Program Assessment Report (PAR)

Earth & Environmental Sciences, BS (EES) Baccalaureate Degree

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ACADEMIC YEAR COVERED BY THIS REPORT: 2021-2022

I. PROGRAM LEARNING OUTCOMES

The Earth & Environmental Sciences baccalaureate degree program (BA & BS) develops many skills • Combining a range of sciences (geology, chemistry, physics, biology, mathematics, and computer science) in creatively solving practical problems • Collaborating with others to complete projects • Interpreting text, numbers, and graphs • Thinking critically • Presenting information and thoughts in written and oral formats Learning Outcomes of the program include 1) Students will master basic concepts of earth and environmental science and be able to apply those concepts within the natural world. 2) Students will display proficiency in field and laboratory techniques used in the practice of earth and environmental sciences. 3) Students will be able to write detailed scientific reports for appropriate audiences. The program does not have professional accreditation.

II. PROCEDURES USED FOR ASSESSMENT

A. Direct Assessment

1) Master basic concepts and apply those concepts in natural world. The department offers an eclectic array of earth and environmental science courses. Our courses are intended to provide students with fundamental knowledge (assessed by objective homework, exams, and essays) that they then apply in independent projects that include either research papers focused on each particular course topic or field research, with associated reporting to instructors and peers. The EES discipline and our baccalaureate degree is characterized by interdisciplinary synthesis of information. Accordingly, these term paper/presentations and field research experiences become increasingly multidisciplinary as students acquire a broader education as they progress through the degree program. Application to the natural world is assessed through multidisciplinary term papers and field/lab research—both of which are important skills (along with communication) of professionals in our field. Data used for

assessment are collected from homework, lab/field reports (written and oral), written exams, quizzes, term papers, and capstone projects. Most course assessments are conducted with both an answer key for objective questions and by subjective analysis of conceptual knowledge. A portion of student assessment in field/lab courses is from instructor's evaluation of ability to use learned techniques. 2) Display proficiency in field and laboratory techniques. Students must be proficient in the use of methods and instrumentation used by professionals who work in the earth and environmental sciences. The proper use and fundamental understanding of research-level methods and instrumentation is promoted by the department's requirement that baccalaureate students take at least 26–38% of their total credit hours (depending on whether earth or environmental science concentration) in laboratory- and field-focused courses. Most students also take additional elective courses that have a laboratory or field practicum component. Proficiency is assessed from lab/field reports, notebook evaluation, and instructor evaluation of, for example, use of equipment and reporting methodology (e.g., proper observation methods, quality assurance). Most course evaluations are conducted with both an answer key for objective questions and by semi-subjective analysis, with rubric, of students' notes. 3) Demonstrate ability to write reports. In addition to fundamental knowledge and the ability to conduct research, communication is one of the three most important aspects of science. Scientific writing and oral presentation are instructed in a variety of ways, from our students' first year through their last. We offer a First-Year Seminar (mostly freshmen, but some transfer students) where we work on getting students comfortable speaking in front of their peers weekly and the students write a short essay on a weekly reading assignment. Speaking logically and writing logically go hand-in-hand together. All of our 3000- and 4000-level courses have required writing assignments where students receive instructor feedback on content and grammar. The department teaches a 3-credt hour Scientific Communication course (manuscripts, conference presentations, proposals, etc.). We offer multiple Integrated Writing (IW) courses in EES. Content is important, but an emphasis is placed on improvement from draft-to-draft and demonstration by the student that they are learning from practice and instructor and peer comments. These IW courses within EES offer exposure to literature-based research, content topics in EES, and opportunities to revise and rewrite several reports ultimately achieving a final report including references and annotated bibliography. *Detailed descriptions of specific assessment tools are included in the Supporting Documents section.

B. Scoring of Student Work

1) Master basic concepts and apply those concepts in natural world. Data used for scoring are collected from homework, lab/field reports (written and oral), written exams, and term papers. Most course evaluations are conducted with both an answer key for objective questions and by subjective analysis of conceptual knowledge. A portion of student assessment in field/lab courses is from instructor's evaluation of ability to use learned techniques. EES 1990 First Year Seminar: Students were evaluated by weekly discussion question related to the text The Story of More by Hope Jahren (80%) and a final term paper related

to content discussed in class under the topic of Climate Change (20%). EES 2550 Lecture: Students were assessed by 3 Exams (60%), Laboratory (20%), Quizzes (10%), and interactive in-class Activities (10%). Exams and quizzes were multiple-choice and short answer assessing content knowledge. EES 2550 Earth History Tectonics Activity: Students explored Plate Tectonics through a simulation activity where they created conditions for convergent, divergent, and transform plate boundaries. Students were graded on the correct response to questions regarding the 3 plate boundaries: what movement takes place at each and what forms at each boundary. EES 2550 Earth History Time Scale: Student were asked to recreate the Geologic Time Scale including Eons, Eras, Periods, and Epochs to represent the Earth's 4.5 billion year history. EES 2600 Environmental Science & Society: Students were evaluated by assessments taken online. These included 25 quizzes counting toward 70% of the final grade, and 3 exams counting toward 30% of the final grade EES 3250 Climate Change: Students were assessed by doing a research analyses. An analysis is a short review of a scientific paper that deals with climate change: what it tells us, and why it's important. The research paper for this project is summary of: Scholarly arguments consist of a claim, supported by evidence, which must be connected to each other by reasoning. EES 4010 Groundwater Monitoring: Students were assessed by Homework: 30%, Final Exam: 40%; Final Presentation: 20%; Class attendance, and participation in discussion (10%). This course is intended to provide an understanding of the following topics through site visits and hands-on exercises: (a) Water quality parameters; water and wastewater treatment processes (b) Geochemistry of groundwater, surface water and drinking water standards (c) Groundwater contamination by petroleum hydrocarbons and solvents (d) Landfills and environmental issues, and (e) Groundwater remediation techniques of petroleum and solvents. In addition, a group of two undergraduate students will do a 15-minute group presentation on an article (a published site remediation case history) that is approved by the instructor. EES 4010 Water Resources: Students were assessed by two mid-term written exams and a cumulative final exam will be given to cover various topics and concepts covered in the class and assigned readings. Homework exercises are and quizzes will be arranged. 3 Exams: 75%; HW/Quiz: 25%, Participation: 5% (bonus). EES 4430 Analysis of Complex Systems: Students were assessed on quantitative analysis and probabilistic forecasting of the behavior of complex nonlinear natural and human systems. Methods of analysis include fractals to quantify spatial, size, and temporal scaling and chaos to study sensitivity to initial conditions and feedback. Modeling includes self-organization and cellular automata. Systems studied include seismology, chemistry, biochemistry, hydrology, medicine, geography, and coupled human and natural systems. EES 4570 Site Remediation: Students are evaluated by assessing the physical, chemical, and biological methods used to remediate contamination in soils and groundwater, emphasizing practical applications. Strategies and technologies to address contamination, including the natural attenuation, containment techniques, pump-and-treat, and in situ technologies. Sufficient technical detail so the student can apply basic engineering design equations. 2) Display proficiency in field and laboratory techniques. Students are scored on their lab/field reports, notebook evaluation, and instructor evaluation of, for example, use of equipment and reporting methodology (e.g., proper observational methods, quality assurance). Most course evaluations are conducted with both an answer key for objective questions and by semi-subjective analysis, with rubric, of students' notes. Assessment of this

learning outcome is conducted by faculty members. Field and Laboratory Techniques Courses EES 2510 Earth Systems Lab: Students were evaluated by 11 lab exercise quizzes, 1 midterm quiz, and 1 final quiz. Each quiz was worth 7.7% of the final lab grade. EES 2550 Earth History Lab: Students were evaluated through hands-on laboratories where they used microscopes to examine various micro and macro-fossils. The students explored Plate Tectonic Theory, Theory of Evolution, Global Climate Change, and Geologic Time through quantitative and qualitative data collection and analysis. EES 4340 Mapping Methods: Students are assessed on the fundamental components of a geological map and the various methods used in the construction of geological maps and geological map information. Methods include fundamental and classic Brunton Compass skills for pace & compass traverses, triangulation, bearing & reverse bearing, and orientations of planes and lines, as well as using basic theodolite and GPS technologies. EES 4350 Field Mapping: Students are assessed by observing field geological information (outcrop lithology and structural info) and then compile that info onto a geological map including the use of aerial photos. 3) Demonstrate ability to write reports. Scoring of this learning outcome is from student homework, their written essays, and their ability to critically revise their own text and that of others. Assessment of this learning outcome is completed by faculty members. Content is important, but an emphasis is placed on improvement from draft-to-draft and demonstration by the student that they are learning from practice and instructor and peer comments. EES has several Integrated Writing (IW) courses. The IW designation for a course must be approved by the undergraduate curriculum committee. Courses will have at least 5000 words (20 double-spaced pages) of writing, which will be evaluated for content, form, style, correctness, and overall writing proficiency and give students the opportunity for revision and improvement. Assignments may take many forms and include a mix of formal writing (e.g., a number of short papers evaluated in both draft and final form, a long assignment broken into smaller parts, thus allowing for multiple drafts, feedback, and revisions,) and informal writing (e.g., journals, logs, short responses to lectures, essay examinations). All writing will count as part of students' performance in the course. Responsibility for ensuring that these course requirements are met rests with the colleges offering the courses. EES 3200 Water, Energy & Environment (IW): Students were to select five different topics and write papers about each of them. The topics could come from a list of recommendations in the syllabus, or the student could write about a topic (or topics) of their own choice reasonably related to the content of the course. Students were grades were calculated using parameter and rubric included with Supporting Documents. EES 4010 How Nature Works: Students were assessed by 50% project report, 20% literature research & Presentations, 10% in-class reading presentations, 20 % project presentation. Students were allowed multiple drafts of project reports prior to submission of final report and presentations. EES 4210 Structural Geology (IW): Students were evaluated on a 10-15 page report written to the level of a scientific report standard. Each report is commented and edited by the instructor and by other students. Then the report is rewritten by the author and reviewed again by the instructor and other students in the class. This process is repeated 3-10 times until a satisfactory version of the report is produced. After the report is completed each student prepares and presents to the class a 10-minute PowerPoint presentation at the level of an international scientific meeting which is graded separately from the report. EES 4270 Process Geomorphology (IW): Students were

to select five different topics and write papers about each of them. The topics could come from a list of recommendations in the syllabus, or the student could write about a topic (or topics) of their own choice reasonably related to the content of the course. Students were grades were calculated using parameter and rubric included in Supporting Documents. EES 4960 Senior Thesis Research: Literature-based research requiring multiple drafts of a final report of at least 7500 words.

C. Indirect Assessment

An exit survey using a free survey database (Survey Monkey) was sent via email to undergraduate students who completed the EES Program during the 2021-2022 academic year. The 3 question survey asked each graduate to evaluate their learning in EES using a likert scale. (1) Very much, (2) Somewhat , (3) Not at all Question 1: I have mastered basic concepts of earth and environmental science and am able to apply these to the natural world. Question 2: I am proficient in field and laboratory techniques used in the practice of earth and environmental sciences. Question 3: I am able to write detailed scientific reports for appropriate audiences. N=2 Q1: (1) Very much 100%; (2) Somewhat 0%; (3) Not at all 0% Q2: (1) Very Much 50%; (2) Somewhat 50%; (3) Not at all 0% Q3: (1) Very Much 50%; (2) Somewhat 50%; (3) Not at all 0%

III. ASSESSMENT RESULTS/INFORMATION:

a)Grade point earned in concept-related courses and/or assignments. PLO 1. (0-4, where A = 4, B = 3, etc.) b) Grade point earned in field/lab courses. PLO 2. Calculated as average (0-4, where A = 4, B = 3, etc.) c)Grade point earned in writing courses/capstone projects. PLO 3. Calculated as average (0-4, where A = 4, B = 3, etc.) d)Curriculum e) Undergraduate Research

a) Students display mastery in basic concepts of earth and environmental sciences EES 1990: N=10; 4.0 average EES 2510 lecture: N=16; 3.44 average EES 2550 lecture: N=6 ; 2.83 average EES 2550 tectonics simulation: N=6; 4.0 average EES 2550 time scale: N=6; 2.33 average EES 2600 lecture: N=13; 3.46 average EES 3250 research analysis: N=10; 3.4average EES 4010 Water Resources lecture: N=9; 3.67 average EES 4010 Groundwater lecture: N=8; 4.0 average EES 4430 lecture: N= 7; 3.42 average EES 4570 lecture: N=3; 4.0 average b) Students display proficiency in field and laboratory techniques in the practiceof earth and environmental sciences EES 2510 Lab: N=16; 3.38 average EES 2550 Lab: N= 6; 3.67 average EES 4340: N=8; 3.75 average EES 4350: N= 4; 3.0 average c) Students are able to write detailed scientific reports for appropriate audiences EES 3200: N=27; 3.48 average EES 4010 How Nature Works: N=7; 4.0 average EES 3240: N=32; 3.09 average EES 4210: N=9, 2.44 average EES 4270: N=3; 4.0 average EES 4960; N=2; 4.0 average d) The Environmental Sciences Program is undergoing a redesign to incorporate an interdisciplinary approach. e)There are insufficient

experiential learning (research) opportunities to meet the desire of our students.

a) This is a positive trend, but more needs to be done with regard to student retention and success. Integrated measure of all three Learning Outcomes b) Students are proficient in field (Mapping Methods) and field/lab techniques (Limnology and Environmental Field Techniques). They excel because they enjoy these types of courses. Learning Outcome #2 c) Above average (3.0 = B) score among all students shows most are able to write scientific reports. In-class teaching in Spring 2020 was interrupted by COVID-19, whereas other years were entirely in-class. Learning Outcome #3 d) Reinvigorate retired and develop new 2000- and 3000-level courses with a proportional reduction of 4000-level. This is expected to create a clearer education path for our majors, help ensure they are prepared for upper-division courses, and possibly help student retention. This process began in spring 2020. Learning Outcome #1 e) New field courses are needed to complement existing ones. Also noted by students. New courses are being planned for sampling and analysis in Iceland and Bahamas as early as Summer 2021. Learning Outcome #2 f) Develop a First-Year Seminar course to help retain students. Such a course was instructed successfully, based on student feedback, for the first time in Spring 2020. Learning Outcomes #1 and #3 g) Modify (as needed) existing courses so they meet IW standards. This process was initiated in Fall 2019, with two courses meriting IW status, and several others are being considered by undergrad studies committee. Writing for Research (new course) was developed in Fall 2020. Learning Outcome #3 h) Faculty need to create more opportunities for undergraduate involvement in research. Learning Outcomes #1 and #2

IV. ACTIONS TO IMPROVE STUDENT LEARNING

The current EES programs are under revision with the intention of the new Interdisciplinary Environmental Sciences Program being released in fall 2023. The program in Environmental Sciences at Wright State University will be a regional and national leader in scholarship, research and teaching excellence and will provide a significant contribution to the interdisciplinary / complex field of the environmental sciences. To provide a multi-disciplinary program bringing together earth science, biology, ecology, physics and chemistry that will enable a diverse student body to make productive contributions in research, education and service while obtaining overall proficiency in environmental sustainability. An Environmental Steering Committee has formed and is meeting bimonthly to discuss revisions in the program including establishing measurable program learning outcomes and associating the PLOs to existing courses. A newly founded Environmental Advisory Board is being established and will have the first meeting fall 2022. The purpose of the Advisory Board is to advise and assist the Program in strategic planning and development. This includes advice pertaining to creating effective curriculum, experiential learning opportunities, (e.g., internships), implementation of short and long-term goals, community outreach and service, and the garnering of financial support for education, research and scholarship in the environmental sciences. The EES

Undergraduate Studies Committee meets monthly to discuss program and course updates, instructional approaches, current and future course offerings, policies, advising, petitions, and student achievment.

V. SUPPORTING DOCUMENTS

Additional documentation, when provided, is stored in the internal Academic Program Assessment of Student Learning SharePoint site.