Updated: 22 January 2020

Print version

CEE 680: Water Chemistry

Lecture #1

Intro: Course Administration, Scope and Chemistry Review

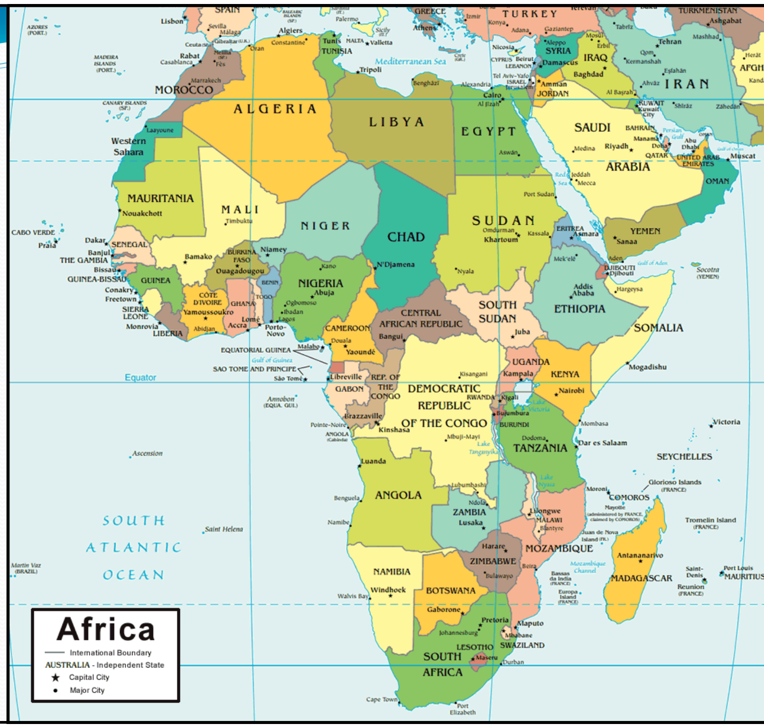
(Stumm & Morgan, Chapt. 1)

(pp.1-4)

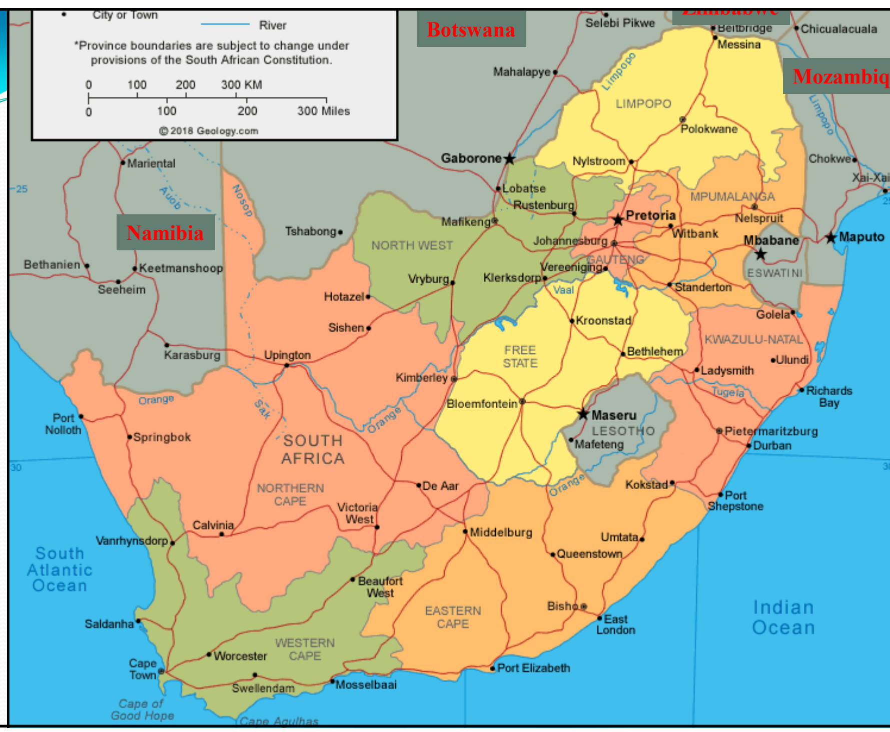
(Benjamin, 1.1 & 1.4)

David Reckhow

David Reckhow



David Reckhow



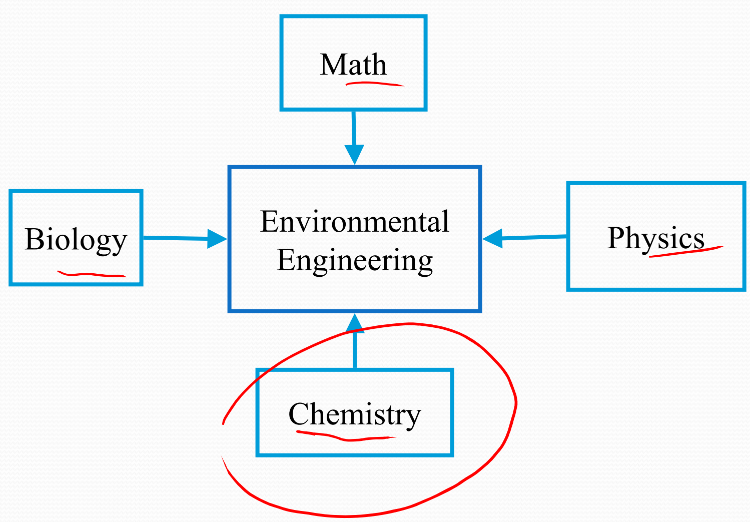
Course Administration

- Course Syllabus
- Textbook: Benjamin, Water Chemistry, 2nd Edition, Waveland Press, 2015
  - must read, not all topics may be covered
- Detailed Course Outline
- Homework policy
  - most graded;
- Projects
  - MINEQL, review of literature
- Web site

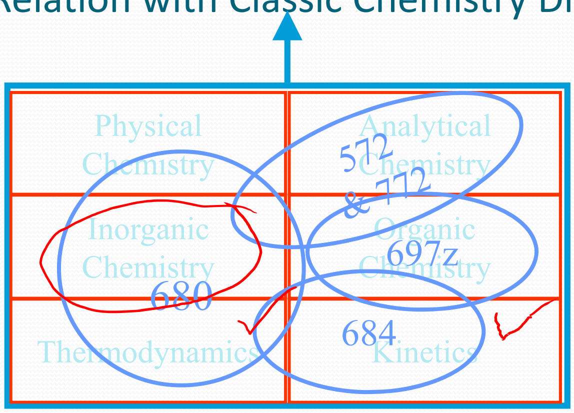
Other References

1. Langmuir, Aqueous Environmental Geochemistry, Prentice-Hall, 1997.
2. Pankow, Aquatic Chemistry Concepts. Lewis Publ., Chelsea, MI, 1991
3. Stumm & Morgan, Aquatic Chemistry. 3rd Ed., John Wiley & Sons., 1995
   - Extra copy on shelf in 3^{rd} floor Elab II office
   - UM Science GB855 .S78 1996
4. Jensen, A problem Solving Approach to Aquatic Chemistry, Wiley, 2003.
   - UM Science GB855 .J46 2003
5. Sawyer, McCarty & Parkin, Chemistry for Environmental Engineering, McGraw Hill, 2003.
   - Extra copy of 3^{rd} edition on shelf in 3^{rd} floor Elab II office
6. Eby, Principles of Environmental Geochemistry, Cengage Learning, 2004.
7. Brezonik & Arnold, Water Chemistry, Oxford Univ Press, 2011
   - FC On line: GB855 .B744 2011eb
8. Snoeyink & Jenkins, Water Chemistry, John Wiley & Sons., 1980.
   - UM Science QD169.W3 S66

Relation with Environmental Engineering



Relation with Classic Chemistry Disciplines



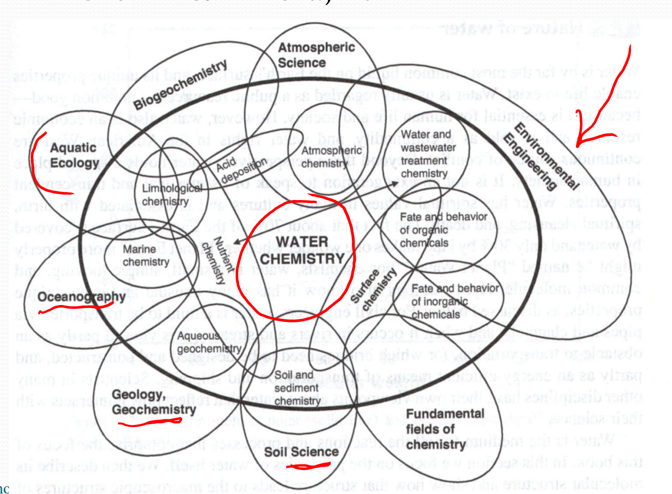
- CEE 680
  - Water Chemistry
- CEE 572 & 772
  - Chemical Analysis
- CEE 684
  - Chemical Kinetics
- CEE 697z
  - Organics in water

CEE 680 is very similar to Geo-Sci 519 (Aqueous Environmental Geochemistry

David Reckhow CEE 680 #1 11

Interdisciplinary sub-fields

- From Brezonik & Arnold, 2011



David Reckhow 12

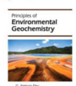
Others

- Geo-Sci 519
  - With lab. Chemical processes affecting the distribution and circulation of chemical compounds in natural waters. Geochemistry of precipitation, rivers, lakes, groundwater, and oceans; applications of thermodynamic equilibria to predicting composition of aqueous systems. Behavior of trace metals and radionuclides in near surface environments. Prerequisite: Chem 111, 112.

Select Your Course Items

Spring 2020 - GEO-SCI - 519 - 01 - 43935 - Aqueous Envrn Geochm -

Required



Principles of Environmental Geochemistry
by Eby, G. Nelson
Edition: Reprint
ISBN: 9781478631644
Format: Paperback
Publisher: Waveland Pr Inc
Pub. Date: 4/1/2016

GEO-SCI 519 Aqueous Envrn Geochm

First

Section 01-LEC(43935) Status Units 4 Enroll 12 Cap 25
Session University

Days & Times	Room	Instructor	Topic	Restrictions/Notes
MoWeFr 10:10AM - 11:00AM	Morrill Sci. Ctr. (IV) rm S159	Matthew Winnick	TBA	Yes

Section 01LL-LAB(43988) Status Enroll 12 Cap 20
Session University

Days & Times	Room	Instructor	Topic	Restrictions/Notes
Tu 9:30AM - 12:30PM	Morrill Sci. Ctr. (I) rm N303	Staff	TBA	Yes

General Questions for Water, Soil & Geochemists

- What is the chemical composition of natural waters?
  - Will it change with time, location?
- What happens to chemical species when they enter new aquatic or non-aquatic environments?
  - How does transport affect the chemistry?
- What types of reactions occur in managed natural systems?
  - What do we need to do to make it work better?

Examples for Water Treatment

- How can we use chemistry to stop corrosion and dissolution of lead?
- What with the pH, alkalinity and hardness be after mixing two different types of water
  - e.g., groundwater and surface water
- How do we get the best performance from chemical precipitation processes
  - e.g., coagulation, softening
- What can we do to optimize oxidation treatments
  - e.g., removal of Mn, trace organic constituents

David Reckhow CEE 680 #1 15

Solving real problems

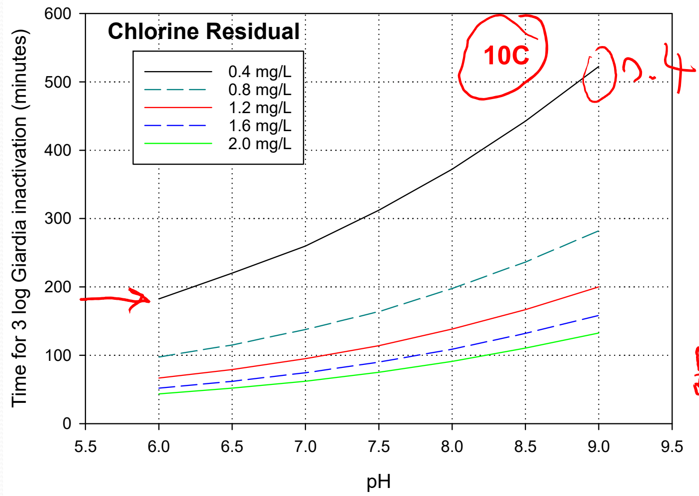
- Why was this water treatment plant once perfectly designed for treating its raw water?

- Why has air pollution control rendered it far less effective?
- How can it be re-designed to work well again?

David Reckhow CEE 680 #1 16

Disinfection with Free Chlorine

- Required contact time increases with pH



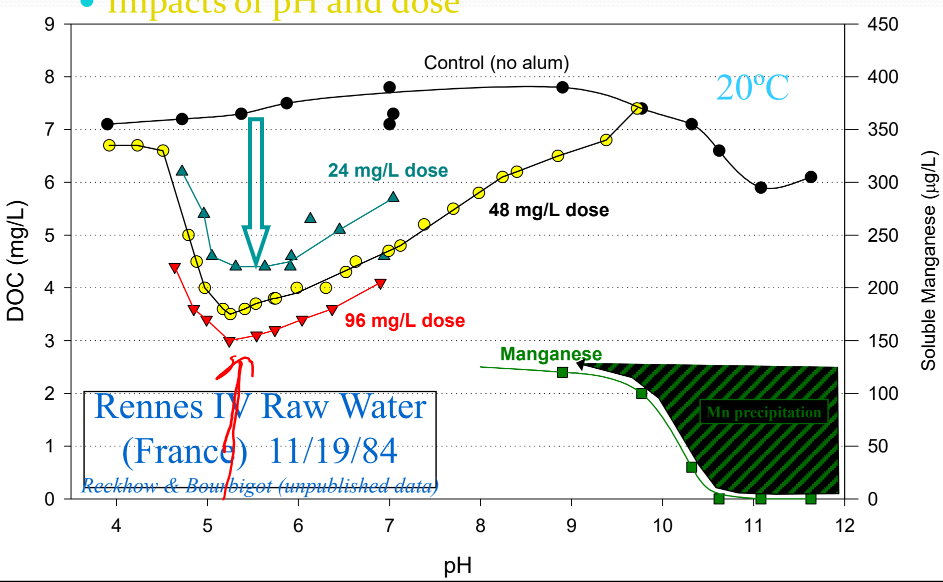
Based on USEPA CT tables

HOCl
OCl⁻

17

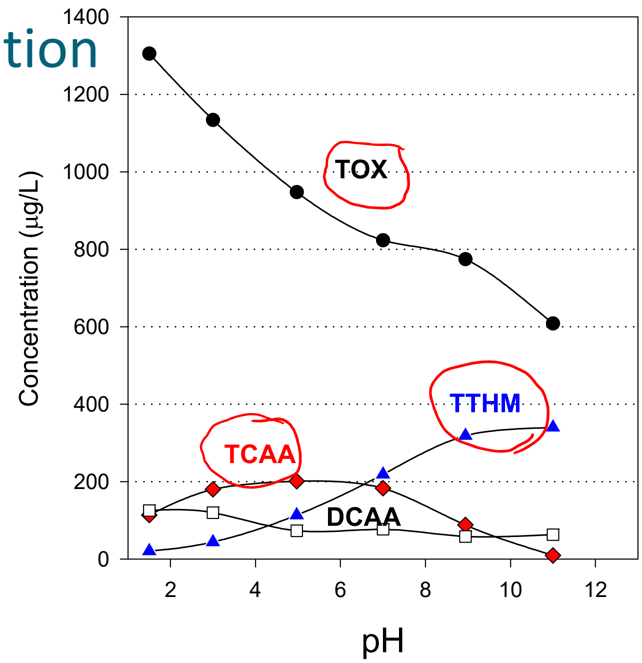
DOC removal by alum coagulation

- Impacts of pH and dose



DBP Formation

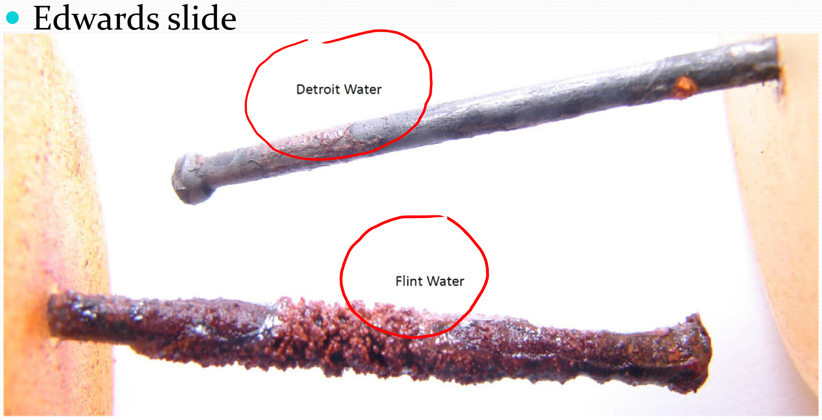
- Effect of pH with free chlorine



From: Reckhow & Singer, 1984
(4.2 mg/L TOC, 3 days, 20 mg/L dose, 20°C)

Flint water crisis

- Edwards slide



Steel Exposed One Month to Detroit vs. Flint River Water

Elemental abundance in fresh water

From: Stumm & Morgan, 1996; Benjamin, fig 1.4; Langmuir figure 8.12

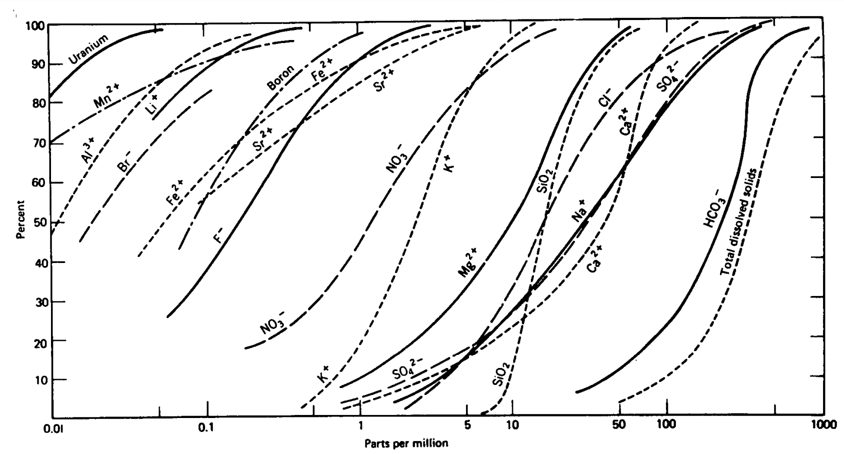


Figure 15.1. Cumulative curves showing the frequency distribution of various constituents in terrestrial water. Data are mostly from the United States from various sources. (Adapted from Davies and DeWiest, 1966.)

- To next lecture