**Application for GE Foundations, Natural Science: 4 credits**

1. ENR 2100 - Introduction to Environmental Science Lecture (3 credits)
2. ENR 2101 - Introduction to Environmental Science Laboratory (1 credit)

## Foundations

Please explain in 50-500 words why or how this course is introductory or foundational in the study of Natural Science.

ENR 2100 and ENR 2101 are taught by the School of Environment and Natural Resources (SENR). When taken together (ENR 2100 + ENR 2101) will fulfill 4 credits of the GE Foundations, Natural Science category. Introduction to Environmental Science Lecture (ENR 2100) is a 3-credit course that is currently taught at Ohio State as a Natural Science, Biological Science GE course. Introduction to Environmental Science Lab (ENR 2101) is a brand new 1-credit online laboratory. Both ENR2100 and ENR2101 follow a similar sequence in topics that introduce a wide breadth of study within this highly interdisciplinary field.

ENR 2100 will fulfill Natural Science Goals 1 and 2, and Expected Learning Outcomes (ELOs) 1.1, 1.2, 2.1, 2.2, and 2.3. ENR 2101 will fulfill Natural Science Goal 1 and ELO 1.3. When the 1-credit ENR 2101 laboratory is taken in combination with the 3-credit ENR 2100 lecture, together these 4-credits (i.e., 1-credit lab + 3-credit lecture) fulfills all Goals (i.e., Goals 1 and 2) and all ELOs (i.e., ELOs 1.1, 1.2, 1.3, 2.1, 2.2, 2.3) for the Foundations, Natural Science GE category.

SENR will offer ENR 2100 and ENR 2101 separately as a 3-credit lecture and 1-credit laboratory, rather than combining them together as a 4-credit course. We want to do this because (1) it will allow for greater flexibility for students when scheduling courses, (2) ENR 2101 will be offered exclusively online, while ENR 2100 will be offered as both an in-person synchronous course and an online asynchronous course each semester so that students can choose to take ENR 2100 in-person or online and (3) to accommodate SENR majors who will be required to take ENR 2100 but will not be required to take ENR 2101. Requiring SENR majors to take 4-credits (instead of 3-credits) would put them over the credit limit for earning a B.S. degree and make it difficult for them to finish their B.S. degree in 4 years. In addition, students earning a B.S. degree in SENR are already required and will continue to be required to take natural science labs in biology, chemistry, physics and soil science.

ENR 2100 and ENR 2101 will foster an understanding of the principles, theories, and methods of modern science, the relationship between science and technology, the implications of scientific discoveries and the potential of science and technology to address problems of the contemporary world. Students will develop a foundational knowledge and understanding of natural sciences to evaluate the economic, social and ethical implications of scientific discoveries and new found technologies. Students will learn that environmental science is an interdisciplinary field of study,

which combines practices, theories and methods from the biological sciences, physical sciences and social sciences. Students will develop an understanding for the complex nature of Earth systems, how humans are part of and rely on these natural systems, how human activities contribute to environmental problems, and how changes in human activities, behaviors, beliefs and values can solve environmental problems. Developing scientific literacy skills to encourage life-long learning, will be emphasized throughout the course with high-impact readings, documentaries and the opportunity for students to practice and apply these skills through writing assignments and the creation and presentation of a scientific poster on contemporary topics in environmental science.

ENR 2100 and ENR 2101 will focus on similar topics and follow similar course designs. Course topics will be divided into 13 learning modules (see list below). One module will be taught approximately each week of the semester. Course materials for ENR 2100 and ENR 2101 will be completely free to all students and consist of lecture slides, lecture presentations, lecture transcripts, closed-caption lecture videos, study guides, self-check quizzes, vocabulary lists, journal articles, book chapters, documentaries, software, technical reports, grading rubrics, and data sets. Course materials will be provided to students through Carmen, the Ohio State Libraries, academic, professional or government websites and online open-source textbooks. Course materials have gone through extensive testing and usage to ensure that they meet accessibility guidelines required by the Ohio State Digital Accessibility Policy. Students who receive accommodations through Student Life Disability Services will receive all required accommodations.

Course Modules for ENR 2100 and ENR 2101:

1. Scientific Process and Experimental Design
2. Natural Science Literacy
3. Persistent Pollutants
4. Human Populations
5. Energy, Ecosystems and Population Ecology
6. Community Ecology
7. Biomes and Biodiversity
8. Water Resources and Food Production
9. Protecting Earth’s Water
10. Protecting Earth’s Atmosphere
11. Nonrenewable Energy, Fossil Fuels and Climate Change
12. Alternative and Renewable Energy
13. Sustainable Living

## Specific Goals for Natural Sciences

### **GOAL 1: Successful students will engage in theoretical and empirical study within the natural sciences, gaining an appreciation of the modern principles, theories, methods, and modes of inquiry used generally across the natural sciences.**

**GOAL 1 will be fulfilled in ENR 2100 (Lecture) and ENR 2101 (Laboratory)**

Course Modules for ENR 2100 and ENR 2101:

1. Scientific Process and Experimental Design
2. Natural Science Literacy
3. Persistent Pollutants
4. Human Populations
5. Energy, Ecosystems and Population Ecology
6. Community Ecology
7. Biomes and Biodiversity
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9. Protecting Earth’s Water
10. Protecting Earth’s Atmosphere
11. Nonrenewable Energy, Fossil Fuels and Climate Change
12. Alternative and Renewable Energy
13. Sustainable Living

**Expected Learning Outcome 1.1: Successful students are able to explain basic facts, principles, theories and methods of modern natural sciences; describe and analyze the process of scientific inquiry.** Please link this ELO to the course goals and topics and indicate specific activities/assignments through which it will be met. *(50-700 words)*

## ELO 1.1 will be fulfilled in ENR 2100 (Lecture)

## ENR 2100 - Exams (2 exams per semester, 25% each, 50% total): Students will complete a total of 2 exams each semester. Each exam will consist of 50 questions that focus on 7 weekly course modules. Exams will be completed using Carmen and open for 7 days to accommodate all students. Each exam will be unique and worth 25% of a student’s Final Grade for ENR 2100. Students will have two attempts and we will keep the highest score between both attempts. Each attempt will contain new questions and answers. Exams will focus on readings, lecture slides and lecture presentations. Exams are open-book, however, students must complete the work on their own without help from peers.

## ENR 2100 - Objectives of exams:

1. Evaluate student learning at the end of weekly course modules.
2. Assess reading comprehension, problem solving skills, critical thinking and vocabulary usage.
3. Assess understanding of key concepts principles, theories, and methods.

## ENR 2100 - For each exam, students will be required to:

## Answer multiple-choice, true/false, matching and fill-in-the-blank questions. These questions will be based on lecture slides and presentations given by the instructor.

1. Analyze and interpret data presented in figures, graphs and tables.
2. Use reasoning skills to solve problems using mathematics and statistics.
3. Make quantitative comparisons of data presented in graphs and tables.

**Expected Learning Outcome 1.2: Successful students are able to identify how key events in the development of science contribute to the ongoing and changing nature of scientific knowledge and methods.** Please link this ELO to the course goals and topics and indicate specific activities/assignments through which it will be met. *(50-700 words)*

## ELO 1.2 will be fulfilled in ENR 2100 (Lecture)

## ENR 2100 - Quizzes (5 quizzes per semester, 5% each, 25% total): Students will complete a total of 5 quizzes each semester, all of which will be completed using Carmen. Quizzes will be open for 7 days to accommodate all students. Each quiz will contain 10-20 questions that focuses on 1-2 weekly course modules. Students will have two attempts and we will keep the highest score between both attempts. Each attempt will contain new questions and answers. Each quiz will be unique and worth 5% of a student’s Final Grade for ENR 2100. These quizzes are open-book, however, students must complete the work on their own without help from peers. Quizzes will focus on readings and course materials.

## ENR 2100 - Objectives of quizzes:

## Understand how data is collected by scientists, why replication is important in experiments. Analyze the process of scientific inquiry, principles, theories and methods of natural science.

1. Critically evaluate and responsibility use information from the natural sciences. Analyze data using statistics.
2. Learn how our knowledge and understanding about a scientific discipline has changed over time through the generation of testable explanations and predictions, newfound knowledge, new techniques and new instrumentation.
3. Recognize social and ethical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.

## ENR 2100 - For each quiz, students will be required to:

## Read articles, book chapters and/or technical reports provided by instructor on Carmen or Ohio State Libraries. Watch short documentaries or instructional videos. There will be no cost to the student, all readings and videos will be free.

## Answer multiple-choice, true/false, matching and fill-in-the-blank questions. These questions will be based on the articles and book chapters students read, documentaries and instructional videos students watch and data that students collect and analyze.

**Expected Learning Outcome 1.3: Successful students are able to employ the processes of science through exploration, discovery, and collaboration to interact directly with the natural world when feasible, using appropriate tools, models, and analysis of data.** Please explain the 1-credit hour equivalent experiential component included in the course: e.g., traditional lab, course-based research experiences, directed observations, or simulations. Please note that students are expected to analyze data and report on outcomes as part of this experiential component. *(50-1000 words)*

## ELO 1.3 will be fulfilled in ENR 2101 (Laboratory)

## ENR 2101 - Weekly Participation Activities (15 activities per semester, 1% each, 15% total): Each student will complete a total of 15 weekly participation assignments this semester (1 activity per week), all of which will be submitted on Carmen. Each activity will be open for 7 days to accommodate all students. Each activity will be unique and worth 1% of the student’s Final Grade for ENR 2101. These assignments are open-book, however, a student must complete the work on their own without help from peers. A student who demonstrates good faith effort on all aspects of the weekly participation activity and demonstrated engagement in the activity will receive full credit.

## ENR 2101 - Objectives of weekly participation activities:

1. To introduce students to each week’s lab through readings, instructions or activities.
2. To serve as a formal weekly check-in that promotes and encourages two-way communication between student and instructor.
3. To graph data or organize data in a table. How to calculate mean, standard deviation, range. To compare data between different scientific studies.

ENR 2101 - For each weekly participation activity, students will be required to:

1. Complete a small 15–20-minute task (e.g., graph data, identify unknown samples, construct a scientific table, analyze and/or interpret data) that will be paired with topics contained in weekly modules.

## Written Laboratory Assignments (10 assignments per semester, 5.5% each, 55% total): You will complete a total of 10 laboratory assignments over 5 labs this semester, all of which will be submitted on Carmen and due on Sundays at 11:59PM. Each lab will be conducted over two weeks and comprise of two related laboratory assignments. For example, Lab Assignment 1 and Lab Assignment 2 will both pertain to the first lab on Experimental Design (see course schedule within syllabus). Within the first lab assignment, you will collect and report data. Within the second lab assignment you will summarize and analyze class data collected in the first lab assignment. Each assignment will be unique and worth 5.5% of your Final Grade for the course. Therefore, each lab will be worth 11% of your Final Grade (5.5% x 2 assignments = 11%) These assignments are ope-book. Assignments will be available on Carmen for 7 days to

## accommodate all students. Readings, data sets, and instructional videos that are required for laboratory assignments will all be free and provided through Carmen.

## Objectives of written laboratory assignments:

1. Describe common instruments, equipment, techniques and methods used by scientists to collect data. Learn about protocols, operation, benefits and limitations of each.
2. Use described methods to collect data and report data to peer group.
3. Analyze consolidated peer group data through calculations (i.e., mean, p-value, standard deviation).
4. Summarize consolidated peer group data through visualizations (i.e., graphs, charts, tables).

## Each written laboratory assignment will consist of two parts and you will be required to:

## Part 1 - Learn about the lab procedure and how scientists have used the technique or methods in the peer-reviewed literature. Execute the experiment and report standardized data to your peer group on Carmen. Create, analyze and interpret graphs and tables using Microsoft Word and Microsoft Excel.

## Part 2 - Answer short-answer and essay-style questions. These questions will be based on the data that you collect and analyze, and experiments that you conduct on your own at home. Some questions will require you to complete calculations, plot data, produce tables, and describe procedures and experimental approaches.

## ENR 2101 - Scientific Poster Assignments (5 assignments per semester, 6% each, 30% total): Students will complete a total of 5 scientific poster assignments this semester, all of which will be submitted on Carmen. Each assignment will be unique and worth 6% of a student’s Final Grade for ENR 2101. These assignments are open-book, however, students must complete the work on their own without help from peers. An open textbook titled “Scientific Posters, A Learners Guide” will serve as a reference as students complete poster assignments: <https://ohiostate.pressbooks.pub/scientificposterguide/>. This textbook is free to all students.

## ENR 2101 - Objectives of scientific poster assignments:

## Locate primary source journal article using Web of Science, PubMed or another search engine.

## Understand how journal articles are organized (e.g., abstract, introduction, results) and how to read an article, find information, interpret data and become proficient at reading and understanding figures, graphs and tables.

## Become familiar with scientific writing and how to effectively communicate results, information, data, and technical material in a scholarly work (e.g., poster, journal article, technical report).

## Conduct peer review and understand its importance to the scientific process.

## Create scientific figure and tables. Write a caption for each figure and table.

ENR 2101 - Five scientific poster assignments that students will complete each semester:

## Poster Assignment 1: Find, download and read 6 primary source journal articles using Ohio State University Libraries’ free online resources (<https://library.osu.edu/>). These articles should all focus on the same topic and/or issue of a student’s choice. issue of a student’s choice. Find, read or watch 4 secondary sources on this same topic and/or issue. Write a concise 200–300-word summary of the information found in sources.

1. Poster Assignment 2: Write a title, abstract and introduction section for scientific poster.
2. Poster Assignment 3: Use Microsoft PowerPoint and Excel to create a total of 4 figures and/or tables for poster. Figures can be charts, diagrams, graphs, illustrations, images, maps, photographs. Using data from journal articles, students will create at least 1 original graph and 1 original table for their poster.

## Poster Assignment 4: Create a scientific poster using PowerPoint from a template that is provided by instructor. This poster will contain a title, author information, introduction, materials and methods, results, discussion, references, figures and tables.

## Poster Assignment 5: Students will record a 5-minute poster presentation and upload the audio file and a PDF file of their poster to the Virtual Poster Event on Carmen. Students will conduct peer reviews for 2 of their classmates’ poster presentations.

**GOAL 2: Successful students will discern the relationship between the theoretical and applied sciences, while appreciating the implications of scientific discoveries and the potential impacts of science and technology.**

**GOAL 2 will be fulfilled in ENR 2100 (Lecture)**

Course Modules for ENR 2100 and ENR 2101:

1. Scientific Process and Experimental Design
2. Natural Science Literacy
3. Persistent Pollutants
4. Human Populations
5. Energy, Ecosystems and Population Ecology
6. Community Ecology
7. Biomes and Biodiversity
8. Water Resources and Food Production
9. Protecting Earth’s Water
10. Protecting Earth’s Atmosphere
11. Nonrenewable Energy, Fossil Fuels and Climate Change
12. Alternative and Renewable Energy
13. Sustainable Living

**Expected Learning Outcome 2.1: Successful students are able to analyze the inter-dependence and potential impacts of scientific and technological developments.**Please link this ELO to the course goals and topics and indicate specific activities/assignments through which it will be met. *(50-700 words)*

## ELO 2.1 will be fulfilled in ENR 2100 (Lecture)

## ENR 2100 - Exams (2 exams per semester, 25% each, 50% total): Students will complete a total of 2 exams each semester. Each exam will consist of 50 questions that focus on 7 weekly course modules. Exams will be completed using Carmen and open for 7 days to accommodate all students. Each exam will be unique and worth 25% of a student’s Final Grade for ENR 2100. Students will have two attempts and we will keep the highest score between both attempts. Each attempt will contain new questions and answers. Exams will focus on readings, lecture slides and lecture presentations. Exams are open-book, however, students must complete the work on their own without help from peers.

## ENR 2100 - Objectives of exams:

1. Evaluate student learning at the end of weekly course modules.
2. Assess reading comprehension, problem solving skills, critical thinking and vocabulary usage.
3. Assess understanding of key concepts principles, theories, and methods.

## ENR 2100 - For each exam, students will be required to:

## Answer multiple-choice, true/false, matching and fill-in-the-blank questions. These questions will be based on lecture slides and lecture presentations given by the instructor.

1. Analyze and interpret data presented in figures, graphs and tables.
2. Use reasoning skills to solve problems using mathematics and statistics.
3. Make quantitative comparisons of data presented in graphs and tables.

**Expected Learning Outcome 2.2: Successful students are able to evaluate social and ethical implications of natural scientific discoveries.**Please link this ELO to the course goals and topics and indicate specific activities/assignments through which it will be met. *(50-700 words)*

## ELO 2.2 will be fulfilled in ENR 2100 (Lecture)

## ENR 2100 – Writing Assignments (5 assignments per semester, 5% each, 25% total): Students will complete a total of 5 writing assignments each semester, all of which will be submitted on Carmen. Each assignment will be unique and worth 5% of a student’s Final Grade in ENR 2100. Assignments will be open on Carmen for 14 days to accommodate all students. Readings, data sets, documentaries that are required for writing assignments will all be free and provided through Carmen or links to these materials will be provided on Carmen. These assignments are open-book, however, a student must complete the work on their own without help from peers.

## ENR 2100 - Objectives of writing assignments:

1. Locate primary source journal article using Web of Science, PubMed or another search engine.
2. Understand how journal articles are organized (e.g., abstract, introduction, results) and how to read an article, find information, interpret data and become proficient at reading and understanding figures, graphs and tables.
3. To make informed decisions and develop potential solutions to environmental issues based on published scientific articles, results and data.
4. Develop skills and gain experience in scientific writing and how to effectively present data using figures and tables.
5. Gain an appreciation for how discoveries in natural science often requires collaboration between many scientists from many different specializations.

## ENR 2100 - For each writing assignment, students will be required to:

## Answer short-answer and essay-style questions. These questions will be based on readings, documentaries or data provided by academic or governmental institutions. Some questions will require students to use formulas and equations, complete calculations, calculate statistical values, plot data, produce tables, and describe procedures and experimental approaches.

1. Use reasoning skills to propose method, protocol or technique that could be utilized to solve an environmental problem.
2. Evaluate the economic, social and ethical implications of scientific discoveries and new technologies.

**Expected Learning Outcome 2.3: Successful students are able to critically evaluate and responsibly use information from the natural sciences.** Please link this ELO to the course goals and topics and indicate specific activities/assignments through which it will be met. *(50-700 words)*

## ELO 2.3 will be fulfilled in ENR 2100 (Lecture)

## ENR 2100 - Quizzes (5 quizzes per semester, 5% each, 25% total): Students will complete a total of 5 quizzes each semester, all of which will be completed using Carmen. Quizzes will be open for 7 days to accommodate all students. Each quiz will contain 10-20 questions that focuses on 1-2 weekly course modules. Students will have two attempts and we will keep the highest score between both attempts. Each attempt will contain new questions and answers. Each quiz will be unique and worth 5% of the Final Grade for ENR 2100. These quizzes are open-book, however, students must complete the work on their own without help from peers. Quizzes will focus on readings and course materials.

## ENR 2100 - Objectives of quizzes:

## Understand how data is collected by scientists, why replication is important in experiments. Analyze the process of scientific inquiry, principles, theories and methods of natural science.

1. Critically evaluate and responsibility use information from the natural sciences. Analyze data using statistics.
2. Learn how our knowledge and understanding about a scientific discipline has changed over time through the generation of testable explanations and predictions, newfound knowledge, new techniques and new instrumentation.
3. Recognize social and ethical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.

## ENR 2100 - For each quiz, students will be required to:

## Read articles, book chapters and/or technical reports provided by instructor on Carmen or Ohio State Libraries. Watch short documentaries or instructional videos. There will be no cost to the student, all readings and videos will be free.

## Answer multiple-choice, true/false, matching and fill-in-the-blank questions. These questions will be based on the articles and book chapters that students read, documentaries and instructional videos that students watch and data that students collect and analyze.