 12 essay exam questions graded with scoring guide Method 2: Lab activity with full lab report write up graded using a rubric	Method 1: Class average >72% Method 2: Class average >72%	Method 1: Class average was 85% Method 2: Class average was 83%	Students are able to discuss how evolutionary forces have shaped animals physiology	Continue with course activities.	Continue use of assessments
Learning Outcome: Cellular Organization	Method 1: 14 essay exam questions graded with scoring guide Method 2: Lab activity with full lab report write up graded using a rubric	Method 1: Class average >72% Method 2: Class average >72%	Method 1: Class average was 85% Method 2: Class average was 83%	Students are able to collect, analyze and/or discuss data about cellular function	Continue with course activities.	Continue use of assessments
Learning Outcome: Genetics	Method 1: 5 essay exam questions graded with scoring guide Method 2: Lab activity with full lab report write up graded using a rubric	Method 1: Class average >72% Method 2: Class average >72%	Method 1: Class average was 85% Method 2: Class average was 83%	Students are able to are able to collect, analyze and/or discuss data on how genetic changes/differences alter the physiology of animals	Continue with course activities.	Continue use of assessments

Learning Outcome: Ecosystems	Method 1: 18 essay exam questions graded with scoring guide Method 2: Two lab activities with full lab report write ups graded using a rubric	Method 1: Class average >72% Method 2: Class average >72%	Method 1: Class average was 85% Method 2: Class average was 85%	Students are to collect, analyze and/or discuss data on physiological adaptations of animals to their environment and how physiology determines the environments animals are able to live in	Continue with course activities.	Continue use of assessments
Learning Outcome: Structure and function	Method 1: 32 essay exam questions graded with scoring guide Method 2: Lab activity with full lab report write up graded using a rubric	Method 1: Class average >72% Method 2: Class average >72%	Method 1: Class average was 85% Method 2: Class average was 83%	Students are to collect, analyze and/or discuss data on how differences in protein expression lead to differences in cellular function which lead to differences in physiology	Continue with course activities.	Continue use of assessments
Learning Outcome: Systems regulation	Method 1: 35 essay exam questions graded with scoring guide Method 2: Two lab activities with full lab report write ups graded using a rubric Method 3: Two lab activities with worksheets involving data analysis and interpretation graded using a rubric	Method 1: Class average >72% Method 2: Class average >72% Method 3: Class average >72%	Method 1: Class average was 85% Method 2: Class average was 85% Method 3: Class average was 89%	Students are to collect, analyze and/or discuss data on how animals maintain homeostasis despite changes in their internal or external environments	Continue with course activities.	Continue use of assessments

<p>Learning Outcome: The process of science</p>	<p>Method 1: 31 essay exam questions where figures had to be interpreted graded with scoring guide Method 2: Three hypothesis driven lab activities with full lab report write ups graded using a rubric Method 3: Two hypothesis driven lab activities with worksheets involving data analysis and interpretation graded using a rubric</p>	<p>Method 1: Class average >72% Method 2: Class average >72% Method 3: Class average >72%</p>	<p>Method 1: Class average was 85% Method 2: Class average was 85% Method 3: Class average was 89%</p>	<p>Students are able to generate as well as test hypotheses. Students are able to collect and evaluate data as well interpret and evaluate already collected data.</p>	<p>Continue with course activities.</p>	<p>Continue use of assessments</p>
<p>Learning Outcome: Quantitative reasoning</p>	<p>Method 1: 12 essay exam questions where students had to calculate answers or make figures graded with scoring guide. Method 2: Four lab activities with full lab report write ups graded using a rubric Method 3: Three lab activities with worksheets involving data analysis and interpretation graded using a rubric</p>	<p>Method 1: Class average >72% Method 2: Class average >72% Method 3: Class average >72%</p>	<p>Method 1: Class average was 84% Method 2: Class average was 85% Method 3: Class average was 90%</p>	<p>Students are able to analyze physiological data statistically and display data graphically.</p>	<p>Continue with course activities.</p>	<p>Continue use of assessments</p>

Learning Outcome: Communication	Method 1: Three presentations with different formats graded by peer-review using a rubric Method 2: Lab activity where students collected data in groups and wrote a group lab report.	Method 1: Class average >72% Method 2: Class average >72%	Method 1: Class average was 94% Method 2: Class average was 84%	Students can effectively communicate scientific information at different levels and can work collaboratively.	Continue with course activities.	Continue use of assessments
Learning Outcome: Science and society	Method 1: Lab activity assessing effect of commonly consumed foods on blood glucose levels with worksheet that has essay questions about role of dietary choices on diabetes prevention/treatment. Graded using a rubric.	Method 1: Class average >72%	Method 1: Class average was 89%	Students can effectively collect and analyze data that can be used to address a societal problem.	Continue with course activities.	Continue use of assessment

*Direct and indirect: at least one measure per objective must be a direct measure.

Evidence of Learning: General Education Courses
(use as a supplement to your five-year summary, if needed)

Evidence of Learning: General Education Courses Breadth Area – Life Sciences						
Course: Principles of Zoology ZOOL 1110	Semesters taught: Fall 2019 84 students; Spring 2020, 47 students				Sections included: 2	
Threshold: A 73% class average is chosen as a threshold with the goal that all students reach at least a C grade level on each outcome.						
Measurable Learning Outcome	Method of Measurement	Target Performance	Actual Performance	Interpretation of Findings	Action Plan/Use of Results	“Close the Loop”
Nature of Science. Scientific knowledge is based on evidence that is repeatedly examined, and can change with new information. Scientific explanations differ fundamentally from those that are not scientific.	Measure 1 Fall 2019: 43 exam questions Spring 2020: 38 exam questions	Measure 1 Class average >73%	Measure 1: Fall 2019: Class average = 88% Spring 2020: Class average = 88%	Measure 1: Students were effectively introduced to the nature of science.	Measure 1: Continue current approach.	Similar success observed in subsequent semesters.
Integration of Science All natural phenomena are interrelated and share basic organizational principles. Scientific explanations obtained from different disciplines should be cohesive and integrated.	Measure 1: Fall 2019: 112 exam questions Spring 2020: 121 exam questions	Measure 1: Class average >73%	Measure 1: Fall 2019: Class average = 85% Spring 2020: Class average = 82%	Measure 1: Students were effectively introduced to the introgression of science.	Measure 1: Continue current approach.	Threshold exceeded both semesters despite slight dip in Spring 2020. Watch trend (COVID may have played a role).
Science and Society The study of science provides explanations that have significant impact on society, including technological advancements, improvement of human life, and better understanding of human and other influences on the earth’s environment.	Measure 1: Fall 2019: 28 exam questions Spring 2020: 29 exam questions	Measure 1: Class average >73%	Measure 1: Fall 2019: Class average = 91% Spring 2020: Class average = 88%	Measure 1: Students were successfully introduced to the significance of science in society.	Measure 1: Continue current approach.	High performance in both semesters despite slight dip in Spring 2020. Watch trend.

Evidence of Learning: General Education Courses Breadth Area – Life Sciences						
Course: Principles of Zoology ZOOL 1110	Semesters taught: Fall 2019 84 students; Spring 2020, 47 students				Sections included: 2	
Threshold: A 73% class average is chosen as a threshold with the goal that all students reach at least a C grade level on each outcome.						
Measurable Learning Outcome	Method of Measurement	Target Performance	Actual Performance	Interpretation of Findings	Action Plan/Use of Results	“Close the Loop”
Problem Solving & Data Analysis Science relies on empirical data, and such data must be analyzed, interpreted, and generalized in a rigorous manner.	Measure 1: Fall 2019: 118 exam questions Spring 2020: 110 exam questions	Measure 1: Class average >73%	Measure 1: Fall 2019: Class average = 86% Spring 2020: Class average = 84%	Measure 1: Students were successfully introduced to problem solving & data analysis in Zoology.	Measure 1: Continue current approach.	Threshold exceeded both semesters despite slight dip in Spring 2020. Watch trend (COVID may have played a role).
Levels of Organization All life shares an organization that is based on molecules and cells and extends to organisms and ecosystems.	Method 1: Fall 2019: 91 exam questions Spring 2020: 112 exam questions	Method 1: Class average >73%	Method 1: Fall 2019: Class average = 90% Spring 2020: Class average = 86%	Method 1: Students were successfully introduced to levels of organization in Zoology.	Method 1: Continue current approach	Threshold exceeded both semesters despite slight dip in Spring 2020. Watch trend (COVID may have played a role).
Metabolism and homeostasis: Living things obtain and use energy, and maintain homeostasis via organized chemical reactions known as metabolism.	Method 1: Fall 2019: 99 exam questions Spring 2020: 108 exam questions	Method 1: Class average >73%	Method 1: Fall 2019: Class average = 82% Spring 2020: Class average = 78%	Method 1: Students were successfully introduced to metabolism & homeostasis in Zoology.	Method 1: Continue current approach.	Threshold exceeded both semesters despite slight dip in Spring 2020. Watch trend (COVID may have played a role).

Evidence of Learning: General Education Courses Breadth Area – Life Sciences						
Course: Principles of Zoology ZOOL 1110	Semesters taught: Fall 2019 84 students; Spring 2020, 47 students				Sections included: 2	
Threshold: A 73% class average is chosen as a threshold with the goal that all students reach at least a C grade level on each outcome.						
Measurable Learning Outcome	Method of Measurement	Target Performance	Actual Performance	Interpretation of Findings	Action Plan/Use of Results	“Close the Loop”
Genetics and evolution: Shared genetic processes and evolution by natural selection are universal features of all life	Method 1: Fall 2019: 158 exam questions Spring 2020: 175 exam questions	Method 1: Class average >73%	Method 1: Fall 2019: Class average = 88% Spring 2020: Class average = 85%	Method 1: Students were successfully introduced to genetics & evolution in Zoology.	Method 1: Continue current approach.	Threshold exceeded both semesters despite slight dip in Spring 2020. Watch trend (COVID may have played a role).
Ecological interactions: All organisms, including humans, interact with their environment and other living organisms.	Method 1: Fall 2019: 122 exam questions Fall 2020: 120 exam questions	Method 1: Class average >73%	Method 1: Fall 2019: Class average = 89% Fall 2020: Class average = 87%	Method 1: Students were successfully introduced to ecological interactions in Zoology.	Method 1: Continue current approach.	High performance in both semesters despite slight dip in Spring 2020. Watch trend.

Zoology 1010, Summer 2022: Signature Assignment

Course Context and Background

Recall from early in the course that life is carbon-based, meaning that all major classes of biologically important molecules are built on a framework of carbon atoms. The two most basic metabolic processes carried out by organisms are photosynthesis and respiration.

Photosynthesis in plants and algae takes C out of the air in form of CO₂ and builds carbohydrate molecules. This process is the foundation for producing the energy that supports all aquatic and terrestrial ecosystems.

Respiration occurs in the cells of all organisms and breaks down carbohydrate molecules to extract usable energy from them. It releases H₂O and CO₂ as by-products.

As you know, CO₂ in the atmosphere is critical to creating temperature conditions favorable to life by trapping some outgoing heat in the earth's lower atmosphere (= troposphere) by a natural process known as the greenhouse effect. Photosynthesis is the biological process that takes carbon dioxide out of the atmosphere and respiration is the biological process that returns it to the atmosphere. In addition, there are various geological processes that release CO₂ into the atmosphere (e.g., volcanoes) or store it in the ground or ocean (e.g., formation of carbon-containing rocks, like limestone).

In the past two centuries, human activities—especially intensive land management and the burning of fossil fuels—have added new sources of CO₂ to the atmosphere and greatly increased its concentrations compared to those present in the preindustrial world. With higher levels of CO₂ and other greenhouse gases (e.g., methane), has come greater atmospheric heat retention, higher average temperatures on Earth, and various changes to patterns of precipitation and wind. Collectively these changes are called “climate change.”

In the long-run, humanity's most sustainable option for controlling climate change is to greatly reduce anthropogenic (human-caused) CO₂ emissions. In the short run, some atmospheric scientists believe that we will need to resort to specific **geoengineering** tactics to pull carbon out of the atmosphere—**carbon capture or sequestration**—or to reduce the amount of incoming solar radiation (the ultimate source of all atmospheric heat) by various techniques described as **solar radiation m (SRM)**.

Signature Assignment Details

In completing the assignment, consider only the second category of geoengineering—SRM. To better understand the issue before writing about it, refer to any or all of the three items posted in Canvas in the module labeled “Signature Assignment Reading.” You are not required to review all of this information. You are also welcome to consult other sources, provided they come from a legitimate scientific or governmental source, or from an established news agency or organization.

Audience: Consider your audience to be other non-scientists who have an interest in learning about what it would mean to intentionally alter the Earth's atmosphere in this way.

Big Question: a) Do you think such geoengineering efforts may be warranted in the near future (next 20 years) **and** b) given that humanity may decide to deploy one or more of these methods within this timeframe, what concerns do you have about its use?

Format: Write a short essay ~ equivalent to one full page of single-spaced text (12-point font). In it, state whether you think this type of atmospheric intervention may be needed (and why) and explain what concerns you have about its implementation, regardless of whether you agree that it is a necessary action.

Grading Criteria: 1) Does it have the appropriate length and format? (6 points), 2) Is it well written and mostly or entirely free of spelling and grammatical errors? (6 points), and 3) Does it employ specific, factual information to address the two questions provided and connect it with one or more the sources you consulted while writing this? (8 points).

Zoology 1110: Signature Assignment

Consider the following ‘big question’: Why does variation among individuals (a reflection of genetic diversity) provide the raw material for adaptation and what is the significance of adaptation for: (1) species survival and (2) practical value for humans? With this question in mind, watch four videos: as you watch, fill in the questionnaires on your lab manual, pages 127-130.

Video 1: The Making of the Fittest: Natural Selection and Adaptation

natural_selection_SD.m4vDownload natural_selection_SD.m4v

Play media comment.

Also available at:

<https://www.biointeractive.org/classroom-resources/making-fittest-natural-selection-and-adaptation>Links to an external site.

Video 2: The Origin of Species: Lizards in an Evolutionary Tree OriginSpecies-

Lizards_SD.m4vDownload OriginSpecies-Lizards_SD.m4v

Play media comment.

Also available at:

<https://www.biointeractive.org/classroom-resources/origin-species-lizards-evolutionary-tree>Links to an external site.

Video 3: The Making of the Fittest: Evolving Switches, Evolving Bodies

Evolving_Switches_Evolving_Bodies_SD.m4vDownload

Evolving_Switches_Evolving_Bodies_SD.m4v

Play media comment.

Also available at:

<https://www.biointeractive.org/classroom-resources/making-fittest-evolving-switches-evolving-bodies>Links to an external site.

Video 4: The Making of the Fittest: Natural Selection in Humans

human_selection_SD.m4vDownload human_selection_SD.m4v

Play media comment.

Also available at:

<https://www.biointeractive.org/classroom-resources/making-fittest-natural-selection-humans>Links to an external site.

When finished, also consider and answer the general discussion questions on page 131.

Homework Task: Consider and describe how you would explain the significance of evolutionary adaptation to a friend or family member who is not a scientist.

First, explain how you would effectively explain what adaptation really is, given that there is so much confusion in the public. In other words, what do you see as critical pieces needed explain how biological adaptation occurs (5 points)?

Second, explain which video from Lab 11 you think would be best to have your friend or family member watch to illustrate your points. That is, explain which video best illustrates the critical pieces necessary to explain the process of biological adaptation (5 points).

Third, explain how you would illustrate the biological value of adaptation for a population or species (in an evolutionary sense) and, in addition, explain the practical value that adaptation in nature has for humans (5 points). Within your explanations, provide at least one example each from your lectures and from the videos.

Fourth and finally, explain how you would incorporate the concept of resource partitioning as an example of adaptation (5 points). For example, how does resource partitioning provide a reflection of adaptation? Also, how does resource partitioning enhance species diversity?

As part of your answer:

Incorporate to specific details from the videos.

Incorporate specific details from your niche partitioning laboratory project and scientific manuscript.

Incorporate specific details you have studied in your textbook and during lecture.

Human Physiology (Zool 2200): Signature Assignment “Five things everyone should know about...”

This course is part of the WSU General Education program. GE courses introduce students to academic disciplines through important “big questions” (BQ). At their core, “big questions” provide students the opportunity to integrate and apply their knowledge of the discipline to address a significant, personal, social, or professional issue. GE courses also introduce students to underlying foundational knowledge and intellectual tools that run through all academic areas and are part of the ongoing preparation to address real-world problems. All WSU General Education courses have “signature assignments” (SA) that require you to integrate and apply course content to address a big question with, for instance, critical or creative thinking, problem-solving, or analysis. Signature assignments 1) will address a specific audience, 2) will tackle personal, social, or a professional question or issue, and 3) will integrate and apply course content through the use of 4) intellectual tools. This course is designed to tackle the following big question (BQ) “**How do our organs and organ systems work together to maintain health?**” through the signature assignment (SA) “**Five things everyone should know about....**”

For the signature assignment, you will create a one-page poster that describes five things everyone should know about an organ or organ system we covered in class. For the poster, you will list these five interesting facts about your chosen subject that would be useful for the general public to know. Make sure to explain the physiology behind the facts and why it is useful to know. For example, say you chose the stomach as your organ. One of your interesting facts and paragraphs describing the fact could be:

1. **Your stomach can go from holding 50 milliliters when empty to holding 2-4 liters when full.** Your stomach is a very stretchy organ. One of its major roles is to store your food. When you eat a really large meal that is high in protein or fat, like on Thanksgiving, your stomach stores that meal and only releases a little bit of the food at a time to your intestine, because protein and fat take a while to digest. When your stomach is storing food you will feel full. So eating foods with protein or fat may keep your hunger at bay for longer than foods high in sugars that are easily digestible and therefore released from the stomach quickly.

You may include figures, diagrams, pictures, colored text, etc. to make your poster pleasing to look at.

Posters can be built online using PowerPoint, Word, Adobe products etc. Just make sure you save it as a file type that is viewable on Canvas. [Students get free access to Adobe products](#) so the sky is the limit. If you are unsure if it is viewable saving it as a PDF is always advisable.

You will be graded by peer-review. Your peers will use the following rubric to score your poster.

Please rank the poster in each of the 4 categories on a scale of 1-5. 1 being the lowest score and 5 being the highest.

Is the information on the poster accurate and sources cited? (1-5)

Is the writing appropriate for a general audience? (1-5)

Is the writing free from grammatical mistakes? (1-5)

Is the poster well laid out and pleasing to look at? (1-5)

Five of your classmates will review your poster and you can receive a maximum of 20 points based on your peers' review of your poster. You will receive an additional 5 points for completing peer-reviews of 5 other posters. Making the assignment worth a total 25 points.

THE HEART

5 FUN & INTERESTING FACTS!

①

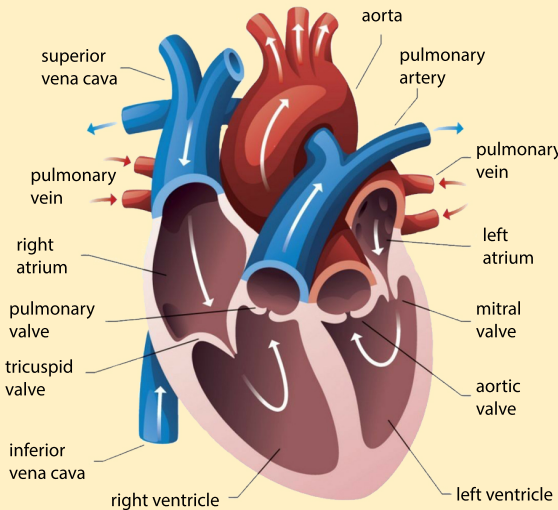
The human heart is about the size of a fist and on average weighs around 10 ounces. By comparison, the heart of a blue whale is about 5 ft long, 4 ft wide, and 5 ft tall, and can weigh up to 440 pounds!

②

The heart pumps around 2,000 gallons of blood through your body and beats around 100,000 - 115,000 times each day. If you live to be 80, your heart may pump up to 50 million gallons of blood and could beat more than 3 billion times throughout your lifetime!

Sources:

<https://blog.education.nationalgeographic.org/2015/08/31/how-big-is-a-blue-whales-heart/>
<https://www.somatechnology.com/blog/fun-fact-friday/how-many-times-does-your-heart-beat-in-a-day/>
<https://www.cvalakecounty.com/blog/the-little-known-history-of-pacemaker-implantation/>
<https://medlineplus.gov/heartdiseases.html>
<https://www.bostonscientific.com/en-US/patients/about-your-device/pacemakers/how-pacemakers-work.html>
<https://abcnews.go.com/blogs/health/2012/02/14/10-things-you-may-not-know-about-your-heart>
<http://www.who-invented.org/who-invented-pacemaker/>



③

The largest artery in your body is the aorta which is roughly the size of a garden hose. Your heart pumps blood through your aorta at a little over 1 mile per hour, and the contractions in your heart can be so strong that they can create enough pressure to squirt blood 30 feet!

⑤

The pacemaker implantation surgery was first tested on a dog in 1949 before being performed on a human for the first time in 1958 on a 43-year old patient. Though the pacemaker failed shortly after surgery, the patient received a total of 26 more pacemakers that extended his life to the age of 88!

A pacemaker is a small device that is implanted into your chest that sends electrical impulses to stimulate your heart to regulate its beating.

④

Coronary artery disease occurs when the coronary artery in the heart is blocked or narrowed, and is the most common cause of heart disease and the major reason heart attacks occur. You can reduce your risk of heart disease by lowering your cholesterol, quitting smoking, and having a proper diet and exercise regime!

Additional Summary Information (as needed)
 Zoology Major Course List:

Weber State University – ZOOLOGY MAJOR
 Bachelor of Science Degree (BS) – 2017-2022

Required Zoology Courses:

ZOOL 1110 LS Principles of Zoology	(4)	_____
ZOOL 2220 Diversity of Animals	(4)	_____
ZOOL 3200 Cell Biology	(4)	_____
ZOOL 3300 Genetics	(4)	_____
ZOOL 3450 Ecology	(4)	_____
ZOOL 3600 Comparative Physiology	(4)	_____
ZOOL 3720 Evolution	(3)	_____
ZOOL 4990 Seminar	(1)	_____
Total Credit Hours		28

Upper-division Zoology Electives (minimum 4 courses):

ZOOL 3470 Zoogeography	(3)	_____
ZOOL 3500 Conservation Biology	(3)	_____
ZOOL 3730 Population Biology	(3)	_____
ZOOL 3820 Biology of Cancer	(3)	_____
ZOOL 4050 Comparative Vertebrate Anatomy	(4)	_____
ZOOL 4100 Vertebrate Embryology	(4)	_____
ZOOL 4120 Histology	(4)	_____
ZOOL 4210 Advanced Human Physiology	(4)	_____
ZOOL 4220 Endocrinology	(4)	_____
ZOOL 4300 Research Applications in Genetics	(4)	_____
ZOOL 4350 Animal Behavior	(4)	_____
ZOOL 4470 Wildlife Ecology and Management	(4)	_____
ZOOL 4480 Aquatic Ecology	(4)	_____
ZOOL 4490 Marine Ecology	(4)	_____
ZOOL 4500 Parasitology	(4)	_____
ZOOL 4640 Entomology	(4)	_____
ZOOL 4650 Ichthyology	(4)	_____
ZOOL 4660 Herpetology	(4)	_____
ZOOL 4670 Ornithology	(4)	_____
ZOOL 4680 Mammalogy	(4)	_____
ZOOL 4700 Topics in Zoology ^A	(3-4)	_____
Total credit hours		12-16

Experience in Zoology (minimum 2 credit hours – may be taken in the same or separate semesters - or select a 5th course from upper-division electives above):

ZOOL 3099 Teaching the Human Anat. Lab.	(3)	_____
ZOOL 3100 Advanced Human Anatomy	(3)	_____
ZOOL 4800 Problems in Zoology	(1-4)	_____
ZOOL 4820 Human Physiol. Lab. Teach. Assist.	(1)	_____
ZOOL 4830 Readings in Zoology	(1-4)	_____
ZOOL 4890 Cooperative Work Experience	(1-4)	_____
ZOOL 4920 Short Courses	(1-4)	_____
ZOOL 4950 Field Zoology	(1-3)	_____
ZOOL 4970 Thesis	(2)	_____
ZOOL 4980 Research Design	(2)	_____
Total credit hours		2

Required Chemistry Courses:

CHEM 1210+1215 PS Principles of Chemistry I	(5)	_____
CHEM 1220+1225 Principles of Chemistry II	(5)	_____
Total credit hours		10

Required Math Courses (minimum 1 course):

MATH 1050 QL College Algebra	(4)	_____
MATH 1060 Trigonometry	(3)	_____
MATH 1080 QL Pre-calculus	(5)	_____
MATH 1210 Calculus I	(4)	_____
Total credit hours		3-5

Required Statistics Courses (minimum 1 course):

MATH 1160 (1040) QL Introduction to Statistics	(3)	_____
MATH 3410 Probability and Statistics I	(3)	_____
SOC 3600 Social Statistics	(3)	_____
PSY 3600 Statistics in Psychology	(3)	_____
Total Credit Hours		3

Required Physics Courses (minimum 1 course):

PHYS 1010 PS Elementary Physics	(3)	_____
PHYS 2010 PS College Physics I w/lab	(5)	_____
PHYS 2210 PS Physics for Sci. and Eng. I w/lab	(5)	_____
Total Credit Hours		3-5

Elective Support Courses (minimum 4 courses, must include at least 1 BTNY or MICR; Courses taken with separate labs counts as 1 course):

Botany

BTNY 1203 LS Plant Biology	(3)	_____
BTNY 2104 Plant Form and Function*	(4)	_____
BTNY 2114 Evolutionary Survey of Plants*	(4)	_____
BTNY 2303 Ethnobotany	(3)	_____
BTNY 3105 Anatomy of Vascular Plants	(4)	_____
BTNY 3204 Plant Physiology	(4)	_____
BTNY 3214 Soils	(4)	_____
BTNY 3454 Plant Ecology	(4)	_____
BTNY 3504 Mycology	(4)	_____
BTNY 3624 Taxonomy of Vascular Plants	(4)	_____

Chemistry

CHEM 2310 Organic Chemistry I	(4)	_____
with CHEM 2315 Organic Chemistry I Lab	(1)	_____
CHEM 2320 Organic Chemistry II	(4)	_____
with CHEM 2325 Organic Chemistry II Lab	(1)	_____
CHEM 3070 Biochemistry I	(3)	_____

Earth and Environmental Sciences

GEO 3710 Intro to Geographic Information Systems ^A	(4)	_____
GEO 3840 Remote Sensing: Principles and Methods ^A	(4)	_____

Math

MATH 3450 Advanced Statistical Methods ^A	(4)	_____
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Microbiology

MICR 2054 LS Principles of Microbiology	(4)	_____
MICR 3053 Microbiological Procedures	(3)	_____
MICR 3203 Immune System in Health & Disease	(3)	_____
MICR 3254 Immunology	(4)	_____
MICR 3305 Medical Microbiology	(5)	_____
MICR 3484 Environmental Microbiology	(4)	_____
MICR 3853 Food Microbiology	(3)	_____
MICR 4054 Microbial Physiology	(4)	_____
MICR 4554 Virology	(4)	_____

Neuroscience

NEUR 2950 (=2050) Introduction to Neuroscience ^A	(3)	_____
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Physics

PHYS 2020 College Physics II w/lab	(5)	_____
PHYS 2220 Physics for Sci. and Eng. II w/lab	(5)	_____

Zoology

ZOOL 2100 Human Anatomy	(4)	_____
ZOOL 2200 LS Human Physiology	(4)	_____
Total credit hours		12-20

Note:
^APre-Requisites for most upper-division Botany courses
^AClass may not show in CatTracks; please see Department Chair.

Please check the Catalog and CatTracks for Pre-Requisites & Co-Requisites

Please meet with a **Zoology** advisor for course planning.

Worksheet is for Zoology major coursework and does not include minor or university coursework.
 40 credit hours must be 3000 level or higher (upper division) for the Bachelor of Science degree.

Zoology Minor Class List:

Weber State University – ZOOLOGY MINOR

A minimum of 19 credit hours of Zoology coursework is required for the completion of a minor.

Required Minor Courses (11 credits hours):

- ZOOL 1110 *LS* Principles of Zoology (4) _____
- ZOOL 2220 Diversity of Animals (4) _____
- ZOOL 3720 Evolution (3) _____

Elective Courses (Select a minimum 8 credit hours of 2000 level or above):

- ZOOL 2100 Human Anatomy (4) _____
- ZOOL 2200 *LS* Human Physiology (4) _____
- ZOOL 3099 Teaching the Human Anatomy Laboratory(3) _____
- ZOOL 3200 Cell Biology (4) _____
- ZOOL 3300 Genetics (4) _____
- ZOOL 3340 Info. Resources in the Life Sciences (2) _____
- ZOOL 3450 Ecology (4) _____
- ZOOL 3470 Zoogeography (3) _____
- ZOOL 3500 Conservation Biology (3) _____
- ZOOL 3600 Comparative Physiology (4) _____
- ZOOL 3730 Population Biology (3) _____
- ZOOL 4050 Comparative Vertebrate Anatomy (4) _____
- ZOOL 4100 Vertebrate Embryology (4) _____
- ZOOL 4120 Histology (4) _____
- ZOOL 4210 Advanced Human Physiology (4) _____
- ZOOL 4220 Endocrinology (4) _____
- ZOOL 4300 Molecular Genetics (4) _____
- ZOOL 4350 Animal Behavior (4) _____
- ZOOL 4470 Wildlife Ecology & Mgmt. (4) _____
- ZOOL 4480 Aquatic Ecology (4) _____
- ZOOL 4490 Marine Ecology (4) _____
- ZOOL 4640 Entomology (4) _____
- ZOOL 4650 Ichthyology (4) _____
- ZOOL 4660 Herpetology (4) _____
- ZOOL 4670 Ornithology (4) _____
- ZOOL 4680 Mammalogy (4) _____
- ZOOL 4900 Topics in Zoology (1-4) _____
- ZOOL 4920 Short Courses, Workshops, etc (1-4) _____
- ZOOL 4950 Field Zoology (1-3) _____
- ZOOL 4990 Seminar (1) _____

Maximum 2 credit hours from the following courses:

- ZOOL 4800 Problems in Zoology (1-2) _____
- ZOOL 4820 Human Physiology Laboratory Teaching Assistant (1) _____
- ZOOL 4830 Readings in Zoology (1-2) _____
- ZOOL 4890 Cooperative Work Experience (1-2) _____

Worksheet is for Zoology minor coursework and does not include major or university course work.