ENVIRONMENTAL SCIENCE

Q. What is Environmental Science & Environmental Studies?

Environmental science is an interdisciplinary academic field that integrates physical and biological sciences, (including but not limited to Ecology, Physics, Chemistry, Biology, Soil Science, Geology, Atmospheric Science and Geography) to the study of the environment, and the solution of environmental problems. Environmental science provides an integrated, quantitative, and interdisciplinary approach to the study of environmental systems. Related areas of study include environmental studies and environmental engineering. Environmental studies incorporate more of the social sciences for understanding human relationships, perceptions and policies towards the environment. Environmental engineering focuses on design and technology for improving environmental quality.

Environmental scientists work on subjects like the understanding of earth processes, evaluating alternative energy systems, pollution control and mitigation, natural resource management, and the effects of global climate change. Environmental issues almost always include an interaction of physical, chemical, and biological processes. Environmental scientists bring a systems approach to the analysis of environmental problems. Key elements of an effective environmental scientist include the ability to relate space, and time relationships as well as quantitative analysis.

Q. What is Atmospheric Science?

Atmospheric science focuses on the Earth's atmosphere, with an emphasis upon its interrelation to other systems. Atmospheric sciences can include studies of meteorology, greenhouse gas phenomena, atmospheric dispersion modeling of airborne contaminants, sound propagation phenomena related to noise pollution, and even light pollution. Taking the example of the global warming phenomena, physicists create computer models of atmospheric circulation and infra-red radiation transmission, chemists examine the inventory of atmospheric chemicals and their reactions, biologists analyze the plant and animal contributions to carbon dioxide fluxes, and specialists such as meteorologists and oceanographers add additional breadth in understanding the atmospheric dynamics.

Q. What is Ecology?

Ecology is an interdisciplinary analysis of an ecological system which is being impacted by one or more stressors might include several related environmental science fields. For example, one might examine an estuarine setting where a proposed industrial development could impact certain species by water and air pollution. For this study, biologists would describe the flora and fauna, chemists would analyze the transport of water pollutants to the marsh, physicists would calculate air pollution emissions and geologists would assist in understanding the marsh soils and bay mud.

Q. What is Environmental Chemistry?

Environmental chemistry is the study of chemical alterations in the environment. Principal areas of study include soil contamination and water pollution. The topics of analysis include chemical degradation in the environment, multi-phase transport of chemicals (for example, evaporation of a solvent containing lake to yield solvent as an air pollutant), and chemical effects upon biota. As an example study, consider the case of a leaking solvent tank which has entered the habitat soil of an endangered species of amphibian. As a method to resolve or understand the extent of soil contamination and subsurface transport of solvent, a computer model would be implemented. Chemists would then characterize the molecular bonding of the solvent to the specific soil type, and biologists would study the impacts upon soil arthropods, plants, and ultimately pond-dwelling organisms that are the food of the endangered amphibian.

Q. What is Geosciences?

Geosciences include environmental geology, environmental soil science, volcanic phenomena and evolution of the Earth's crust. In some classification systems this can also include hydrology, including oceanography. As an example study of soils erosion, calculations would be made of surface runoff by soil scientists. Fluvial geo-morphologists would assist in examining sediment transport in overland flow. Physicists would contribute by assessing the changes in light transmission in the receiving waters. Biologists would analyze subsequent impacts to aquatic flora and fauna from increases in water turbidity.

Q. What is Hydrology?

Hydrology is the study of the movement, distribution, and quality of water on Earth and other planets, including the hydrologic cycle, water resources and environmental watershed sustainability. A practitioner of hydrology is a hydrologist, working within the fields of earth or environmental science, physical geography, geology or civil and environmental engineering.

Domains of hydrology include hydrometeorology, surface hydrology, hydrogeology, drainage basin management and water quality, where water plays the central role. Oceanography and meteorology are not included because water is only one of many important aspects within those fields. Hydrological research can inform environmental engineering, policy and planning.

Branches of hydrology: Chemical hydrology is the study of the chemical characteristics of water. Ecohydrology is the study of interactions between organisms and the hydrologic cycle. Hydrogeology is the study of the presence and movement of ground water. Hydroinformatics is the adaptation of information technology to hydrology and water resources applications. Hydrometeorology is the study of the transfer of water and energy between land and water body surfaces and the lower atmosphere. Isotope hydrology is the study of the isotopic signatures of water. Surface hydrology is the study of hydrologic processes that operate at or near Earth's surface. Drainage basin management covers water-storage, in the form of reservoirs, and flood-protection. Water quality includes the chemistry of water in rivers and lakes, both of pollutants and natural solutes.

Applications of hydrology

- Determining the water balance of a region.
- Determining the agricultural water balance.
- Designing riparian restoration projects.
- Mitigating and predicting flood, landslide and drought risk.
- Real-time flood forecasting and flood warning.
- Designing irrigation schemes and managing agricultural productivity.
- Part of the hazard module in catastrophe modeling.
- Providing drinking water.
- Designing dams for water supply or hydroelectric power generation.

- Designing bridges.
- Designing sewers and urban drainage system.
- Analyzing the impacts of antecedent moisture on sanitary sewer systems.
- Predicting geomorphological changes, such as erosion or sedimentation.
- Assessing the impacts of natural and anthropogenic environmental change on water resources.
- Assessing contaminant transport risk and establishing environmental policy guidelines.

Q. What is Meteorology and what are the different areas of Meteorology?

Meteorology is the interdisciplinary scientific study of the atmosphere. Studies in the field stretch back millennia, though significant progress in meteorology did not occur until the eighteenth century. The nineteenth century saw breakthroughs occur after observing networks developed across several countries. After the development of the computer in the latter half of the twentieth century breakthroughs in weather forecasting were achieved. Meteorological phenomena are observable weather events which illuminate and are explained by the science of meteorology. Those events are bound by the variables that exist in Earth's atmosphere; temperature, air pressure, water vapor, and the gradients and interactions of each variable, and how they change in time. Different spatial scales are studied to determine how systems on local, region, and global levels impact weather and climatology. Meteorology, climatology, atmospheric physics, and atmospheric chemistry are sub-disciplines of the atmospheric sciences. Meteorology and hydrology compose the interdisciplinary field of hydrometeorology. Interactions between Earth's atmosphere and the oceans are part of coupled ocean-atmosphere studies. Meteorology has application in many diverse fields such as the military, energy production, transport, agriculture and construction.

Meteorologists are scientists who study meteorology. Meteorologists work in government agencies, private consulting and research services, industrial enterprises, utilities, radio and television stations, and in education. Meteorologists are best-known for forecasting the weather. Many radio and television weather forecasters are professional meteorologists, while others are merely reporters (weather specialist, weatherman, etc...) with no formal meteorological training.

Aviation meteorology: Aviation meteorology deals with the impact of weather on air traffic management. It is important for air crews to understand the implications of weather on their flight plan as well as their aircraft, as noted by the Aeronautical Information Manual: The effects of ice on aircraft are cumulative-thrust is reduced, drag increases, lift lessens, and weight increases. The results are an increase in stall speed and a deterioration of aircraft performance. In extreme cases, 2 to 3 inches of ice can form on the leading edge of the airfoil in less than 5 minutes. It takes but 1/2 inch of ice to reduce the lifting power of some aircraft by 50 percent and increases the frictional drag by an equal percentage.

Agricultural meteorology: Meteorologists, soil scientists, agricultural hydrologists, and agronomists are persons concerned with studying the effects of weather and climate on plant distribution, crop yield, water-use efficiency, phenology of plant and animal development, and the energy balance of managed and natural ecosystems. Conversely, they are interested in the role of vegetation on climate and weather.

Hydrometeorology: Hydrometeorology is the branch of meteorology that deals with the hydrologic cycle, the water budget, and the rainfall statistics of storms. A hydrometeorologist prepares and issues forecasts of accumulating (quantitative) precipitation, heavy rain, heavy snow, and highlights areas with the potential for flash flooding. Typically the range of knowledge that is required overlaps with climatology, mesoscale and synoptic meteorology, and other geosciences.

Nuclear meteorology: Nuclear meteorology investigates the distribution of radioactive aerosols and gases in the atmosphere.

Maritime meteorology: Maritime meteorology deals with air and wave forecasts for ships operating at sea. Organizations such as the Ocean Prediction Center, Honolulu National Weather Service forecast office, United Kingdom Met Office, and JMA prepare high seas forecasts for the world's oceans.

Q. What is Natural Resource Management?

Natural resource management refers to the management of natural resources such as land, water, soil, plants and animals, with a particular focus on how management affects the quality of life for both present and future generations (stewardship). Natural resource management deals with managing the way in which people and natural landscapes interact. It brings together land use planning, water management, biodiversity conservation, and the future sustainability of industries like agriculture, mining, tourism, fisheries and forestry. It recognizes that people and their livelihoods rely on the health and productivity of our landscapes, and their actions as stewards of the land play a critical role in maintaining this health and productivity. Natural resource management is also congruent with the concept of sustainable development, a scientific principle that forms a basis for sustainable global land management and environmental governance to conserve and preserve natural resources. Natural resource management specifically focuses on a scientific and technical understanding of resources and ecology and the life-supporting capacity of those resources. Environmental management is also similar to natural resource management.

Q. What is Oceanography?

Oceanography is the scientific study of all aspects of the ocean, their boundaries and their continents. To be more specific, oceanography is the study of the seas, its coastline, estuaries, coastal waters, shelves and the ocean bed. As such it is an interdisciplinary science that integrates principles of Biology, Chemistry, Geology, Meteorology and Physics.

Oceanography is an exciting field offering you the advantage of being involved with a variety of scientific disciplines and an opportunity for lifelong learning. Oceanography is today of great significance to developing countries. A career in this area is really a challenging one and it provides opportunity to those with intrinsic curiosity and a desire to venture into the vast realm of the unknown, which exists within our oceans. The work involves collecting samples, conducting surveys, analyzing data using sophisticated equipment in the sea for long hours. Oceanographers apply the basic sciences to study the world’s oceans and coastal waters. They study the motion and circulation of the ocean waters and their physical and chemical properties, and how these properties affect coastal areas, climate, and weather. Often, they are chemists, physicists, biologists, or geologists who bring their special skills to ocean studies. Being essentially a research–oriented profession, long periods are spent at the sea with all its challenges and hazards. Depending upon the areas of specialization they work in several fields such as marine biology, geological oceanography, physical oceanography and chemical oceanography.

Q. What is Marine Biology?

Marine biology is the scientific study of organisms in the ocean or other marine or brackish bodies of water. Given that in biology many phyla, families and genera have some species that live in the sea and others that live on land, marine biology classifies species based on the environment rather than on taxonomy. Marine biology differs from marine ecology as marine ecology is focused on how organisms interact with each other and the environment, and biology is the study of the organisms themselves.

Q. What is Biophysics? What are the major areas of Biophysics?

Biophysics is an interdependent science discipline that employs unique methods of physics and physical chemistry to acquire knowledge on the biological systems present in our world. It applies the principles of Physics and Chemistry and the methods of Mathematical Analysis and Computer Modeling to understand how biological systems work. Biophysics explains biological function in terms of the molecular structures and their properties. Biophysics is a bridge between biology and physics. This discipline is concerned with applications of the principles and methods of physical sciences to biological problems.

Biophysics is one of the most fascinating and intellectually challenging fields of scientific study because it deals with humans. Biophysics has a great importance in all our lives today. Biophysics shares a strong bond with other advanced biological fields biochemistry, bioengineering, systems biology, nanotechnology, and agro physics, it can be said that Biological systems is the very root of all our existence. Biophysics incorporate the study of all levels of biological organization, from molecules to ecosystems. The main aspect of biophysics is the use of the ideas and methods of physics and chemistry to study and explain the structures of living organisms and the mechanisms of life processes.

The applications of Biophysics depend on society's needs. One of the first major findings in biophysics was the discovery of the double helix structure of the DNA molecule in 1953. Biophysics helped create powerful vaccines against infectious diseases. Biophysical methods are increasingly used to serve everyday needs, from forensic science to bioremediation. Medical imaging technologies including MRI (Magnetic Resonance Imaging), CAT (Computed Axial Tomography) scans etc. are the invention of Biophysics.

One who study the field of biophysics is known as Biophysicist. They study life at every level, from atoms and molecules to cells, organisms and environments. Biophysicists attempt to explain why our biophysical environment behaves as it does. Biophysicists study how organisms develop, see, hear, think and live. They investigate how the brain processes and stores information, the heart pumps blood, muscles contract, plants use light in photosynthesis, genes are switched on and off and many other questions. Biophysicists usually work with groups or teams of other scientists and professionals with other backgrounds to collaborate on solving common problems. For example, they work along with those in medical and criminology fields to find solutions to various problems they come across.

The major areas of biophysics are the following:

Molecular biophysics -is the study of large molecules and particles of comparable size which play important roles in biology.
Radiation biophysics- consists of the study of the response of organisms to ionizing radiations, such as alpha, beta, gamma and x-rays and to ultraviolet light.
Physiological biophysics- called by some as Classical biophysics, is concerned with the use of physical mechanisms to explain the behavior and the functioning of living organisms or parts of living organisms and with the response of living organisms to physical forces.
Mathematical and theoretical biophysics- deals primarily with the attempt to explain the behavior of living organisms on the basis of mathematics and physical theory.
Medical biophysics - deals with the study that uses physics to describe or effect biological process largely for the purpose of medical application. The areas of research combining Physics and physiology include medical imaging such as MRI, computed tomography and PET (Positron emission tomography); oncology and cancer diagnosis using radiolabelling and molecular imaging; and vasculature and circulatory system function.

Eligibility for those who intend to pursue biophysics career is that they must basically have an undergraduate degree with Physics, Biology and Chemistry. Some institutes also offer undergraduate programmes with special attention given to biophysics.

In India, however there are only few universities that offer courses in biophysics at the undergraduate level. Most biophysicists begin their career with a four-year Bachelor of Science degree in Biophysics, and then go on to earn a master's and a PhD in physics or a sub-discipline of physics. Biophysicists who wish to do research generally need to obtain a PhD and spend one to five years in post-doctoral research in a university or government laboratory. In medical biophysics, one to two years of post-degree clinical (residency) training is required.

Course areas of Biophysics include molecular biophysics, membrance biophysics, neuro-biophysics, biophysical techniques, bioenergetics, medical biophysics.

A biophysicist can find employment as a biophysics researcher or scientist with research institutes or government organizations in various academic grades for research oriented programmes. A biophysicist can also find employment in a biophysics related industry. Biologically-oriented high-tech companies, pharmaceutical companies and the like will hire the services of a qualified and experienced biophysicist. A biophysicist can even find employment as a professor or member of faculty in a university, medical or dental college offering a program in biophysics. Forensics laboratories, chemical companies, food-processing plants, drug manufacturers, cosmetic industry, and manufacturers of agricultural chemicals (fertilizers, pesticides etc.) also employ biophysicists. There is a wide range of opportunities abroad in Biophysics, to carry on higher studies and to work.

Some of the World class organisations that hire biophysicists are National Institute for Research in Reproductive health (NIRRH), Mumbai; All India Institute of Medical Sciences, New Delhi; Institute of Microbial Technology, Chandigarh; Indian Institute of Science (IISC), Bangalore and National Institute of Virology (ICMR), Pune.

Q. What is Geosciences?

Geoscientists study the composition, structure, and other physical aspects of the Earth, and the Earth's geologic past and present by using sophisticated instruments to analyze the composition of earth, rock, and water. Many geoscientists and hydrologists help to search for natural resources such as groundwater, minerals, metals, and petroleum. Others work closely with environmental and other scientists to preserve and clean up the environment.

Geoscientists usually study and work in one of several closely related geosciences fields, including geology, geophysics, and hydrology. Geologists study the composition, processes, and history of the Earth. They try to find out how rocks were formed and what has happened to them since their formation. They also study the evolution of life by analyzing plant and animal fossils. Geophysicists use the principles of physics, mathematics, and chemistry to study not only the Earth's surface, but also its internal composition, ground and surface waters, atmosphere, oceans, and magnetic, electrical, and gravitational forces. Hydrologists study the quantity, distribution, circulation, and physical properties of water and the water cycle.

Within these major geosciences fields, there are numerous subspecialties. For example, petroleum geologists map the subsurface of the ocean or land as they explore the terrain for oil and gas deposits. They use sophisticated instrumentation and computers to interpret geological information. Engineering geologists apply geologic principles to the fields of civil and environmental engineering, offering advice on major construction projects and assisting in environmental remediation and natural hazard-reduction projects. Mineralogists analyze and classify minerals and precious stones according to their composition and structure, and study the environment surrounding rocks in order to find new mineral resources. Sedimentologists study the nature, origin, distribution, and alteration of sediments, such as sand, silt, and mud. These sediments may contain oil, gas, coal, and many other mineral deposits. Paleontologists study fossils found in geological formations to trace the evolution of plant and animal life and the geologic history of the Earth. Stratigraphers examine the formation and layering of rocks to understand the environment which formed them. Volcanologists investigate volcanoes and volcanic phenomena to try to predict the potential for future eruptions and hazards to human health and welfare. Glacial geologists study the physical properties and movement of glaciers and ice sheets. Geochemists study the nature and distribution of chemical elements in groundwater and earth materials.

Geophysicists specialize in areas such as geodesy, seismology, and magnetic geophysics. Geodesists study the Earth's size, shape, gravitational field, tides, polar motion, and rotation. Seismologists interpret data from seismographs and other geophysical instruments to detect earthquakes and locate earthquake-related faults. Geomagnetists measure the Earth's magnetic field and use measurements taken over the past few centuries to devise theoretical models that explain the Earth's origin. Paleomagnetists interpret fossil magnetization in rocks and sediments from the continents and oceans to record the spreading of the sea floor, the wandering of the continents, and the many reversals of polarity that the Earth's magnetic field has undergone through time. Other geophysicists study atmospheric sciences and space physics.

Q. What are the courses available in Environmental Science and what is the Career and Job Prospect?

Undergraduate and Post-graduate courses in environmental science are offered by several institutes across the country. Career in Environmental Science starts with a B.Sc/B.E degree in this subject. The minimum qualification for B.Sc (Environmental Science) is 10+2 pass with Science subjects. The duration of this course is three years. For M.Sc in Environmental Science which is of two year duration, B.Sc Environmental Science or in any science subject is must. The two year M.Tech in Environmental Science course is also offered by some technical institutes for which B.E/B.Tech students are eligible. There are also short term PG Diploma courses in Environment Management and Environmental Science. At the higher level there are doctoral and post-doctoral courses like M.Phil and PhD courses in Environmental Science.

Environmental science graduates have multiple career options. They can work with different government departments and agencies like Forest and Environment, Pollution Control Boards, Urban planning, Industries, Water resources and Agriculture etc. Now NGOs working for environmental protection are a good option for environmental scientist. Private industries and firms also absorb a large chunk of environmental scientists to suggest proper methods and process. Waste treatment industries, refineries, distilleries, mines, fertilizer plants, food processing industries and textile mills employ environmental scientists. Environmental scientists also can be involved in research activities in public and private sector institutions. Environmental scientists also can seek employment in media as environment journalists. Teaching in collages, universities is also a good option available for environmental scientists.

Many universities and technical institutions offer B.Sc/ M.Sc/ B.E/ B.Tech/ M.Tech courses in Environmental Science. Some names are given below. University of Delhi, Delhi; Delhi College of Engineering, Delhi; Jawaharlal Nehru University, New Delhi; IIT, Delhi, Kanpur, Kharagpur and Madras; Jamia Milia Islamia, New Delhi; University of Mumbai; University of Chennai, Chennai; Indian Institute of Environment Management (SIES), Mumbai; University of Mysore, Mysore; University of Pune, Pune; Visveswariah Technological University, AIT, Chikmagalur; Bharathiar University, Coimbatore; Rajiv Gandhi Proudyogiki Vishwavidyalaya , Indore (MP); UP Technical University (Instt of Engg & Tech) Lucknow; Center for Environment Education, Nehru Foundation for Development, Ahmedabad; Andhra University, Waltair; Aligarh Muslim University, Aligarh; Guru jambheshwar University, Hisar and Cochin University of Science and Technology,Kochi.

The Profession: The efforts towards clean air, water protection, noise abatement, waste management, pollution control and the like requires new goods and services, creating many more fresh jobs. Environmental science as a profession promises tremendous employment opportunities. Environmental science is a composite of both natural and social sciences. Resource management and resource technology are also significant features of environmental science. Opportunities in this field are immense. Not only for environmental scientists but also for environmental engineers, environmental biologists, environmental modelers and environmental journalists.

Environmental science is a broad term, incorporating various different activities. In can be applied in the following fields:

- Industry
- Research and Development
- Social Development
- Environmental Journalism
- Environmental Modelling

Work of Environmental Scientist: An environmental scientist's job is to utilize the knowledge of various principles and concepts of science and engineering disciplines, in order to protect and preserve the environment. Environmental scientists also conduct research studies in order to develop theories or methods of abating and controlling the sources of environmental pollution. So the major tasks performed by environmental scientists consist mainly of proactive and research-oriented work. It may involve tasks like:

- Administrative Tasks
- Advisory Tasks
- Protective Tasks

Environmental Science Jobs

- A Habitat Garden Educator in the Neighborhood
- The Roles and Functions of an Environmental Health Specialist
- Health and Safety Manager - A Great Job for a Highly Motivated Individual
- Green Career Opportunities for Environmental Health Specialists
- Get a Green Job as an Environmental Health Specialist
- Environmental Health Specialists: Ensuring a Healthy Environment for Everyone
- Erosion Control Specialists Make the Study of Soil Their Life's Work
- Be Your Own Boss - Be a Beekeeper
- A Wilderness Ranger is a Great Career Choice for Those Who Love the Great Outdoors
- Trail Coordinator - Great Job for Those Who Love to Hike and Enjoy the Wilderness
- Water Analysts Hold Positions of Responsibility to Protect Our Water Supply
- Pollution Control Design
- Recycle Coordinator - Good For the Environment, and Little College Education
- Park Ranger Jobs are Scarce - If You Love the Outdoors, Take a Shot
- Marine Biologists Help Ensure Survival of All Species on Earth
- Land Managers Will Spend Much of Their Time Outside, Loving Nature is Important
- Land Surveyors Perform Many Duties and Command Good Salaries
- Field Science Educators Help Students Develop an Interest In the Environment
- Environmental Technicians Research the Problem of Pollution

- Environmental Research Assistants Gain Valuable Experience For Future Endeavors
- Environmental Restoration Planners Make Positive Changes to the Environment
- Environmental Officers; Caring For Our Earth
- Environmental Enforcement Officers Work to Protect Our Forests
- Environmental, Health & Safety Analysts: Keeps Employees Safe and Healthy
- Entomologists Lead to Surprising Conclusions About History, Disease, or Solving Crimes
- Botanists Are in Demand and Have Many Career Paths to Choose
- Certified Environmental Professionals for Canada
- Bird Bander Jobs are Scarce and Seasonal, but Interesting for Nature Lovers
- Archaeologists Study History and Past Civilizations - For History Buffs, It's the Perfect Choice of Vocations
- Air Quality Control, an Easy Field to Get Into, But Experience is Required to be a Specialist in the Field
- Our Storm Chasers-Meteorologists
- Environmental Systems Analyst - A Career That's Both Demanding And Rewarding
- Fish Hatchery Technicians Have A Variety of Duties
- Ecologist - A Constantly Changing Profession For A Constantly Evolving Science
- Why Green Educators are a Growing Job
- Environmental Lobbyist
- Environmental Educator
- Climatologist
- Air Quality Specialist
- Fisheries Technician
- Ecologist
- Forester
- Science Teacher

Q. How is the life of an Environmental Scientist?

On a typical day an environmental scientist's tasks might include:

- Collecting, synthesizing, analyzing, managing and reporting environmental data, such as pollution emission measurements, atmospheric monitoring measurements, meteorological and mineralogical information, and soil or water samples.
- Analyzing data to determine validity, quality, and scientific significance, and to interpret correlations between human activities and environmental effects.
- Communicating scientific and technical information to the public, organizations or internal audiences through oral briefings, written documents, workshops, conferences, training sessions or public hearings.
- Providing scientific and technical guidance, support, coordination, and oversight to governmental agencies, environmental programs, industry or the public.
- Processing and reviewing environmental permits, licenses and related materials.
- Reviewing and implementing environmental technical standards, guidelines, policies and formal regulations that meet all appropriate requirements.