



The Environmental Chemistry Bootcamp

COURSE AGENDA

Instructors: Denise Turner and William Spain

- 8:00 AM **Registration**
- 8:30 AM **Course Introduction**
- 9:00 AM **Defining and Understanding Matter**
- Atoms, elements, molecules, and compounds
 - The amazing structure of the atom
- 9:45 AM **Break**
- 10:00 AM **The Periodic Table**
- Learn how all the known elements in the universe are related to one another
 - Chemical symbols, atomic number, atomic weight
 - Understand key chemical reactivity trends in the periodic table
- 11:00 AM **Metric Measurement**
- Review the metric system that is used in analytical reports and scientific data
 - Learn an easy way to convert Celsius temperatures to Fahrenheit
- 11:30 PM **Lunch on your own or with colleagues**
- 12:45 PM **Structure and Bonding**
- Understand chemical bonding and why bond strengths are critical to life on earth
 - How does the geometry of bonding affect compound toxicity?
 - How can exactly the same atoms be put together to make different compounds?
- 2:00 PM **Break**
- 2:15 PM **Nuclear Chemistry**
- Radioactivity: alpha, beta, and gamma radiation
 - How do changes in the nucleus of an atom create an entirely new element?
 - Really understand $E = mc^2$!

- How do we use nuclear fission to create electricity and nuclear fusion to create sunlight?

3:15 PM

Inorganic Chemistry

- Acids, bases, salts, and pH
- Physical and chemical properties of metals
- Soil and mineral chemistry

4:15 PM

Case Studies

4:30 PM

End of Day 1

Day Two

8:00 AM

Registration/Coffee

8:30 AM

Review

9:30 AM

Break

9:45 AM

Organic Chemistry

- Learn how to identify classes of organic chemicals, e.g., alcohols, acids, hydrocarbons, and amines
- What is biomagnification and why does it occur?
- Why are organic chemicals like DDT, dioxins, PCBs, and PAHs so toxic to the environment?
- Applicability, Process and Requirements for Title V Major Sources and the Key Issues of Operational Flexibility and Modifications

11:30 AM

Biological Chemistry

- What are fats, trans-fats, carbohydrates, and cholesterol, etc.?
- What is soap and why does it clean our clothes?
- What makes up our proteins and why are they so critical to life?
- What is the structure of our DNA/RNA and how does it work?

12:00 PM

Lunch on your own or with colleagues

1:15 PM

The Chemistry of Water

- Learn about the unique chemical properties of water that make it so critical to life on earth

1:45 PM

The Chemistry Behind MSDS

- What does all that boring chemical data really mean?
 - Why do you need to know CAS numbers, boiling points, vapor pressures, vapor densities and solubilities
 - How can MSDS data be used to keep the workplace safe?
 - Work through a case study using MSDS data

3:00 PM

Break

- 3:15 PM **Chemical Compatibility**
- Tools for determining chemical compatibility
 - Proper storage, inventory control, and inadvertent mixing of chemicals

- 4:00 PM **Hazardous Waste Characteristics**
- An example of how chemical reactivity is regulated by EPA

4:30 PM **End of Day Two**

Day Three

8:30 AM **Review**

9:30 AM **Break**

- 9:45 AM **Chemical and Physical Reactions**
- Understand the basic types of chemical reactions
 - Learn about common chemical reactions: hydrolysis, hydrogenation, neutralization, polymerization, oxidation/reduction, catalysis, photolysis, and biodegradation, etc.
 - How is wastewater treated at your local POTW?

- 11:00 AM **Sampling and Analysis**
- Sampling plans and correct sampling procedures
 - Representative sample, discrete/composite samples, background samples, blanks/splits, spikes and percent recoveries
 - Common analytical procedures
 - VOCs, TOC, BTEX, total metals, TCLP, PAHs, BOD/COD, TDS/TSS – what do all these abbreviations mean and when are these tests used?

12:30 PM **End of Day 3**

Day 4

8:30 AM **Review**

- 9:00 AM Organic Nomenclature
- Learn easy tips for translating complex chemical names
 - Why do chemists use numbers in such compounds as 1,1,1-trichloroethane?
 - What do the prefixes ortho-, meta-, para- tell you about the structure of a compound?
 - What's all the fuss about "trans" fats and how does this term relate to chemical structure?
 - Atoms, elements, molecules, and compounds
 - The amazing structure of the atom

9:45 AM **Break**

- 10:00 AM **Advanced Applications of the Periodic Table**
- Review the structure of the periodic table and what it tells you about atomic structure and chemical reactivity

- Learn how all the known elements in the universe are related to one another
- Chemical symbols, atomic number, atomic weight
- Understand key chemical reactivity trends in the periodic table

10:30 AM

The Chemistry of Air Pollution

- Regardless of the politics, why do scientists call it the “greenhouse” effect?
- What are the possible causes of global warming, both human and non-human?
- What is global dimming?
- What is the recipe for smog?
- What are common sources of organic and inorganic air pollutants and how do they affect our atmosphere?

11:45 PM

Lunch on your own or with colleagues

1:00 PM

The Chemistry of Solutions

- What is a solution and why is solubility so critical to chemical reactivity?
- How do we predict solubility?
- Why does antifreeze prevent the water in our car radiators from freezing in the winter and boiling in the summer?
- How have modern chemists produced water based paints, since most pigments are not generally soluble in water?

2:00 PM

Break

2:15 PM

Toxicological Chemistry

- What is a risk assessment and how do we use them to predict potential environmental/human harm?
- What is a poison and how do we determine its toxicity?
- What is the meaning of such terms as hypersensitivity, lachrymator, acute/chronic toxicity, carcinogen, mutagen, teratogen?

3:15 PM

Advanced Sampling and Analysis

- Learn about recent Nobel prize winning advances in non-destructive techniques to determine chemical structure
- How have these techniques been translated into non-invasive medical procedures such as MRIs and sonograms?
- How can a chemist tell when a reaction is finished without even wasting a drop of the reaction mixture?
- How can solids be used to purify reaction mixtures?

4:30 PM

End of Day 4

Day Five

8:30 AM

Review and Case Studies

10:00 AM

Break

10:15 AM

Chemistry of Nitrogen, Phosphorus, & Sulfur

- Why are these three elements critical to life on earth?

- What is the structure of your DNA and proteins?
- How are caffeine, nicotine, cocaine, and morphine related?
- Why were large accumulations of bird droppings so critical in WWI that the Allies blockaded their sources?
- How did sulfur solve the critical problem of creating a heat resistant synthetic rubber?
- What Nobel prize winning chemist produced the first chemical warfare agents used in WWI?

11:30 PM **Lunch on your own or with colleagues**

12:45 PM **The Complex Reactions of Metals**

- What are the most abundant metals in the earth's crust and how are they used?
- What metals are found in rubies, sapphires, emeralds, and pearls?
- Why have organo-tin compounds recently been banned from most marine applications?
- Why is aluminum the metal of choice for many building materials, as well as food containers?
- What is the origin of the term "tin" can, and how did these containers potentially contribute to the demise of a famous Arctic explorer?
- Why is mercury poisoning a major problem in the Amazon?
- How was silver used to make the first photograph?

1:45 PM **Break**

2:00 PM **Chemistry of Water Pollution**

- What is hard water and why is it a problem?
- Why is the ocean salty when it is fed by "freshwater" rivers and streams?
- Why is there a "dead zone" at the mouth of the Mississippi River that is roughly the size of New Jersey?
- Are our oceans dying?
- Why is the availability of potable water thought to be one of the greatest challenges facing the human race in the 21st century?

3:00 PM **Meeting Adjourns**



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