Northeastern University
College of Engineering

Weekly STEM Newsletter 5 (April 17 - April 24, 2020)

Environmental Engineering and Environmental Science

Introduction

The practice of environmental engineering dates back to the dawn of civilization. Ever since groups of people began settling down, they have had to deal with the challenges of providing safe drinking water and disposing of solid waste and sewage. As cities have risen and large-scale farming and manufacturing has grown, people also have to worry about air quality, soil contamination, and light and sound pollution (amongst other problems). Environmental engineers have stepped in to tackle these problems.

Environmental engineering is a branch or discipline of engineering that is concerned with protecting the health of living organisms and natural ecosystems from the effects of adverse environmental effects, such as pollution, and with improving the quality of the environment. Environmental engineers use a wide range of science topics, such as ecology and hydrology, as well as math and engineering principles to conduct their work.

The job of an environmental engineer differs widely from one engineer to another, as there are many possible career paths within this engineering field. Some examples include water and air pollution control, designing recycling plants or wastewater treatment facilities, conducting hazardous-waste management studies, developing regulations to prevent mishaps, or writing environmental impact statements for proposed construction projects. Environmental engineers deal with a variety of local and worldwide environmental issues, such as protection of wildlife, minimizing the effects of acid rain and ozone depletion, controlling and reigning in automobile emissions, and planning for the impacts of climate change.

It is important to note that although they sound similar, environmental engineering and environmental science are two different fields. Environmental scientists are concerned with explaining and understanding natural phenomena involving the environment (such as coastline erosion or the effects of humans on a given area), whilst engineers solve problems using this knowledge (such as designing retaining walls to prevent erosion or designing a fish ladder to bypass a newly constructed dam).

In light of Environmental Engineers' focus on improving the environment, make sure you take part in Earth Day, next Wednesday (April 22nd): https://www.earthday.org/

Northeastern Connections

Research informs coastal and river system engineering

Several research labs at Northeastern University's Marine Science Center are working to build knowledge of natural systems and to improve and inform engineering strategies for our waterways. It is critical that background and real-time data about the dynamic hydrological and climatological systems around us be made available to engineers who are planning and operating structures that connect human communities and natural landscapes.

Ed Renier, Senior Wetlands

Northeastern's Global Resilience Institute (GRI) Associate Director and Marine Science Center Professor Mark Patterson is working with Professors Brian Helmuth and Loretta Fernandez to assess management of tide gates, devices used to control tidal river water in estuaries to protect against floods. The researchers are working with coastal communities in Massachusetts to assess and ensure proper operation of tide gates to better protect people and ecosystems.

Dr. Steven Scyphers and members of his research team in the Social-Ecological Sustainability Lab developed a system to assess damage to shorelines and coastal structures during the 2017 Atlantic hurricane system which had caused significant damage to areas of the Caribbean and Florida. Results suggested that mangroves provided protective benefits for nearby structures similar to traditional engineering. This may help planners develop sustainable engineered systems and adapt to increasingly frequent storms.

Scientists in the Earth Surface Systems Lab, run by Dr. Sam Munoz, are using sediment records and climate data to understand controls and outputs along the Mississippi River and major deltas in the United States. This research aims to improve estimates for catastrophic flood risk, and to inform civil engineers seeking to control these massive waterways.

Scientists in the Munoz Lab retrieve

Autonomous kayak-robot

Environmental engineering contains many subtypes of engineering, such as the above mentioned coastal and river system engineering. In addition, environmental engineering is often quite interdisciplinary - involving a variety of different types of science and engineering. For example, at Northeastern, Professor Hanumant Singh's research lab uses robots and high-resolution imagery to study icebergs and arctic animals both above and below the ocean surface.

"To get a concrete idea of the rate of melting, accurate measurements of the shape and surface of an iceberg need to be compared over time. But mapping an object in constant motion is a robot's Achilles heel.

Singh, who engineers drone systems for remote and underwater environments, has made it his goal to get around that challenge with calculations that account for the movement of an iceberg simultaneously as the robot navigates around it and maps it. In other words, he freezes movement—with a bunch of math, really." https://coe.northeastern.edu/news/using-drones-to-monitor-iceberg-sizes/

In 2018, a supercolony of penguins was confirmed (it's existence having been previously suggested) using Hanumant Singh's drone system. This colony consists of more than 1,500,000 Adélie Penguins, living on the remote Danger Islands on the Antarctic peninsula. https://news.northeastern.edu/2018/03/02/supercolony-of-penguins-discovered-using-northeastern-researchers-drone-system

Do Now

What can you do to help save the world? You may think that saving the world is something others should do, such as professional scientists and engineers or lawyers and politicians.

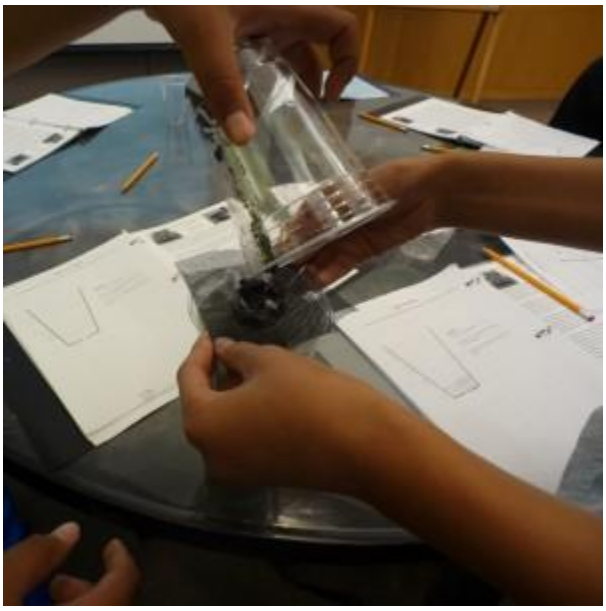
Thinking about and changing the ways in which you use water, energy, food, and other things can make a difference, and now is a great time to start. By making small changes, you can do your part to help change the world.

Therefore, for our Do Now, please try out the Your Plan, Your Planet online tool, created by

Google, in partnership with the California Academy of Sciences and the Ellen MacArthur Foundation. Consisting of a series of interactive, game-like activities rooted in scientific calculations, *Your Plan, Your Planet* will show you how people consume food, water, energy, and other stuff and will help you learn more about the kinds of changes you can make to help ensure a healthy planet today and tomorrow.

Activity

There is a global water crisis ongoing today: 1 in 9 people lack access to safe (i.e. clean, drinkable) water and 1 in 3 people lack access to a toilet. This is not just a problem in developing countries, there are ongoing issues with water access in the USA. Maybe you've heard of Flint, Michigan, where lead from aging pipes leached into the water supply? Or perhaps you're not allowed to drink the water that comes out of the fountains in your school (also due to lead pipes)? Water contamination (pollution) is a serious problem, but one that can be tackled. Preventing the pollution from entering the water in the first place is great, but sometimes the pollution is already there and we want to make the water drinkable. How do we do this? By filtering it of course! Let's do some environmental engineering ourselves and design, create, and test some water filters. A quick safety note: please be aware that the filters you will be designing and testing are NOT as efficient as professional water filters and will not be able to filter out certain particles and contaminants, therefore, **please do not drink the water** they filter!



Please read through our water filters presentation, which will introduce you to and walk you through the activity: https://prezi.com/3ymj1fo3--yd/

Materials Needed:

- Plastic cup (to build filter in)
- See through plastic or glass cup (to filter water into)
- Scissor or sharp object to put a hole in the plastic cup
- Dirty water to filter (such as pond water, or by mixing dirt into tap water)
- Various materials to create your water filter:
    - *Ideas: Grass, cotton balls, tape, gravel, sand, paper, t-shirt, etc.*

Discussion Questions:

- How clean is your water? Is it safe to drink? How could you tell?
- How quickly did your design filter the water? How could you speed up this process without sacrificing the effectiveness of the filter?
- Which material worked well to filter the water? Why?
- Which material did not work well to filter the water? Why?
- How could you improve your water filter design?

Share Your Results

We'd love to know how the activity and/or the "do now" turned out! What worked and what didn't work? Please share with us something you learned and/or send us pictures of your water filters! Email us at stem@northeastern.edu.

Related links/Extensions

Want to learn more about Environmental Engineering or Earth Day? Check out these links:

- 12 TED talks to watch this Earth Day https://blog.ted.com/12-talks-to-watch-this-earth-day/
- The Water Princess, illustrated by local illustrator Peter H. Reynolds
- Your Carbon Footprint handout (1 page)
- Games to explore Environmental Engineering/Science and/or Earth Day/Climate Change
  - https://www.theverge.com/2020/2/13/21135321/video-games-climate-change-beyond-blue-bee-simulator-temtem-endling
  - https://www.filamentgames.com/blog/5-awesome-environmental-science-learning-games/
- Free, online Environmental Engineering courses: https://www.edx.org/learn/environmental-engineering
- Environmental Engineering/Science Professional Society: https://www.aaees.org/
- Northeastern's Environmental Engineering student group, SEWERS: https://coe.northeastern.edu/orgs/sewers

Water Filter Activity

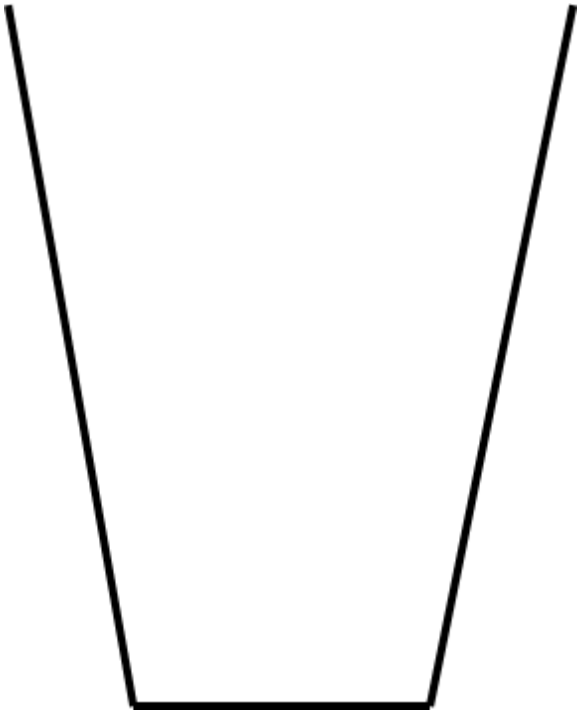
Objective: Design a filter to clean dirty water.

Test parameters = cleanliness, cost.

Bill of Materials:

Below, please indicate which materials you used for your design, and how much of each material you used (ex: 2 cotton balls, 1 foot of tape, etc).

Material	How much used?



Explain Your Designs:

In the diagram above, draw your final design. Below, write a short explanation of what materials you used and why.