

Title

“The Habitable Planet: A Systems Approach to Environmental Science”
A Special Collection from the Annenberg Foundation

Target Audience

This course is intended for pre-service and in-service teachers of grades 9-12.

Prerequisites

To successfully participate and complete the assignments in this course, the learner must:

- Have past experience using the classroom computer.
- Have past experience working with the Internet.
- Be familiar with taking an online course or have completed the PBS “Practice Learning Online with PBS TeacherLine” course.
- Be familiar with high school science curriculum.

Course Description

This inquiry-based course will enable learners to research and explore the concepts from *The Habitable Planet* course from Annenberg Learner. They will use the applicable concepts and resources from the course that meet their curriculum and student-learning needs. During the course, learners will:

- Explore how using an inquiry-based approach based on the scientific and engineering practices makes science instruction meaningful and engaging to students.
- Determine an instructional change to their teaching based on scientific thinking, the scientific and engineering practices and *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*.
- Develop a dynamic conceptual framework using essential questions for a self-guided study of *The Habitable Planet* course.
- Design a science unit that engages students in environmental science topics and develops their scientific thinking skills.

Instructor/Facilitator

See instructor/facilitator sheet.

Credits

To be determined by college or university.

Goals

The overall goal of this course is to educate high school teachers about the importance of inquiry-based learning based on the scientific and engineering practices in the science classroom and how it may be applied when studying environmental science concepts.

By the end of the course, learners will be able to apply the following in their teaching practice:

- Understand how using an inquiry-based approach based on the scientific and engineering practices makes science instruction meaningful and engaging to students.
- Determine an instructional change to their teaching and develop a teaching unit based on scientific thinking, the scientific and engineering practices, and *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*.
- Understand the natural functioning of the different Earth systems.
- Know about the effects of human actions on different natural systems.

Outline of Content and Assignments

After previewing the documents in the Course Information area, learners will proceed to Course Content to complete the following six sessions in order. Throughout the sessions, learners are asked to articulate their ideas in various forms and encouraged to reflect on their thoughts and experiences. The discussion forums are designed to allow learners to glean information from other learners' experiences. For the course project, learners will create an instructional unit that they can implement in the classroom and use to engage students in learning about environmental science.

This course specifically addresses the following standards:

- ISTE NETS*T 1 (a, b, c, d); 2 (a, b); & 5 (a, c)
- *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* by the National Research Council
- Common Core State Standards for Mathematical Practices

Session 1: Scientific Thinking and Practices

During Session 1, learners will explore the principles of inquiry-based learning based on the scientific and engineering practices from the recently published *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Learners will read about essential questions and how to engage students to think scientifically using essential questions. This session sets the stage for the remaining work in the course. Learners will implement the principals discussed in this session and determine their approach to exploring the many resources and materials in this course based on their curriculum and students' learning needs.

During this session, learners will:

- Define your professional goals and expectations for this course.
- Explain your prior knowledge and experiences teaching science.
- Discuss how using an inquiry-based approach based on the scientific and engineering practices makes science instruction meaningful and engaging to students.
- Determine and rationalize an instructional change to your teaching based on best practices. (Course Project)

Read:

- "Scientific and Engineering Practices in K-12 Classrooms - Understanding A Framework for K-12 Science Education"
- "From Trivial Pursuit to Essential Questions and Standards-Based Learning"
- "What is an Essential Question?"

Participate in Online Discussions:

- Introduce themselves to other learners.
- Discuss how using an inquiry-based approach based on the scientific and engineering practices makes environmental science instruction personally meaningful and engaging to students.

Watch Videos

- “Physics by Inquiry”
- Essential Questions Videos 1 and 2

Complete Journal Reflections:

- Reflect on expectations for the course.
- Reflect on prior knowledge and experiences related to teaching science.

Complete Activities and Assignments:

- Review course expectations, schedule, and format and the course project requirements.

Session 2: Many Planets, One Earth

In this session, learners will explore parts of Unit 1 “Many Planets, One Earth” together keeping in mind the course project and their own curricular and students’ needs. This unit will familiarize learners with the structure, style, and elements of the Annenberg Learner units to facilitate the independent exploration of the remaining 12 units during Sessions 3-5. The content and structure introduced in this session will assist learners with the content and structure in the other units they choose to explore and incorporate into their Course Project.

During this session learners will examine the key conditions that make Earth habitable and compare these conditions with neighboring planets. Learners will explore the carbon cycle and the relationship between increased concentrations of CO₂ and the impact on the systems of the Earth. This unit also describes how Earth’s carbon cycle regulates its climate and keeps surface temperatures within a habitable range. Another central factor is also examined: the rise of free oxygen in the atmosphere starting more than 2 billion years ago. By engaging in the interactive “The Carbon Cycle” learners will gain a sense of how the carbon cycle works.

During this session, learners will:

- Identify the misconceptions they have about Earth and its history and how to best determine the misconceptions held by students.
- Experiment with the human factors that contribute to the rise in atmospheric CO₂ levels and manipulate inputs to the carbon cycle itself in an interactive lab.
- Discuss how to prepare students for studying about planet Earth.
- Determine and rationalize an instructional change to their teaching based on best practices (Course Project).

The following essential questions will guide learners through this session:

- How is it that a one-time collection of cosmic dust has gradually changed over time and produced this incredible planet with its tremendous biological diversity?
- What transitions has Earth gone through and why?
- How does the Earth’s carbon cycle act as a thermostat?

Read:



- “Carbon Cycling and Earth’s Climate”
- “Testing the Thermostat: Snowball Earth”
- “Atmospheric Oxygen”

Watch Videos:

- “Many Planets, One Earth”

Engage in Interactive:

- First lesson in Carbon Lab interactive “The Carbon Cycle”

Participate in Online Discussions:

- Discuss how to use the resources and techniques experienced in this course to help students understand how Earth has become the “habitable planet”.

Complete Journal Reflections:

- Reflect on misconceptions about Earth and how to determine the misconceptions held by students.

Complete Activities and Assignments:

- Complete “The Carbon Cycle” Data Table
- Complete Course Project: Part 1

Sessions 3-5

In Sessions 3-5 of the course, learners will independently explore twelve units (Units 2 -13 described below) compiled of multimedia materials designed to help them discover a unique look about environmental science and:

- Develop a dynamic conceptual framework for the study of science, its theoretical constructs, and the scientific and engineering practices.
- Establish a thorough grasp of inquiry-based teaching utilizing the scientific and engineering practices for engaging students and helping them to think critically to construct knowledge.
- Design a science unit that engages students in environmental science topics and develops their scientific thinking skills.

Using an inquiry-based approach, learners will follow their own research path to explore video, interactives, the Web, and text materials, which provide a comprehensive and interactive learning experience. Learners will use the course materials to develop their course project: An inquiry-based instructional unit that includes 2-5 essential questions to teach an environmental theme or concept from their required curriculum.

Each unit consists of a/an:

- Unit overview
- 30-minute video with viewing guides keyed to each video segment (found in each unit’s Professional Development Guide)
- Online text chapters
- Visuals which can be downloaded
- Interactive labs (available for Units 1-7, 9-10, 12-13)
- Glossary of science terms

- A Professional Development Guide that provides many ideas and resources for further activities, background for videos and interactives, and common misconceptions relevant to that Unit's main ideas.

Each week, learners will come together as an online community in the discussion forum to share their course project drafts, review each other's instructional plans, discuss different pedagogical approaches, and offer "not to be missed" resources from the units.

Learners will also be required to submit weekly journal reflections and assignments, as follows, indicating their thinking and work toward completing their course project and the resources they have explored each week.

- Session 2: Learners will submit Part 1: Making a Change.
- Session 3: Learners will submit Part 2: Research & Exploration.
- Session 4: Learners will complete Part 3: Theory to Practice
- Session 5: Learners will complete Part 4: Share & Collaborate
- Session 6: Learners will complete Part 5: Finalize and Submit

Unit Titles and Descriptions:

Unit 1. Many Planets, One Earth

Astronomers have discovered dozens of planets orbiting other stars, and space probes have explored many parts of our solar system, but so far scientists have only discovered one place in the universe where conditions are suitable for complex life forms: Earth. What are the unique characteristics that make our planet habitable and how were these conditions created?

Unit 2. Atmosphere

The atmosphere is a critical system that helps to regulate Earth's climate and distribute heat around the globe. What are the fundamental processes that cause atmospheric circulation and create climate zones and weather patterns? How does carbon cycling between atmosphere, land, and ocean reservoirs help regulate Earth's climate?

Unit 3. Oceans

Oceans cover three-quarters of the Earth's surface, but many parts of the deep oceans have yet to be explored. How do large-scale ocean circulation patterns help regulate temperatures and weather patterns on land? What kind of microscopic marine organisms form the base of marine food webs?

Unit 4. Ecosystems

Why are there so many living organisms on Earth, and so many different species? How do the characteristics of the nonliving environment, such as soil quality and water salinity, help determine which organisms thrive in particular areas? This unit considers how scientists study ecosystems to predict changes over time and how the ecosystems respond to human impacts.

Unit 5. Human Population Dynamics

What factors influence human population growth trends most strongly, and how does population growth or decline impact the environment? Does urbanization threaten our quality of life or offer a pathway to better living conditions? What are the social implications of an aging world population? This unit examines how demographers approach these questions through the study of human population dynamics.

Unit 6. Risk, Exposure and Health



Humans are exposed to numerous chemicals every day from environmental sources such as air and water pollution, pesticides, cleaning products, and food additives. Some of these chemicals are threats to human health, but tracing exposures and determining what levels of risk they pose is a painstaking process. How do harmful substances enter the body, and how do they damage cells? How are dangers assessed, what kind of regulations help to reduce exposures, and how are human health risks managed?

Unit 7. Agriculture

In many nations, the need to feed a growing population is spurring an intensification of agriculture—finding ways to grow higher yields of food, fuel, and fiber from a given amount of land, water, and labor. What are the physical and environmental factors that limit crop growth and how can agriculture's extensive environmental impacts be minimized?

Unit 8. Water Resources

Earth's water resources, including rivers, lakes, oceans, and underground aquifers, are under stress in many regions. Humans need water for drinking, sanitation, agriculture, and industry; and contaminated water can spread illnesses and disease vectors, so clean water is both an environmental and a public health issue. How is water distributed around the globe? How does it cycle among the oceans, atmosphere, and land? This unit examines how human activities are affecting our finite supply of usable water.

Unit 9. Biodiversity Decline

Living species on Earth may number anywhere from 5 million to 50 million or more. Although we have yet to identify and describe most of these life forms, we know that many are endangered today by development, pollution, over-harvesting, and other threats. This unit demonstrates how scientists measure biodiversity, how biodiversity benefits our species, and what trends might cause Earth's next mass extinction due to biodiversity decline.

Unit 10. Energy Challenges

Industrialized nations rely on vast quantities of readily available energy to power their economies and produce goods and services. As populations increase in developing countries and citizens demand better standards of living, global energy consumption will continue to rise. What are the new technologies that can produce ample supplies of energy without some of the environmental costs linked to current energy resources?

Unit 11. Atmospheric Pollution

What forms of atmospheric pollution affect human health and the environment at levels from local to global? Industrialized nations have made important progress toward controlling some pollutants in recent decades, but air quality is much worse in many developing countries, and global circulation patterns can transport some types of pollution rapidly around the world. This unit examines the basic chemistry of atmospheric pollution and shows which human activities have the greatest impacts on air quality.

Unit 12. Earth's Changing Climate

Earth's climate is a sensitive system that is subject to dramatic shifts over varying time scales. Today human activities are altering the climate system by increasing concentrations of heat-trapping greenhouse gases in the atmosphere, which raises global temperatures. This unit examines the science behind global climate change and explores its potential impacts on natural ecosystems and human societies.

Unit 13. Looking Forward: Our Global Experiment

What type of emerging technologies offer potential solutions to environmental problems? Can human ingenuity ensure the survival not only of our own species but of the complex ecosystems that enhance the quality of human life? This unit explores the wide range of efforts now underway to mitigate the worst effects of man-made environmental change, looking toward those that will have a positive impact on the future of our habitable planet.

Session 6: Moving Forward to Engage Students

In this final session, learners will complete and submit their Course Projects. Learners will read an article on what high-quality teaching looks like in a science classroom. They will also think about how to continue the exploration of inquiry with their students and read about Howard Gardner's latest theories on nurturing the development of certain mindsets for the 21st century. Learners will finish their work by reflecting on their acquired knowledge and ongoing professional development goals, while also saying goodbye to their fellow online learners.

Learners will:

- Develop an instructional unit that incorporates essential questions and develops students' scientific thinking skills while utilizing the scientific and engineering practices. (Course Project)
- Discuss the types of mindsets that inquiry-based learning using the scientific and engineering practices best helps to develop in the classroom.
- Assess their learning in this course by comparing their prior knowledge and acquired knowledge.
- Analyze the learning experience in this course by reflecting on their professional goals and expectations.

Read:

- "Before It's Too Late: A Report to the Nation from the National Commission on Mathematics and Science Teaching for the 21st Century"
- "5 Minds for the Future: Cultivating Thinking Skills"

Complete Journal Reflections:

- Reflect on acquired knowledge.
- Reflect on professional goals and expectations.

Participate in Online Discussions:

- Discuss which of the mindsets the use of inquiry-based learning based on the scientific and engineering practices best helps to develop.

Complete Activities and Assignments:

- Submit final version of the Course Project: Habitable Planet Instruction
- Post-Course Evaluation Survey

Schedule

This course is scheduled to take approximately 45 hours to complete. Each session spans one week. The number of hours identified for each session reflects time spent online, but does not reflect the total time spent completing offline coursework and assignments. All learners are different and some may spend double the indicated number of hours completing all coursework depending on learning styles and work habits.

Requirements

Learners are expected to:

- Complete all assignments.
- Participate and actively engage in discussions with fellow learners while contributing to the social construction of knowledge.
- Be self-directed and self-motivated.
- Ask for assistance when they need it.

Materials (hardware, software, plug-ins)

Technical Requirements

- Word processor
- Internet service provider
- E-mail

Academic Dishonesty Policy

To be inserted by university institution only.

Evaluation

This course is evaluated on a letter grade basis, and may be available for graduate credit. See graduate credit details pertaining to specific graduate credit institutions.

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