

# Annual Program Assessment Report

**Academic Year Assessed:** 2022-2023

**College:** College of Letters and Sciences

**Department:** Earth Sciences (ESCI)

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Program(s) Assessed:

Majors/Minors/Certificate	Options
Earth Science	Geography
	Geology
	GIS/Planning
	Paleontology
	Snow Science

## Annual Assessment Process

- Data are collected as defined by Assessment Plan YES  NO
- Population or unbiased samples of collected assignments are scored by at least two faculty members using scoring rubrics to ensure inter-rater reliability.  
YES  NO
- Areas where the acceptable performance threshold has not been met are highlighted.  
YES  NO  NA
- The scores are presented at a program/unit faculty meeting for assessment.  
YES  (scheduled)  NO
- The faculty reviewed the assessment results, and responds accordingly (Check all appropriate lines)
  - Gather additional data to verify or refute the result.
  - Identify potential curriculum changes to try to address the problem
  - Change the acceptable performance threshold, reassess
  - Choose a different assignment to assess the outcome
  - Faculty may reconsider thresholds
  - Evaluate the rubric to assure outcomes meet student skill level
  - Use Bloom's Taxonomy to consider stronger learning outcomes
  - Choose a different assignment to assess the outcome
  - OTHER: (If none of the above are appropriate, just describe briefly the results of faculty review – you will have the opportunity to provide more detail within the report)

6. Does your report demonstrate changes made because of previous assessment results (closing the loop). YES \_\_\_ NO \_\_\_X

1. Assessment Plan, Schedule, and Data Source

- a. Assessment schedule:

**Program Learning Outcomes (PLOs):**

**1. Integration of the Earth System**

- a. Interpret and apply various components of the Earth system, including the geosphere, biosphere, atmosphere, hydrosphere, and the cryosphere.
- b. Interpret/Describe human interactions with Earth system in:
  - i. management of natural resources.
  - ii. development of human societies.
  - iii. human impacts on local to global scales.

**2. Application of data and geospatial literacy**

- a. Apply spatial thinking and reasoning in appropriate areas of the Earth Sciences demonstrated by the ability to make a well-designed map and solve problems using geospatial techniques (GIS).
- b. Evaluate the quality of both quantitative and qualitative data in the areas of their chosen option.
- c. Apply systems thinking and critical analysis in addressing real-world Earth Science problems/issues.

**3. Effectively communicate science**

- a. Demonstrate ability to communicate Earth science concepts.
- b. Appropriately apply graphs and graphics.
- c. Demonstrate information literacy through the appropriate use of source citations, bibliographic references, comprehensive literature search, and ability to critically analyze published literature.

**4. Application of cultural competencies and ethical standards and practices**

- a. Apply cultural competencies (local, regional, national, and international) and ethical standards as relevant to their focus in the Earth Sciences.
- b. Apply relevant aspects of Native American Indians' distinct and unique cultural heritage pursuant to Indian Education for All in Montana.

**5. Demonstration of a mastery of discipline specific concepts, theory, and applications**

- a. Demonstrate an ability to integrate advanced concepts in student's chosen disciplinary option.
- b. Demonstrate an ability to use the major tools of their chosen field.

ASSESSMENT PLANNING CHART						
Program Learning Outcomes	Course Alignments: Include rubric, number and course title	Identification of Assessment Artifact				
1A	ERTH101EarthSys; GEO309SedStrat	Lab exercise; exam question/lab exercise				
1B	ERTH101EarthSys; GPHY425GeogTht	Lab exercise; final project				
2A	GEO429FieldCamp; GPHY384AdvGIS	Geologic mapping field trip assignment; TBD				
2B	ERTH450SnowDyn; GPHY484AppGIS	TBD; TBD				
2C	Geo315StructGeo; GPHY425GeogTht	Exercise; final project				
3A	GEO417Taph; GPHY284IntroGIS	Term paper; Map project and/or lab assignment				
3B	ERTH307Geomorph; GPHY284IntroGIS	Group projects posters, GIS labs and map making, data synthesis and graphical representation; Map project and/or lab assignment				
3C	GEO428FieldMeth; GPHY484AppGIS	Field trip write-up; TBD				
4A	GEO428FieldMeth; GPHY141World	Ethics of geologic field data collection; exam question, project 2				
4B	GEO309SedStrat; GEO429FieldCamp	Field trip #2 report; cultural site visit assignment				
5A	GEO417Taph; GEO429FieldCamp; GPHY425GeogTht	Term paper or exam Qs; field trip assignment; final project				
5B	ERTH450SnowDyn; GEO428FieldMeth; GPHY384AdvGIS	TBD; field trip assignment; TBD				
PLO	Courses	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025
1A	ERTH101EarthSys; GEO309SedStrat	X				
1B	ERTH101EarthSys; GPHY 425	X				
2A	GEO429FieldCamp; GPHY384AdvGIS		X			
2B	ERTH450SnowDyn; GPHY484AppGIS		X			
2C	Geo315StructGeo; GPHY425GeogTht		X			
3A	GEO417Taph; GPHY284IntroGIS			X		
3B	ERTH307Geomorph; GPHY284IntroGIS			X		
3C	GEO428FieldMeth; GPHY484AppGIS			X		
4A	GEO428FieldMeth; GPHY141World				X	
4C	GEO309SedStrat; GEO429FieldCamp				X	
5A	GEO417Taph; GEO429FieldCamp; GPHY425GeogTht					X
5B	ERTH450SnowDyn; GEO428FieldMeth; GPHY384AdvGIS					X

- b. Threshold values for demonstrating achievement: 80% of students will meet or exceed Level 2 competency, as defined in the rubric below.

## 2. What Was Done

- a. Was the completed assessment consistent with the plan provided? YES \_\_\_\_\_ NO X

Originally, we had planned to assess GPHY 484 as part of PLO 3C. However, after discussions with the instructor, we decided to substitute GEO 443 Sedimentary Petrology as it was a better fit for assessment.

- b. Rubric demonstrating how data was evaluated:

PLO #3 Effectively communicate science				Threshold Values
Indicators	Level 1	Level2	Level 3	
Demonstrate ability to communicate Earth Science concepts	Communicates basic Earth Science concepts	Clearly communicates advanced Earth Science concepts	Demonstrates effective communication of complex Earth Science concepts	80% of students will meet or exceed Level 2 competency
Appropriate application of graphs and graphics	Communicates basic Earth Science concepts through graphs and graphics	Clearly communicates advanced Earth Science concepts through graphs and graphics	Demonstrates effective communication of complex Earth Science concepts through graphs and graphics	
Demonstration of information literacy...	Demonstrates ability to use and cite published literature, data sets, or primary sources	Demonstrates in-depth knowledge of locating and utilizing published literature, data sets, or primary sources	Demonstrates ability to critically analyze published literature, data sets, or primary sources	

Course artifacts were delivered to the Curriculum Team at the beginning of the Fall 2023 semester. The Curriculum Team assigned courses to each member, individually evaluated the artifacts based on the level indicators, then met to discuss these evaluations.

## 3. How Data Were Collected

- a. How were data collected?

At least 5 artifacts were collected from course instructors for the courses listed in the Assessment Planning Chart and uploaded to a shared folder coordinated by the Curriculum Team. The objective for the was to address PLO #3. Artifacts were to be

collected from five courses, with one course purposed for multiple objectives (GPHY 284). All artifacts were successfully acquired.

**b. Explain the assessment process, and who participated in the analysis of the data.**

The Earth Sciences department Curriculum Team (Profs. Laskowski, Haggerty, Tuholske) evaluated the data. All documents are stored in a shared folder.

The assessment process: Instructors were asked to provide five randomly selected artifacts to inform the assessment of each PLO. The Department of Earth Sciences Curriculum Committee assessed each document. A list each PLO, the courses used to assess learning outcomes, and competency levels are provided in the Tables below and summarized next.

### Assessment Summary

PLO 3a: Demonstrate ability to communicate Earth science concepts.

Course	Artifact	Level	Justification
GEO 417	1	3	Report is well written and illustrated, clearly communicates complex topics like taphonomy, and relates results to implications for the broader field of Paleontology
	2	3	Report is well written and clearly communicates complex topics, in this case scavenging. Findings are related to the broader field of Paleontology
	3	3	Report is well written and clearly communicates complex topics, in this case how taphonomy can impact interpretations related to the development of flight. Findings are related to the broader field of Paleontology
	4	3	Report is well written and clearly communicates complex topics, in this case the implications for climate change, acid rain, and other environmental factors on fossil preservation. Findings are related to the broader field of Paleontology. Figures are effective.
	5	3	Report is well written and clearly communicates complex topics, in this case the the taphonomic pathways of whale falls. Findings are related to the broader field of Paleontology. Writing is structured in a way that favors breaking down complex topics into key points.
GPHY284	1	3	This artifact refers to a story map focused on wildfires and how they impact the landscape. The map analyzes land use and land cover changes between 2017 and 2021 in response to wildfires. The writing and graphics were effective in communicating complex earth science topics.

	2	3	This map projects highlights multiple datasets that can inform fossil discovery, including geologic maps and surface process datasets. Integrating these two demonstrates high level understanding and communication of Earth Science topics.
	3	2	This project proposal describes using multiple time periods of remote sensing image to communicate the change in glacial ice extent in the Rockies. It is effective at communicating a moderately complex topic in Earth Sciences.
	4	3	This project proposal discusses using well data to interpolate a water level map for the Crow community, addressing issues related to groundwater contamination. It effectively communicates complex Earth Science themes and relates them to human health.
	5	2	This project proposal describes a mapping effort to show the locations where mountain goats are located in the Clark Fork. It is effective, but the topic is not very complex. Though, this was not a requirement of the assignment.

**Summary:** Of the ten artifacts presented, ten out of ten were level 2 and above, reflecting that PLO 3a was successfully met based on these courses.

PLO 3b: Appropriately apply graphs and graphics.

Course	Artifact	Level	Justification
ERTH307	1	2	Map is well labeled and follows correct cartographic principles. Graphs are clear and easy to understand. Data is well-presented.
	2	1	Map is difficult to understand and does not have legend, nor reference. Bar charts are too small to read.
	3	2	Map is well labeled and follows correct cartographic principles. Photographs document results, though the resolution may be too low (could be due to .pdf file I have). Photos are missing figure numbering.
	4	3	Excellent representation of data. Colors are well chosen. All figures are clearly labeled and easy to understand. Artifact presents very complex results in a manner well suited for a general audience.
	5	2	Maps follow principles of cartography and are easy to read. Bar charts are well-designed and convey data correctly. The data presented is not highly complex, thus a 3 is not warranted.
GPHY284	1	1	Map does not contain a legend and thus is hard to understand what information the map is trying to convey.

	2	2	Map is well labeled and follows the principles of cartography. Colors are well chosen, and space is used well. There are a few minor issues with box edges and text.
	3	1	Map conveys information about the geographic context of Montana but fails to label what the “bands” mean in terms of frost-free days. There is too much white space on the figure and the legends are hard to find.
	4	1	Map does not have a legend and the color scheme makes it difficult to understand the watershed boundaries for the high-resolution inset. Layers should have opacity set correctly.
	5	1	Maps lack a legend and thus it is difficult to know where the park boundaries are unless you are already familiar with the region.

**Summary:** Of the ten artifacts presented, six out of ten were level 2 and above, reflecting a need to improve PLOS 3b in curriculum. ERTH307 reflected a higher competency among students but this may be due in part to GPH284 being the first quantitative Geography course students have ever taken.

PLO 3c: Demonstrate information literacy through the appropriate use of source citations, bibliographic references, comprehensive literature search, and ability to critically analyze published literature.

Course	Artifact	Level	Justification
GEO 428	1	1	Report references an academic journal article properly, but citation is placed only once in the text when more references may have been appropriate.
	2	2	The report references an academic journal article and modifies a figure from the paper to add context to the writing. However, the inline citation was casual and not formatted correctly.
	3	3	The report includes references to several journal articles, including those not suggested by the professor. Inline citations are inserted where field observations benefitted from background knowledge. Overall, a high-level of information literacy was displayed.
	4	1	Although several citations were included to supplement the report, inline citations were not included. This results in the reader not knowing where primary literature was relied upon for information.
	5	1	Although several citations were included to supplement the report, inline citations were not included. This results in the
GEO 443	1	2	The report shows that students were able to access multiple online resources and synthesize their findings. The maps were not particularly clear, but they did require the

			students to locate data from the MBMG and modify it to create a visual representation. Furthermore, primary literature was cited appropriately.
	2	3	This report demonstrates that the students were able to access and analyze three types of primary literature to gain an understanding of a particular geologic unit. These include journal articles, geologic maps, and stratigraphic data represented with a graphic log. Overall, this is high quality work that demonstrates information literacy.
	3	3	This report demonstrates that the students were able to access and analyze three types of primary literature to gain an understanding of a particular geologic unit. These include journal articles, geologic maps, and stratigraphic data represented with a graphic log. Overall, this is high quality work that demonstrates information literacy.
	4	3	This report demonstrates that the students were able to access and analyze three types of primary literature to gain an understanding of a particular geologic unit. These include journal articles, geologic maps, and stratigraphic data represented with a graphic log. Overall, this is high quality work that demonstrates information literacy.
	5	2	This map demonstrates that students were able to download GIS data and manipulate it to map the geologic unit of interest for this assignment. The mapping is not a great example of cartographic principles, but it does communicate information about where the Morrison Formation was exposed.

**Summary:** Of the ten artifacts presented, seven out of ten were level 2 and above, reflecting a need to improve PLOS 3c in curriculum. GEO 443 reflected a higher competency among students but this may be due in part to GPH284 being the first quantitative Geography course students have ever taken. Students demonstrated improvement as they advanced from 200-level classes to 400-level classes, but the underperformance relative to our benchmarks requires some modification to our instruction to ensure that outcomes are being met.

#### 4. What Was Learned

Based on the analysis of the data, and compared to the threshold values provided, what was learned from the assessment?

##### a) Areas of Strength

Students met the criteria for a successful outcome in PLO 3a. However, our assessment of PLOs 3b and 3c indicate areas that should be targeted for improvement. In our upcoming faculty meeting, we plan to suggest some teaching activities that target these outcomes, specifically exercises on effective use of citations, strategies for effective literature review, and effective uses of graphics. Part of the reason that PLO 3b was not met was the point in the degree during



which students were completing the work. As we indicated above, we expect that higher level courses will demonstrate more success in using graphics to communicate Earth Science topics.

b) Areas that need improvement

Areas that need improvement are the use of citations when synthesizing literature and communicating Earth Science topics using graphics.

## 5. How We Responded

- b. Describe how “What Was Learned” was communicated to the department, or program faculty. Was there a forum for faculty to provide feedback and recommendations?

We have requested a time to discuss our assessment with ESCI faculty at a faculty meeting. At this meeting, we will highlight areas that students met the criteria and highlight areas where they fell short. We will provide teaching activities to address the learning outcomes where students fell short and solicit feedback from faculty about how we can collectively improve outcomes.

- c. Based on the faculty responses, will there be any curricular or assessment changes (such as plans for measurable improvements, or realignment of learning outcomes?)

YES  NO

If yes, when will these changes be implemented?

We intend for these changes to be implemented as soon as possible, either this semester (Fall, 2023) or the next time courses are taught.

Please include which outcome is targeted, and how changes will be measured for improvement. If other criteria is used to recommend program changes (such as exit surveys, or employer satisfaction surveys) please explain how the responses are driving department or program decisions.

PLO 3b and 3c are the foci.

- d. When will the changes be next assessed?

These PLOs are scheduled to be assessed again in five years (2027-2028).

## 6. Closing the Loop

- a. Based on assessment from previous years, can you demonstrate program level changes that have led to outcome improvements?

Because last year’s assessment did not highlight areas of concern, we cannot assess the impacts of program level changes. We plan to assess these impacts next year, when our suggestions of teaching activities for information literacy and use of graphics will have been implemented.