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## Environmental Science: An Introduction

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**Abstract** The environment is an important part of our daily lives. Today, we are facing serious environmental challenges. Environmental science is a multi-disciplinary discipline that embraces biology, chemistry, physics, agriculture, public health, technology, law, arts, etc. It studies all aspects of the environment in an interdisciplinary manner. Nearly any topic can be studied in terms of its relationship with the natural environment. It is essential to make the public aware of the dire consequences of the environmental degradation. This paper provides a brief introduction to environmental science.

**Keywords** environment, environmental science, environmental studies

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### Introduction

Our existence on this planet requires abundance of land, air, and water. Without doubt, the rapid technological development in the twentieth century has very adversely impacted the environment. To ensure a sustainable development we need to know something about how our environment works. Environment may be regarded as all external conditions and factors that affect living organisms. It is the total of surroundings (air, water, soil, vegetation, people, wildlife) influencing each living being's existence. It literally means the surrounding external conditions influencing development of people, animal or plants [1]. Our environment affects everything we do, from climate changes to air quality, and much more. Science is the desire to find out how something happens. It may be regarded as all of the fields of study that attempt to comprehend the nature of the universe.

The threat to the environment has been increasing. People around the world are experiencing environmental problems such as rising population, poverty, air and water pollution, food insecurity, flood management, land management, deforestation, endangered species, climate change, etc. Careless handling of today's environment would affect tomorrow's generation. Hence, a judicious use of our resources is called for.

### What is Environmental Science?

Environmental science is an interdisciplinary field that applies principles from all the known technology and sciences to study the environment and provide solutions to environmental problems. It is the science of physical phenomena in the environment. As shown in Figure 1, environment science involves various disciplines such as biology, chemistry, physics, statistics, microbiology, biochemistry, geology, economics, law, sociology, arts, geography, resource management, etc. [2]. As shown in Figure 2, environmental scientists tend to understand the interactions between humans and the natural world [3]. They employ a systems approach to the analysis of complex environmental problems, which often include an interaction of physical, chemical, and biological processes [4]. Their environmental efforts address global issues. There are several environmental thinkers



including Charles Darwin, Ralph Emerson, Henry Thoreau, John Muir, Aldo Leopald, and Rachel Carson. In the US, the National Environmental Policy Act (NEPA) of 1969 set forth requirements for analysis of federal government actions on specific environmental issues.

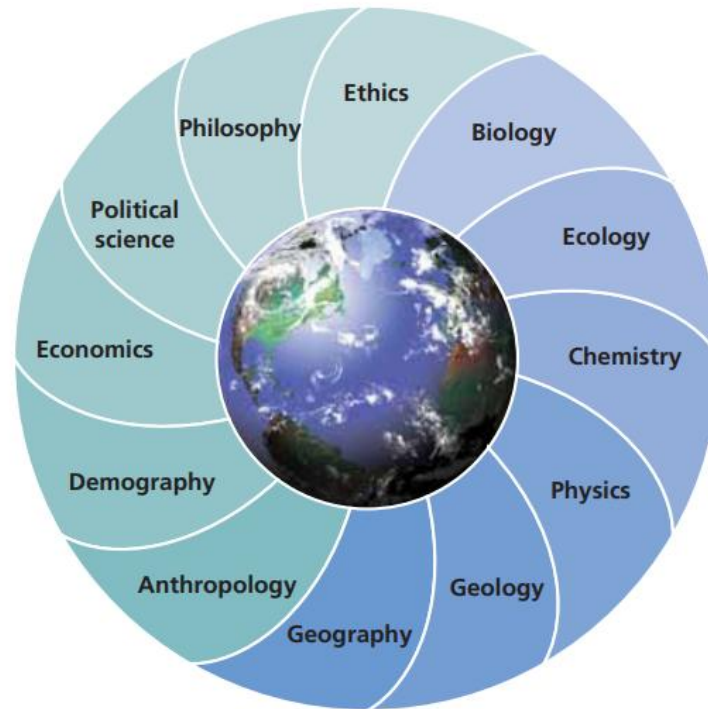


Figure 1: Environmental science is an interdisciplinary field [2]



Figure 2: Environmental scientists understand the interactions between humans and the natural world [3]

### Components of Environmental Science

Environmental science includes the following components.



- *Ecology*: Although the terms "environmental science" and "ecology" are often used interchangeably, ecology should be considered a subset of environmental science. For this reason, ecology is often referred to as environmental biology. Ecology is the study of the relationships between living organisms and their physical environment. It is the science of the relations of all organisms to all their environments.
- *Environmental Chemistry*: This is the study of chemical alterations in the environment. Main areas of study include soil contamination, water pollution, chemical degradation in the environment, etc.
- *Environmental Engineering*: Traditionally, environmental engineering started as part of civil engineering. Now it is one of the fastest growing and most complex disciplines of engineering. Environmental engineering applies science and engineering principles to develop ways to protect human health and minimize the adverse effects of human activities on the environment. The field emerged in response to widespread public concern about environmental degradation such water and air pollution. Environmental engineers solve problems, design systems, and provide solutions to various environmental problems [5].
- *Environmental Economics*: This is a branch of economics that focuses on environmental problems of pollution of earth, air, and water. It studies the financial impact of environmental policies and the effects of environmental policies on the economy. It deals with the impact of economic activities on the environment. It supports environmental policies to deal with air pollution, water quality, toxic substances, solid waste, and global warming. It considers issues such as the conservation and valuation of natural resources, pollution control, waste management, and recycling [6].
- *Environmental Management*: This is a multidisciplinary area that is concerned with the management of human activities and their impacts on the natural environment. It is basically about making decisions on the use of natural resources. It involves pressing issues of justice and survival. Environmental managers consist of a diverse group of people including academics, policy-makers, non-governmental organization (NGO) workers, company employees, civil servants and other individuals or groups who desire to control the direction and pace of development [7].
- *Environmental Laws*: These laws deal with environmental challenges. Environmental laws have been developed in response to growing concern over issues impacting the environment worldwide. They are legal enactments designed to consciously preserve the environment or protect the environment from damage. They are meant to protect human health as well as the environment. The laws cover pollutants, natural resource conservation, energy, farming, and land use.
- *Biodiversity*: Diversity is the number of species found in a given community. Biodiversity refers to the species richness of an area. It is substantially greater in some areas than in the others. Biodiversity is at local, national, and global levels. Biodiversity is diminished or destroyed in a number of ways either by natural changes or by human disruption. As species become extinct, the balance of nature is disturbed to great extent.
- *Pollution*: This is basically undesirable change in physical, chemical, or biological characteristics of air, water, soil, or food that can adversely affect humans or other living organisms. Pollutants are mainly by-products of man's action and may include air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, industrial pollutants, agriculture pollutants, photochemical pollutants, nuclear hazards, and electromagnetic radiation. Figure 3 illustrates different types of pollution [8]. Once pollutants have become dispersed in the air, water, soil, or food at harmful levels, it is usually too expensive to reduce them to acceptable levels. In most cases, pollution clean-up often removes a pollutant from one part of the environment only to create pollution in another.
- *Sustainability*: Sustainability is often regarded as meeting the needs of the current generation without compromising the ability for future generations to meet those same needs. It is the condition in which human needs are met in such a way that a human population can survive indefinitely. To achieve sustainability, we must think about how to implement it in all facets of life: buildings, streets, parks, roads, sidewalks, etc. Cities are key to sustainable development and sustainable future. They are responsible for making policies that affect sustainability. A sustainable society manages its economy



and population size without exceeding all or part of the planet's ability to replenish its resources, and sustain human. A sustainable city, also referred to as an eco-city, designed with consideration for the triple bottom line: social, economic, environmental impact, which is illustrated in Figure 4 [9]. The need for sustainable development is crucial to the future of mankind.

Other components include geosciences, atmospheric sciences, environmental law, environmental accounting, environmental physics, environmental biology, environmental economics, environmental hydrology, environmental health, environmental law, environmental management, environmental toxicology, etc.

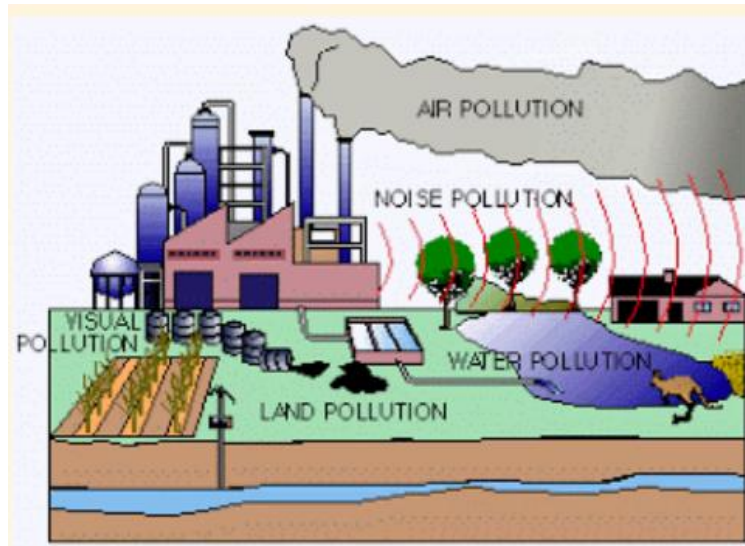


Figure 3: Different types of pollution [5]



Figure 4: The three main components of sustainability [9]

### Conclusion

Environmental science is an interdisciplinary study of how the earth works and how we can deal with the environmental issues we face. There is an increasing need for experts in this field. For this reason, environmental science is now being taught at high schools and higher institutions of learning [10]. Courses on





environmental science will empower the youths to take an active role in the world in which they live. Education and awareness of the field of environmental sciences is becoming global and dynamic. More information about environmental science can be found in books in [1,11-18] and related journals:

- Energy & Environmental Science
- Environment International
- Environmental Development
- Environmental Modelling & Software
- Environmental Pollution
- Environmental Research
- Environmental Research Letters
- Environmental Science & Policy
- Environmental Science & Technology Letters
- Environmental Science & Technology
- Environmental Science & Engineering Magazine
- Journal of Environmental Science, Computer Science and Engineering & Technology
- Journal of Environmental Science: Current Research
- Current Opinion in Environmental Science & Health
- American Journal of Environmental Science and Engineering
- Global Journal of Environmental Science and Management
- International Journal of Environmental Research

## References

- [1]. Y. K. Singh, *Environmental Science*. New Delhi, India: New Age International, 2006.
- [2]. G. T. Miller, Jr. and S. E. Spoolman, *Living in the Environment Concepts, Connections, and Solutions*. Belmont, CA: Brooks/Cole, Cengage Learning, 16<sup>th</sup> edition, 2009.
- [3]. "Environmental sciences," <https://science.nd.edu/undergraduate/majors/environmental-sciences/>
- [4]. "Environmental science," *Wikipedia*, the free encyclopedia, [https://en.wikipedia.org/wiki/Environmental\\_science](https://en.wikipedia.org/wiki/Environmental_science)
- [5]. M. N. O. Sadiku, O. D. Olaleye, and S. M. Musa, "Environmental engineering: A primer," *International Journal of Trend in Research and Development*, vol. 6, no. 3, May- Jun. 2019, pp. 102-104.
- [6]. M. N. O. Sadiku, O. D. Olaleye, and S. M. Musa, "Environmental economics: A primer," *International Journals of Advanced Research in Computer Science and Software Engineering*, vol. 9, no. 7, July 2019, pp. 36-39.
- [7]. M. N. O. Sadiku, O. D. Olaleye, and S. M. Musa, "Environmental management: A primer," *International Journal of Trend in Research and Development*, vol. 6, no. 3, May- Jun. 2019, pp. 105-107.
- [8]. "Environmental pollutions," January 2019, [https://rainashafaa.blogspot.com/2019/01/environmental-pollutions.html?utm\\_source=feedburner&utm\\_medium=feed&utm\\_campaign=Feed:+blogspot/bRHdI/rainasblogs+\(Welcome+to+the+Raina%27s+World\)&m=1](https://rainashafaa.blogspot.com/2019/01/environmental-pollutions.html?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed:+blogspot/bRHdI/rainasblogs+(Welcome+to+the+Raina%27s+World)&m=1)
- [9]. "The sustainable vernon initiative - How does it benefit you?" [http://www.tankerhoosen.info/news/upcoming\\_sustainable\\_vernon\\_2019.htm](http://www.tankerhoosen.info/news/upcoming_sustainable_vernon_2019.htm)
- [10]. "Why study environmental science?" March 2019, <https://unity.edu/environmental-careers/why-study-environmental-science/>
- [11]. J. R. Pfafflin and E. N. Ziegler (eds.), *Encyclopedia of Environmental Science and Engineering*. Boca Raton, FL: CRC Press, 5<sup>th</sup> edition, 2006.
- [12]. P. Knoepfel, *Environmental Policy Analyses: Learning from the Past for the Future - 25 Years of Research*. Springer 2007.



- [13]. R. S. Khoiyangbam and N. Gupta, *Introduction to Environmental Sciences*. New Delhi, India: The Energy and Resources Institute, 2012.
- [14]. L. D. Williams, *Environmental Science Demystified*. New York: McGraw-Hill, 2005.
- [15]. C. Zehnder et al., *Introduction to Environmental Science*. University System of Georgia, 2<sup>nd</sup> Edition, 2018.
- [16]. A. M. Spooner, *Environmental Science for Dummies*. For Dummies, 2012.
- [17]. M. Allaby, *Basics of Environmental Science*. Routledge, 2<sup>nd</sup> edition, 2000.
- [18]. W. Cunningham and M. A. Cunningham, *Principles of Environmental Science*. McGraw-Hill Education, 9<sup>th</sup> edition, 2019.

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