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Advanced Placement Coursework

and Expanding Understanding of Environmental Science

Does the Advanced Placement (AP) environmental science coursework, available through the College Board, prepare students for college-level environmental science classes and properly introduce them to real-world practice in the field? And, what are some of the resources and techniques available to expand student understanding and appreciation of the environmental profession?

AP Environmental Science Coursework

According to the College Board website's description of the Advanced Placement (AP) Environmental Science Course:

"The goal of the AP Environmental Science course is to provide students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world, to identify and analyze environmental problems both natural and human-made, to evaluate the relative risks associated with these problems, and to examine alternative solutions for resolving and/or preventing them."

An admirable goal, but is it achieved via the coursework? Looking at the course content, there are several themes that, according to the College Board, "provide a foundation for the structure of the AP Environmental Science course." The themes are specific and certainly address key aspects of the environmental field:

1. Science is a process.
2. Energy conversions underlie all ecological processes.
3. The Earth itself is one interconnected system.
4. Humans alter natural systems.
5. Environmental problems have a cultural and social context.
6. Human survival depends on developing practices that will achieve sustainable systems.

These foundational themes afford an anchor of objectivity and an overarching guide for the course content.

The Environmental Science outline on the AP website lists major subject areas and provides percentages to show "the relative emphasis that should be placed on the topics in the course." All of the main topics listed below are weighted at 10–15 percent, except for the topic of "Pollution," which is given the strongest emphasis at 25–30 percent.

AP Environmental Science Major Subject Areas

I. Earth Systems and Resources

A. Earth Science Concepts
B. The Atmosphere
C. Global Water Resources and Use
D. Soil and Soil Dynamics

II. The Living World

A. Ecosystem Structure
B. Energy Flow
C. Ecosystem Diversity
D. Natural Ecosystem Change
E. Natural Biogeochemical Cycles

III. Population

A. Population Biology Concepts
B. Human Population
    1. Human population dynamics
    2. Population size
    3. Impacts of population growth

IV. Land and Water Use

A. Agriculture
    1. Feeding a growing population
    2. Controlling pests
B. Forestry
C. Rangelands
D. Other Land Use
    1. Urban land development
    2. Transportation infrastructure
    3. Public and federal lands
    4. Land conservation options
    5. Sustainable land-use strategies
E. Mining
F. Fishing
G. Global Economics

V. Energy Resources and Consumption

A. Energy Concepts
B. Energy Consumption
    1. History
    2. Present global energy use
    3. Future energy needs
C. Fossil Fuel Resources and Use
D. Nuclear Energy
E. Hydroelectric Power
F. Energy Conservation
G. Renewable Energy

VI. Pollution

A. Pollution Types
    1. Air pollution
    2. Noise pollution
    3. Water pollution
    4. Solid waste
B. Impacts on the Environment and Human Health
    1. Hazards to human health
    2. Hazardous chemicals in the environment
C. Economic Impacts

VII. Global Change

A. Stratospheric Ozone
B. Global Warming
C. Loss of Biodiversity
    1. Habitat loss; overuse; pollution; introduced species; endangered and extinct species
    2. Maintenance through conservation
    3. Relevant laws and treaties

The AP website provides much further details on the subject matter outlined above. From the website (https://apstudent.collegeboard.org/apcourse/ap-environmental-science/course-details), environmental science instructors can gain additional insight on essential course content.

Expanding Environmental Science Understanding and Appreciation

From my own present and past environmental and atmospheric science instruction to college students, beginning in the

mid-1980s, I find the breadth and depth of topics in the AP course of study to be quite adequate to introduce students to the wide-ranging field of environmental science. Much of the content matches that of college-level textbooks in the field.

I can add that during teaching of an introductory session of college environmental science, I write on the board in big capital letters: "PERSPECTIVE". In general, perspective is sorely missing from teaching about the environment, and, in some cases, environmental practice.

Many who teach environmental science may have quite limited real-world experience in the subject matter. This is not unusual for this field since, as the wide range of AP topics above indicates, there is much to know about the discipline. To fill in the knowledge gap and expand perspective a bit, instructors may wish to explore some useful background material.

A recent book is helpful to expanding perspective. Ecologist Chris D. Thomas, professor of conservation biology at the University of York, UK, examines "the responses of species and ecosystems to human impacts over periods that range from years to millennia" in *Inheritors of the Earth: How Nature Is Thriving in an Age of Extinction* (PublicAffairs, September 2017; https://www.amazon.com/Inheritors-Earth-Nature-Thriving-Extinction/dp/1610397274). Professor Thomas embarks on "a round-the-world tour of the planet's diverse continents and far-flung islands, visiting locations where [his] research has taken [him] over the past several decades."

Inheritors of the Earth is a thoroughgoing study of the vast variety of species and their evolution. The book thoughtfully challenges traditional negative views of nature and humans interaction with nature. The interaction isn't necessarily all bad, and may likely be mostly good. *Inheritors of the Earth* provides ample examples of how original habitats are "not so much destroyed as replaced by a new environment that still contains quite a lot of species."

Field-tested Thomas provides plenty of much needed perspective on biosphere issues, filling in missing ecological context.

Another helpful, although much older, book that challenges conventional viewpoint is *Human Nature: A Blueprint for Managing the Earth—by People for People* (Times Books, 2004; https://www.amazon.com/Human-Nature-Blueprint-Managing-Earth/dp/0805072489) by physicist and prolific science author James Trefil. In *Human Nature*, Trefil promotes a benefit-to-humans principle that the global ecosystem "should be managed to maximize the welfare, broadly conceived, of human beings." Trefil promotes the use of the most recent advanced technology in informatics, genomics, experimental ecology, and the like, to better understand and more efficiently address environmental challenges.

Exposing students to ideas such as from Thomas and Trefil provides them with a broader vista of the environmental field. Furthermore, coupling classroom lectures and textbook descriptions with laboratory demonstrations can greatly improve student understanding and spark their interest in an environmental career.

For instance, the September 2017 issue of the *Bulletin of the American Meteorological Society* features a cover-story article by Lodovica Illari, John Marshall, and W.D. McKenna of the Massachusetts Institute of Technology. The article—"Virtually Enhanced Fluid Laboratories for Teaching Meteorology" (http://journals.ametsoc.org/doi/full/10.1175/BAMS-D-16-0075.1)—describes the "Weather in a Tank" laboratory, which demonstrates Hadley cells of atmospheric circulation based on a physical and computer-generated simulation derived from a circulating cylinder apparatus.

The laboratory "illustrates how fundamental principles of rotating fluid dynamics shape the observed structure of atmospheric circulation." The theoretical and immensely practical pedagogical aspects of the body of the article includes an appendix that gives details on the construction of the virtual fluid laboratory. The "Weather in a Tank" laboratory is worthwhile to read and apply to introductory atmospheric science course instruction and the portion of environmental science courses that address weather and climate.

Additional practical teaching ideas can be found in several articles addressing the relationship between environmental science and instructional goals and tasks that engage students in the learning process (https://eponline.com/articles/2004/09/01/a-real-world-approach.aspx?admgarea=ht.industry-trends); improved methods to help students "see" invisible physical phenomena (https://eponline.com/articles/2005/09/01/classroom-vision.aspx?admgarea=Features), such as the dispersion of air pollutants; and edgy topics like the ethics and benefits of covering bioterrorism in an environmental science classroom (https://eponline.com/articles/2003/09/01/bioterrorism-education.aspx).

The Future of the Practice

Environmental practitioners of tomorrow will continue to be called upon to successfully complete complex tasks that improve environmental conditions for people and the planet as well as increase the knowledge and stature of the profession. Supplementary texts that expand environmental perspective, innovative pedagogical techniques, and the AP content go a long way toward preparing students for a promising future, if they choose to pursue the discipline in college and beyond. **em**

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