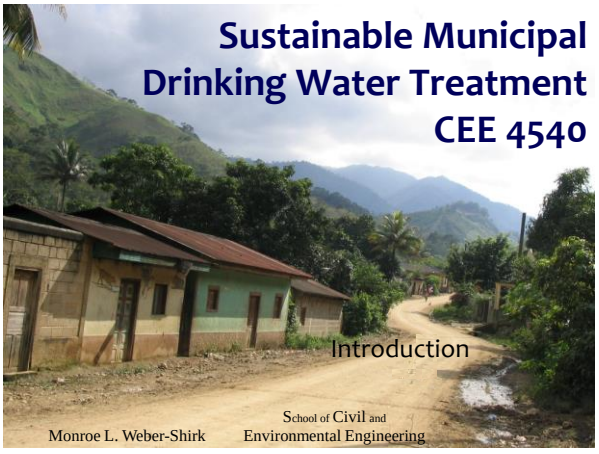


Agenda…

- Spanish options!
- What is this course about?
- Course Organization
- Why am I teaching this course?
- Introductions
- A search for truth that matters
- Groupthink: avoiding the truth
- Myth in engineering
- The Challenge
- It is a short walk to the edge of knowledge

Spanish 1501 (section 10222)

Friday 10:10-11:00 (subject to change depending on new poll results)

SPAN 1501 is not a language course per se; rather, its aim is to give you strategies to maximize your experience abroad. In this class you will:

- develop elementary oral communication skills in Spanish
- practice colloquial use of Spanish in realistic situations
- acquire dynamic cultural strategies that will enhance study abroad

- Meets 1 hour a week
- Consists of 1 credit
- First class will be held during the second week of classes
- Enrolling in this class does not require you to go on the trip and vice-versa. However, this is a great opportunity to develop oral skills in Spanish, especially if you are interested in visiting Honduras with the AguaClara project!
- If you need more information, please email me at ecv27@cornell.edu

What is this course about?

- One of my goals in this course is to encourage creative thinking about solutions to the enormous challenge of providing safe water on tap to communities everywhere.
- We will challenge the myth that this task can be accomplished by applying traditional technologies and we will identify opportunities for new insights
- We will be introduced to the new field of sustainable drinking water treatment
- My thesis is that engineers are needed to challenge existing assumptions and to create and document new sustainable solutions

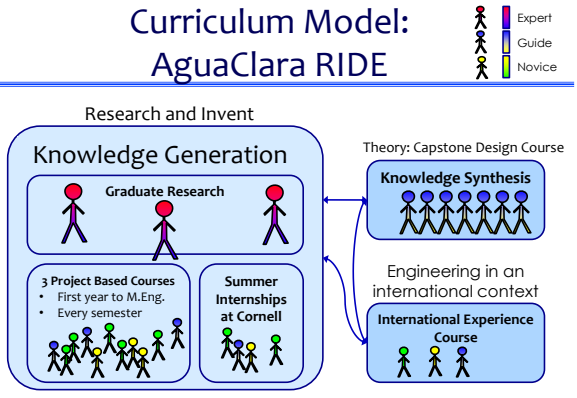
What is this course about?

- I have the goal of helping you develop a fundamental understanding of the processes that control the performance of each of the drinking water treatment steps,
- for a VERY specific problem; the production of safe drinking water for communities starting from surface waters that are contaminated with sediment and microbes.

Course prerequisites

- CEE 3310 or equivalent Fluid Mechanics course
- CEE 3310 can be taken at the same time if you are willing to work harder in CEE 4540 and use your fluids text as a reference
- Online Fluids alternative https://confluence.cornell.edu/display/cee4540/Fluids+Review+Guide

Curriculum Model: AguaClara RIDE



Course Organization

- CEE 4540 wiki : home to everything
  - https://confluence.cornell.edu/display/cee4540
- Class time logistics
  - Video recording synched with lecture notes
- Design Challenges (teams) – except for tutorial!
- ?? Quizzes, 2 Exams (computer based using Python) 1 Final Project
- Software skills for designing sustainable infrastructure
  - We will provide opportunities for you to become an expert in design using open source software

Design Challenges

- How do you learn?
- Why teams?
- Drafts and final submission
- Python tutorial
  - Download Anaconda today! (see https://confluence.cornell.edu/display/cee4540/Anaconda)
  - This Friday's class dedicated to making sure you can start on the Python tutorial

First Assignment

- Learn how to use Jupyter Notebooks for engineering in the next 2 weeks
- Hardest assignment of the semester
- Start TODAY!!!!

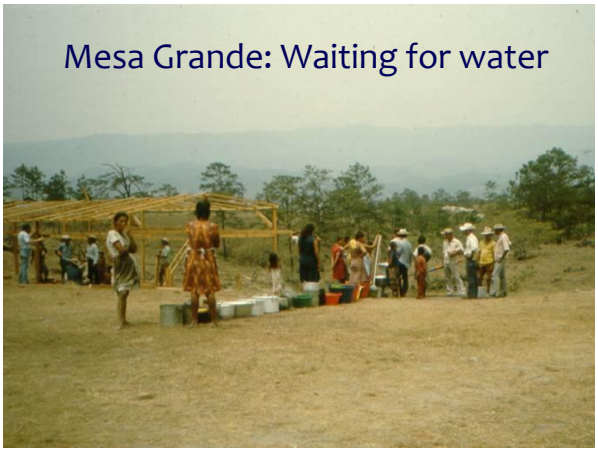
Introductions: Name that Student

- Think about efficiency (multitasking)
- Write your first name on the blackboard while you are waiting
- Point to your name on the board
- Describe VERY briefly something you did this summer that involved water using third person (Monroe built a dam this summer)
- Ask the class, "What is my name?"

Why am I teaching this course?

- Experience in refugee camps in Honduras in 1982-83
- The spark of interest: What makes slow sand filters work?
  - The discovery that no one knew
- Invitation to begin a water project in Latin America (12/2002)
- The realization that what I had been taught wasn't up to the challenge of solving the big global challenge of providing safe drinking water on tap to communities
- 13th time teaching this course – changes every time!

Mesa Grande: Waiting for water

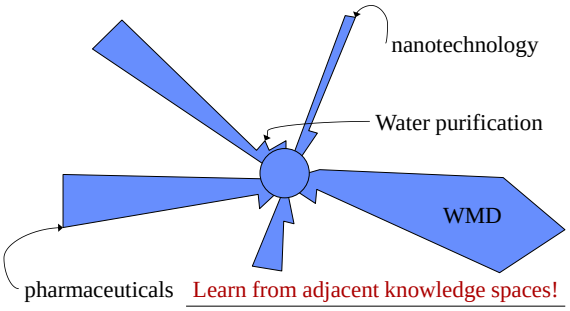


You should be taking a course in business or information technology

- Environmental Engineering is a dead profession
- The science behind environmental engineering is already well understood
- Environmental engineers have been applying the same solutions for the past 100 years
- Providing everyone on the planet with safe drinking water only requires the money and political will to apply known technologies

Discussion time! Do you agree?

Uneven Knowledge Space



Causes of Uneven Knowledge Expansion

extra

- Funding agency (top down science)
  - Target a few areas for growth
  - Soccer game syndrome
- National Pride/Security Agenda
  - Dams
  - WMD
  - NASA
- Private Enterprise
  - The historic preference for high tech inefficiency rather than robust, sustainable technology
  - Private enterprise historically created solutions that require proprietary components

The Challenges of Creating New Knowledge

extra

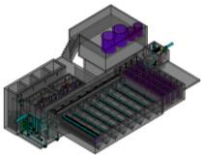
- In many areas of engineering you only have to investigate a little to find the knowledge boundary
  - Flocculation
  - Porous Media Filtration optimization
  - Flow control for chlorinators
  - Efficacy of various coagulants
- New knowledge (especially when at odds with tradition) takes years and even decades to be adopted when economies of competitive mass production aren't at work

A Search for Truth that Matters

AguaClara is creating new technologies, improving old technologies, and developing the design algorithms so that others can build surface water treatment plants of any size

Math – Physics – Fluid Mechanics – Chemistry

The amazing ability to represent reality symbolically



Learning in a collaborative environment (Team assignments)

What is our big goal?
How do you learn?

	Asking for help to learn a solution	Retyping a solution	Copy/paste some solution steps	Copy/paste design challenge
Individuals **within** team				
Collaboration **between** teams				

Groupthink

- Groupthink refers to faulty decision-making in a group (coined by Irving Janis, 1972)
- Groups experiencing groupthink do not consider all alternatives and they desire unanimity at the expense of quality decisions

•Irving, Janis. (1972). *Victims of groupthink.* Boston: Houghton Mifflin; Irving, Janis. (1982). *Groupthink: Psychological studies of policy decisions and fiascos.* 2nd ed. Boston: Houghton Mifflin.

extra

Results of Groupthink

- Examining few alternatives
- Not being critical of each other's ideas
- Not examining early alternatives
- Not seeking expert opinion
- Being highly selective in gathering information
- Not having contingency plans

True, true, true!

Why would a group adopt these behaviors?

extra

Some Symptoms of Groupthink

- Having an illusion of invulnerability
- Rationalizing poor decisions
- Believing in the group's morality
- Sharing stereotypes which guide the decision
- Exercising direct pressure on others
- Not expressing your true feelings
- Maintaining an illusion of unanimity
- Using mindguards to protect the group from negative information

Some Solutions to Groupthink

- Admit that you don't know everything!
- Encourage honesty!
- Question everything
- Check with outside experts
- Hold a "second-chance meeting" to offer one last opportunity to choose another course of action

extra

Welcoming Dissent

- Hi guys, August, 2008
  It occurred to me that before we build the 1.2 m deep AguaClara plant we should all stop for a few minutes and check to see if there is anything that bothers us about this bold new step. Remember the first lectures of CEE 454 when I talked about group think? Group think is when we all work to avoid encountering uncomfortable truths. We keep the party line going and suppress new information that could have caused us to reconsider our plans. Group think is sometimes cited as the cause of the Challenger tragedy.

  So now is the time to make sure we welcome dissenting views. If any of you have seen anything or have any gut feelings about sedimentation tanks or flocculators that makes you think that our design for 1.2 m deep tanks is risky or prone to failure, we want to hear it!
  You can see a draft CAD design at https://confluence.cornell.edu/display/AGUACLARA/Cuatro+Comunidades. (you will need the free viewing software).

How might Environmental Engineers fall into the trap of groupthink?

- I don't want to discover that my technology is obsolete and that the years of effort that I put into improving that technology have been a waste
- Confusion of confidence and scientific proof
- Reliance on empiricism rather than physics
- Confusion of the ability to name a process (Flocculation) with an understanding of the physics of the process
- Reduce "groupthink" by… Respect AND question!

extra

Role of Myth in Environmental Engineering

- Myth can be a useful way of understanding a complex reality
  - creation stories
- Myth can also be used to describe generally accepted but unproven hypotheses (my usage here)
- Myth #1: Science and engineering aren't influenced by myth because they are based on the scientific method

Historic Examples of Myth

extra

- Malaria (bad air disease hypothesis)
- Streams purify themselves in 1 mile
- The air coming out of the ground under conditions of low or sinking groundwater causes typhoid

Environmental Engineering/Public Health Myths (or suspects!)

extra

- Dead bodies cause disease
- Slow sand filters ripen because of biological growth in the filter bed
- Chlorine disinfects dirty water
- Chlorine eliminated typhoid fever from the US
- Cessation of chlorination due to fear of Disinfection By Products caused the cholera outbreak in Peru in 1993
- We already know how to solve the problem of the 3 billion people who do not having access to safe drinking water

The Creation of Myths in Peer Review Literature

extra

- Publish an article where you list hypotheses that might explain some scientific phenomenon
- Quote that first article and fail to mention that it was an unproven hypothesis
- Eventually literature reviews at the beginning of scientific papers in your field will refer to this hypothesis as if it were a theory
- Voila!

Uncovering a "Theory" to Reveal a Myth or a Knowledge Gap

extra

- Does this "theory" provide insights that have led to new discoveries or new applications?
- Does the "theory" include equations that are based on the fundamental laws of nature?
- Does the "theory" use dimensionless constants that are close to one?
- Is it an elegant "theory" with no need for special cases?

Expose the Myth

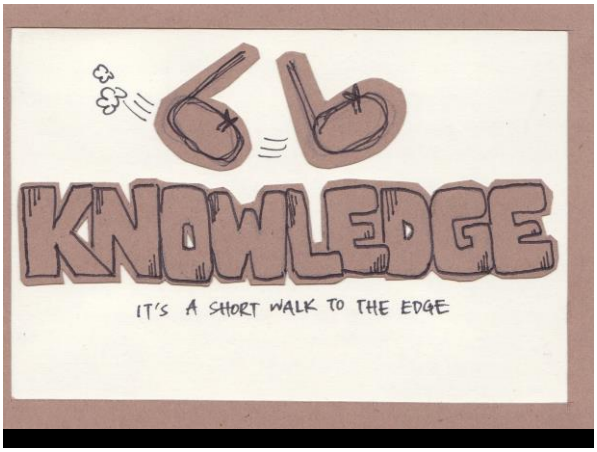
- Let's expose some more environmental engineering myths
- Don't believe everything I say
- You should always be asking,
  - How do we know that?
  - Why can't we do this better
- There are **many** things that I have taught in this class in previous years that I now know are wrong or incomplete understandings

The Challenge: Sustainable Municipal Drinking Water Supplies

- We need the brightest and the best to create new and better solutions so we can meet the goal of providing everyone with safe drinking water
- This challenge is apparently more difficult than building a space station, designing a fuel cell, or inventing the world wide web
- So let's role up our sleeves and begin…

Opportunities

- Honduras trip in January
- Fluoride removal reactor pilot Summer 2018
  - Recruit leaders
- Recruit for Honduras interns
- AguaClara Engineers
- Fulbright Scholar!



It is a short walk…

- …to the edge of knowledge
- There are significant knowledge gaps in every process that I will be teaching in this course
- We aren't able to optimize surface water treatment processes because we don't yet understand the fundamental physics of many of the processes
- We are getting closer…