



Division of Biological Sciences 2022 Assessment Report

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MISSION STATEMENT

The Division of Biological Sciences at The University of Montana-Missoula delivers high-quality academic programs in the biological sciences. The division's mission includes educating students at all levels from the baccalaureate to the doctoral, so that they develop the knowledge, skills, and attitudes to succeed as professional biologists and as citizens in a rapidly changing world facing problems that include significant biological components; to foster strong research programs that create new knowledge, understanding, and approaches in biology and that enhance the learning environment for students; and to apply biological science to benefit the university, state, region, nation and the world.

DEPARTMENT ALIGNMENT WITH PRIORITIES FOR ACTION

After listing each departmental objective, indicate which of the five [Priorities for Action](#) the objective supports. In this section, you may also briefly describe any innovative or noteworthy programs/initiatives that support the Priorities for Action.

- Objective 1: educate students at all levels to develop knowledge, skills, and attitudes to succeed as professional biologists and as citizens in a rapidly changing world. (Priorities 1—place student success at the center of all we do, and 2—Drive excellence and innovation in teaching, learning, and research). I have given specific examples for each PFA below.
 - Objective 2: to foster strong research programs that create new knowledge, understanding, and approaches in biology. (Priorities 2—Drive excellence and innovation in teaching, learning, and research, and 4—Partner with place; our research programs strongly partner with place)
 - Objective 3: to foster strong research programs that enhance the learning environment for students. (Priorities 1—Place student success at the center of all we do, and 2—Drive excellence and innovation in teaching, learning, and research)
 - Objective 4: to apply biological science to benefit the university, state, region, nation, and the world. (Priorities 3—Embody the principle of “Mission First, People Always, 4—Partner with place, 5)—Proudly tell the UM story)
- 1) **Place student success at the center of all we do:** Since our last assessment report DBS has:
- Increased experiential learning through the creation of new lab courses, (e.g., Neuroscience Research Techniques Lab (Certel, Hansen, Hay), Genomics Lab (Good), Developmental Genetics Lab (Voronina), and a new Virtual Reality lab (Bridges, Holick),
 - Increased awareness of and the opportunities for undergraduate research
 - Developed and delivered new interdisciplinary courses that use neuroscience as a platform to integrate STEM and non-STEM curriculum with the aid of a 3-year grant from the W.M. Keck Foundation.
 - Initiated consideration of realigning our majors with current and predicted student demand.
- 2) **Drive excellence and innovation in teaching, learning, and research.** Regarding teaching and learning:
- DBS faculty have brought in almost \$80M in extramural funding to their labs since the last assessment report (2016); the number increases to over \$200M when we include program funding brought in by faculty to the University as a whole.
 - Two neuroscience faculty (Holick in BMED, Bridges in DBS) have implemented a transformational approach to active learning that employs Virtual Reality (VR), to facilitate the understanding of key biological/STEM concepts of scale, spatial relationships, and time. The two also collaborated on a UM IT feel proposal that established the first of its

kind STEM VR lab in Eck Hall. It will allow DBS and campus-wide faculty the opportunity to reimagine teaching in ways that will make connections across biology and improve student learning. Holick was also awarded a Montana University System Teaching Scholar in recognition of her efforts.

- DBS faculty, Grimes and Voronina, were named Scientific Teaching Fellows by Yale's Center for Teaching and Learning as they participated in the Mobile Summer Institute on Scientific Teaching. The purpose of the Summer Institute was to expand participants' evidence-based active learning teaching strategies through workshops developed and facilitated by national teaching experts.
- Erick Greene and Scott Miller completely revamped our Diversity of Life BIOB 170/171 core Bio course after Erick visiting Cornell University to model our offerings in light of our much lower budget. Zac Cheviron has expanded our General Education offerings with a new course about life at high altitude.
- Since our last assessment, even with the pandemic, DBS faculty supervised 356 undergraduates in independent research, with a 10.8 mean number of undergraduates mentored per lab. These undergrads come from across the university, many from outside of Biology; our interdisciplinary nature allows room for students from across disciplines to work in our labs.

3) Embody the principle of "Mission First, People Always" Since the last assessment DBS has:

- Put together a Wellbeing and Community Building document for graduate students that also provides resources for faculty training in DEI.
- Made it through a 14% budget cut without losing any assistant professors.
- Retained four professors with job offers elsewhere.
- We are currently working to bring all DBS staff above \$15/hour. This is still too low given inflation, but it is a first step.

4) Partner with Place Since our last assessment DBS has

- Brought over 1000 undergraduates into field-based experiential learning experiences through both undergraduate research and field trips in mammalogy, ornithology, and fisheries courses. [Ecology](#), [freshwater ecology](#), [FLBS](#)
- Provided the state of Montana with a state of the art Covid analysis facility (our UM Genomics Core), significantly increasing the testing capability of the University and the State.
- Our faculty (Brandon Cooper, Angie Luis, and Doug Emlen) have provided alumni and the public with several key interaction/learning opportunities early on during Covid. We also have had several faculty on the Covid task force to provide science-based evidence for decisions the task force was making.

5) Proudly tell the UM Story.

- The Division of Biological Sciences has world renown faculty publishing at an incredible rate with impressive citation records. We compete for graduate students with the best Biology programs across the US, and send undergraduates to those same programs. We are one of the largest and most productive units on campus, producing a significant portion of the research that contributes to our new R1 status. Overall, we are making connections locally and across the globe to proudly tell the UM story. Our research garners extensive attention in the public media. Here is a non-exhaustive list of public coverage of our work since our last assessment.

-The Missoulian: July 4, 2017 'Bettle study shows speedy ponderosa pines fail faster' [link to article](#)

-Nature: July 13, 2017 'Sea spider respiration is a gut issue' [link to article](#)

-The Atlantic: 2017. 'Sea spiders pump blood with their guts not their hearts' [link to article](#)

-New York Times: May 28, 2018 'Breathe deep: how Antarctic sea spiders get oxygen' [link to article](#)

-Science: Sept 3, 2018 'To grow bigger antlers, these elk risk life and limb' [link to article](#)

-NBC News (local affiliate) 2018 'UM researchers receive \$700,000 in grants to fund lyme disease research' [link to article](#)

-Genetic Engineering and Biotech News: 2018 'Cell network study shines light on lung cancer signal pathways' [link to article](#)

-Genome Web: May 24, 2018 'Lung cancer study investigates role of protein modification in cell signalling' [link to article](#)

-EurekaAlert (AAAS): May 22, 2018 'Big data, networks identify cell-signalling pathways in lung cancer' [link to article](#)

-The Missoulian: June 2018 'University of Montana researcher lands \$5.4M grant to develop vaccine' [link to article](#)

-CNN: March 12, 2019 '5 things to know for March 12th:... trees' [link to article](#)

-The Missoulian: July 13, 2019 'Bird banding workshop at Milltown State Park' [link to article](#)

-The Wildlife Society: Sept 17, 2019 'In tiny streams salamanders dwindle due to climate change' [link to article](#)

-UConn Today: Sept 6th, 2019 'Climate change water variability hurts salamander populations' [link to article](#)

-The Missoulian: Sept 13, 2021 'UM hantavirus study has COVID implications' [link to article](#)

- Knowable Magazine: "The Weapons of Sexual Rivalry" by Kendall Powell, December 5, 2019. [Link to article](#)
- The Independent: Cuthbertson, A. (June 2020). Animals evolved 'extreme weapons' through duels, scientists say after forcing artificial intelligence to fight each other. [Link to article](#)
- New Hampshire Public Radio: July 16, 2021 'Summer weather swings strain ecosystems and animals' [link to article](#)
- The Missoulian: Sept 2021 'Research awards grow by 38% in last fiscal year at the University of Montana' [link to article](#)
- Flathead Beacon, 2021. 'How invasive species upended the aquatic foodweb' [link to article](#)
- Daily Interlake, 2021. 'Study shows how invasive species affect lakes' [link to article](#)
- The Missoulian: Aug 24, 2022 'Bird in hand research in Upper Clark Fork shows elevated levels of metals' [link to article](#)
- The Missoulian: Oct 21, 2022 'Carcass club at University of Montana brings zoological museum to life' [link to article](#)

For this measurement tools table we used the curriculum map for BS Biology, Human Biology concentration (appendix 1) and wrote yes if students are assessed with these tools in one or more courses during their degree.

STUDENT LEARNING OUTCOMES and MEASUREMENT TOOLS

Student Learning Outcomes	Exams	Extra-exam Assessment	Advanced Writing within Biological Disciplines	Presentations and Publications	Capstone Class (Neuro/Micro/E ndo; student choice of course)
1. Have a fundamental knowledge and conceptual understanding of biology (including proximal, ultimate, and applied levels)	Yes	Yes	Yes	Yes	Yes
2. Integrate knowledge and concepts across biological sub-disciplines and cognates	Yes	Yes	(Yes) ask Sarah	Yes	Yes
3. Learn skills required of a modern biologist	Yes	Yes	Yes	Yes	For some capstone courses, Yes
4. Understand the conduct of science and adopt the scientific method (logical generation of testable predictions based on hypotheses)	Yes	Yes	Yes		
5. Critically think and evaluate scientific methods, data and evidence (including statistical inference)	Yes	Yes	Yes	Yes	Yes
6. Develop careers and a lifelong education process.					
7. Be able to communicate science clearly and concisely	Yes	Yes	Yes	Yes	Yes

RESULTS and MODIFICATIONS

Student Learning Outcomes results	Modifications made to enhance learning
Through the human biology concentration we have each type of assessment on each learning outcome except #4 and #6 (see below).	In this concentration we have 5 courses with lab components, 10 courses with advanced writing assessment, 4 courses that require presentations, and a choice of ~8 different capstone courses depending on their interests. I don't think this needs modification.
#4: Understand the conduct of science and develop the scientific method. Our work in the scientific method is covered extensively in lower division labs and courses, but not in the upper division capstone courses, nor with any course that contains presentations (none of those focus explicitly on the scientific method).	If we need to incorporate assessment of the movement through the scientific method we could request the capstone courses to incorporate this material into their course explicitly, with assessment through writing or presentations.
#6: Develop careers and a lifelong education process. We have had a careers course on and off over the last 10 years, but with budget limitations on adjuncts and no replacement for the 7 faculty departure/retirements we've had since our last assessment, this course has not been maintained.	As we are able to hire new faculty we can expand our teaching of the Careers in Biology course. Anna Sala has plans to teach it next fall, but she is unsure of when she is going to retire...extending the cycle of teaching then losing the course. I will not be planning the Biology curriculum next year, but I will suggest to my predecessor that we make a careers course a permanent part of the curriculum.

FUTURE PLANS FOR CONTINUED ASSESSMENT

There are two major ways we could improve assessment in biology. First, we used to do an exit survey of graduating seniors to evaluate how we are meeting the Biology learning outcomes. We should take up that practice again. Second, we should recreate the Careers in Biology course for Freshman. This would allow us to do a better job helping students to develop their career path.

APPENDICIES

1. Curriculum Map for the Biology-Human Biology concentration BS degree.
- 2.
- 3.
- 4.

Required Course (Name and Number)	E=Exams EE= extra-exam AW = advanced writing P=presentations C=Capstone	Outcome 1: Have a fundamental knowledge and conceptual understanding of biology (including proximate, ultimate, and applied levels)	Outcome 2: Integrate knowledge and concepts across biological disciplines and cognates
BIOB 160n/161n principles of living systems/lab	E, EE	IDA	IDA
BIOB 170n/171n principles of biological diversity/lab	E, EE	IDA	IDA
BIOB 260 cell & molecular biology	E, EE	ID	ID
BIOB 272 genetics & evolution	E, EE	IDA	IDA
BIOB 301 developmental biology	E, EE, AW	DM	DM
BIOB 375 general genetics	E, EE, AW	DMA	D (A?)
BIOH 365/366 human anatomy & physiology health prof I/lab	E, EE	DM	DMA
BIOH 370/371 human anatomy & physiology health prof II/lab	E, EE	DM	DMA
BIOM 360 general microbiology	E, EE	DM	DM
BCH 380 or 480-482 biochemistry or advanced biochemistry	E, AW	DM	M
BCH 486 biochem research lab	AW, P, C?	DM	DMA
BIOB 410 immunology	E, AW	DMA	DM
BIOB 435 comparative animal physiology	E, EE, AW, P	DMA	ID
BIOB 468 endocrinology	E, EE, AW, P, C	DMA	DMA
BIOB 486 genomics	E, EE	DM	DMA
BIOE 403 comparative vertebrate anatomy	E, EE, AW	DM	DMA
BIOE 406 behavior & evolution	E	DMA	DMA
BIOM 420 host-microbe interactions	EE, AW, P, C	DMA	DM
BIOM 435 virology	E, EE, AW, C	DMA	DM

Cognate science requirements

- M 162 or M 171 applied calculus or calculus I
- STAT 216 intro to statistics
- PSYX 100s intro to psychology
- PHSX 205n/206n college physics I/lab
- PHSX 207n/208n college physics II/lab
- CHMY (intro or advanced sequence)

KEY: (more detail to the right)

- I = Introduced
- D = Developed/reinforced, with opportunities to practice
- M = Mastery
- A = Assessment evidence collected

students are introduced to the ou
the outcome is developed/reinfor
students have sufficiently practice
evidence is collected and evaluate

Curriculum Map Biology, Human Biology Concentration

Required Course (Name and Number)	Outcome 3: Learn skills required of a modern biologist	Outcome 4: Understand the conduct of science and adopt the scientific method (logical generation of testable predictions based on hypotheses)	Outcome 5: Critically think and evaluate scientific methods, data and evidence (including statistical inference)	Outcome 6: Develop careers and a lifelong education process	Outcome 7: Be able to communicate science clearly and concisely
BIOB 160n/161n principles of living systems/lab	IDA	IDA	ID	ID	IDA
BIOB 170n/171n principles of biological diversity/lab	IDA	IDA	ID	ID	IDA
BIOB 260 cell & molecular biology	ID	ID	IDA	ID	ID
BIOB 272 genetics & evolution	IDA	DA	DA	ID	IDA
BIOB 301 developmental biology	DMA	DMA	D	I	DA
BIOB 375 general genetics	DM	D	D	D	DM
BIOH 365/366 human anatomy & physiology health prof I/lab	DMA	DM	DMA	D	DM
BIOH 370/371 human anatomy & physiology health prof II/lab	DMA	DM	DMA	D	DM
BIOM 360 general microbiology	DM	D	D	I	D
BCH 380 or 480-482 biochemistry or advanced biochemistry	M	DA	DM	D	M
BCH 486 biochem research lab	DM	DMA	DMA	DMA	DMA
BIOB 410 immunology	DM	D	DMA	I	DMA
BIOB 435 comparative animal physiology	DM	D	DM	I	DMA
BIOB 468 endocrinology	DMA	D	DMA	I	DMA
BIOB 486 genomics	DM	DM	D	I	DM
BIOE 403 comparative vertebrate anatomy	DMA	DMA	DMA	I	DMA
BIOE 406 behavior & evolution	DMA	DMA	DMA	DM	DMA
BIOM 420 host-microbe interactions	IDM	IDM	DMA	DM	DMA
BIOM 435 virology	DM	ID	ID	ID	DM

Cognate science requirements

M 162 or M 171 applied calculus or calculus I
 STAT 216 intro to statistics
 PSYX 100s intro to psychology
 PHSX 205n/206n college physics I/lab
 PHSX 207n/208n college physics II/lab
 CHMY (intro or advanced sequence)

KEY: (more detail to the right)

I = Introduced

D = Developed/reinforced, with opportunities to practice

M = Mastery

A = Assessment evidence collected

id = Introduced (the content contained within it)

id = Introduced and students are given opportunities to practice

id = Introduced and can demonstrate mastery

id = Introduced for degree-level assessment (capstone classes, upper division final courses)