

Homi Bhabha Center for Science Education (TIFR), Mumbai
Academic year 2020-21, Semester 2

Course Title: **Environmental Science**

Type of course: **Elective Course (4 credits)**

Course Outline

In this course, we would try to explore the domain of environmental science through six themes: sewage, wastewater, and sanitation infrastructures; flow of rivers and its relation with groundwater, draughts and floods; ecological balances and imbalances; mineral resources and industrialization; science of composting; and use of antibiotics as growth promoters. The themes would be discussed from historical perspectives and with a few case studies. An important component of the course would be the overlap(s) of participants' lived experiences/encounters with these themes and the formal knowledge on these themes in science disciplines.

The Course Philosophy:

The core of environmental science is the core of science itself (science has emerged from human beings trying to understand objects in their environments and their interrelationships). However, in current scenario, we see environmental science as a subsidiary subject, which is supposed to play a crisis-management role. Quite often students of Environmental Science start feeling helpless about the magnitude of environmental problems, and "insensitivity" of general public towards these issues. In this course, we would hold on the crisis-management framework, but delve into the science that is needed to understand the crises, and potentially seek solutions, whenever needed. An important aspect of seeking solutions is to understand the intricate interdependencies among different components of environment and also with our daily lives and society. Environment science requires several skills/competencies to be nurtured in an individual. We will also reflect on these competencies, and how different pedagogies may help in this process.

Course Structure

There would be 4 sessions every week. Three sessions would be common with undergraduate students of CEBS Mumbai, and there would be separate session on pedagogical aspects for the graduate student participants.

The first session on Monday (9:00-10:00 am) would be largely lecture + discussion based. The second session on Saturday (11:30 am to 12:30 pm) would be conducted in form of group discussion. The students would be discussing the relevance of the topic discussed in the week from their own experiences. From 12:30 pm to 1:30 pm would be a summarizing session where we would try to tie up the discussion and the content covered in the week. The fourth session would be about possible pedagogical interventions that can be used while dealing with a particular theme. Time for this fourth session would be discussed separately with participants.

Interested students can write to Ankush Gupta at: ankush@hbcse.tifr.res.in

Plan for the sessions:

Week 1 and 2 (Feb 8-20): Sanitation, Sewage and Nutrient flows:

Assignment 1 - Relevance of sanitation and nutrient flows for you

Week 2 and 3 (Feb 22- Mar 06)- Water flows in nature: Lakes, Rivers, and BOD

Assignment 2 - Relevance of flowing water for you

Week 5 and 6 (Mar 8 -20) - Parthenium, Lantana, Nilgai, and Wild Boars
Assignment 3- Relevance of ecological balance for you

Week 7 – Mid semester review.

Week 8 and 9 (Apr 3 - 10)- Aluminium-production, uses, and fate
Assignment 4- Relevance of mineral resources for you

Week 10 and 11 (Apr 12 – 24) - Composting-the process and managing solid wastes
Assignment 5- Relevance of decomposing fauna and flora biomass for you

Week 12 (Apr 26- May 1) -Antibiotics as growth promoters
Assignment 6- Relevance of practices in food production systems for you

Week 13 (May 3 – 8): Review

Assessment

The course participants would be expected to submit 6 assignments and 1 term end paper with a presentation. The assignments would be based on (a) reflections of participant on the topic and its relevance to his/her life and (b) pedagogical reflections on the various themes: i.e. what kind of pedagogical interventions are needed to help learners understand the key aspects of the theme discussed. Assessment would be based on quality of description and analysis presented in terms of scientific content, real life experiences, ideas about pedagogical interventions and coherence of thoughts presented. Moralistic writing to be avoided.

60 marks: Assignments

40 marks: Term Paper

Readings and reference materials

For each theme, I would be giving my own written notes for reference. Along with these notes, I will provide some reference materials. These references would be drawn from a variety of sources such as research articles, media articles, commercial companies' websites, documentary videos, and some reports by national governments and NGOs.

Some of the references I plan to use are given below. More may be added based on needs of the participants.

- Teaching Environmental Issues and the Affective Domain

<https://serc.carleton.edu/NAGTWorkshops/affective/environment.html>

- Sewage, Sanitation, and Nutrient Flows

- A look at some of the non-traditional toilet designs being commercially marketed in different countries: <https://www.toiletrevolution.com>, <https://www.nature-loo.com.au/>
- A website dedicated to historical documents and articles related to evolutions of sewers across civilizations: <http://www.sewerhistory.org>
- G. Langergraber, E. Muellegger, Review article: Ecological Sanitation—a way to solve global sanitation problems? *Environment International* 31 (2005) 433–444.
- Some reflections of sewage sludge and its increasing contamination due to large number of unnatural chemicals entering the sewage. *Civilization & Sludge: Notes on the History of the Management of Human Excreta*, *Current World Leaders*, Volume 39, No. 6 by Abby A. Rockefeller

<https://www.organicconsumers.org/news/civilization-sludge-notes-history-management-human-excreta>

- Flow in water Bodies

- Dynamics of Kosi River system: http://www.earthscienceindia.info/pdfupload/tech_pdf-23.pdf
- An important documentary about the realities of people who are forced to live within embankments of Kosi River: <https://www.youtube.com/watch?v=yYq8MwMQD4U>
- A good review of River ecology by WWF in context of Bulgaria and Romania which covers many of the concepts covered in Lecture.
http://awsassets.panda.org/downloads/riverecology_eng_bt13dec.pdf
- Aquatic Chemistry by Werner Stumm, and James J. Morgan.

- Composting

- Discussion on different types of composting techniques:
http://www.fao.org/organicag/doc/on_farm_comp_methods.pdf
- Microbiology of Composting by H. J. Kutzner:
https://application.wiley-vch.de/books/biotech/pdf/v11c_comp.pdf
- Role of Fungus in Composting:
http://www.davidmoore.org.uk/Assets/fungi4schools/Reprints/Mycologist_articles/Isaac_answers/v12p185-186decomposition.pdf
- Gajalakshmi, S. and Abbasi, S. A. (2008) 'Solid Waste Management by Composting: State of the Art', Critical Reviews in Environmental Science and Technology, 38:5, 311 — 400
- A TED talk by Jabir Karat on his personal journey with municipal waste:
<https://www.youtube.com/watch?v=b9klCtOp8-Y>
- An article on Jabir Karat's work : <https://www.thebetterindia.com/48340/meet-jabir-karat-man-on-a-mission-to-manage-kerala-waste-green-worms/>

- Ecology

- Neena Priyanka and P. K. Joshi (2013). A review of Lantana Camara studies in India. International Journal of Scientific and Research Publications, Volume 3, Issue 10, pg 1.
- An article by Menaka Gandhi on wild animals as pests: <http://www.firstpost.com/india/the-maneka-gandhi-column-busting-the-menace-myth-about-animals-calls-for-a-scientific-approach-2712166.html>
- Seema Sharma (June 08, 2020). Himachal Pradesh Has Been Killing Monkeys for Four Years. Will It End in 2020? <https://science.thewire.in/environment/himachal-pradesh-rhesus-macaques-vermin-poisoning-death/>

- Mineral Resources- Aluminum

- Olivier Chatterji (2016). Aluminium smelters and industrial hazards in the Maurienne valley. Experts, reformers and local resistance (1892-1939), Actes D'història De La Ciència I De La Tècnica Nova Època , 9, p. 55-78. <https://publicacions.iec.cat/repository/pdf/00000244/00000035.pdf>
- The Red Mud Project: An example of kind of reuse network required among industries for waste utilization: <http://redmud.org/>
- Design for recyclability
<https://recycling.co.za/downloads/PACSA%20Design%20For%20Recycling%20Guide%20Book.pdf>
<https://www.nap.edu/read/6322/chapter/11#108>

- For a comprehensive study on Al toxicity: Krewski et al. (2007). human health risk assessment for aluminium, aluminium oxide, and aluminium hydroxide, J Toxicol Environ Health B Crit Rev.; 10 (Suppl 1): 1–269.
- Human health risk assessment for aluminium, aluminium oxide, and aluminium hydroxide <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2782734/>

- Antibiotics as Growth Promoters

- A good history on how antibiotics got into use as growth promoters. <http://aliciapatterson.org/stories/man-who-turned-antibiotics-animal-feed>
- On antibacterial soaps: <https://www.theguardian.com/science/2016/sep/02/antibacterial-soaps-banned-us-fda>, <https://www.consumer.org.nz/articles/antibacterial-soaps>
- K. Narasimha Murthy, M. Malini, J. Savitha And C. Srinivas (2012) Lactic acid bacteria (LAB) as plant growth promoting bacteria (PGPB) for the control of wilt of tomato caused by Ralstonia solanacearum, Pest Management in Horticultural Ecosystems, 18 (1), pp 60-65 (2012).