

APES Tips of the Week Section VI: Pollution

Water Pollution: ch. 14

- Water Resources Review (see ch. 9/Tips from Section I)
 - 97% Salt Water
 - 3% Fresh water; <1% accessible freshwater
- Point sources (ex. drain pipe) are easy to identify; Nonpoint sources are more general (lawns- which lawn had the chemicals?)
- **Pollutants**
 - Infectious Agents
 - **Coliform Bacteria** from fecal matter; **Cholera** from raw sewage → both cause disease
 - Oxygen demanding wastes
 - Manure (coliform bacteria can lead to disease; Nitrates in manure can lead to eutrophication)
 - Plant Nutrients (N, P, K)
 - Manure & fertilizers
 - Eutrophication: algal bloom → algae die → decrease in dissolved oxygen → species w/ low range of tolerance die
 - “Dead Zone” aka “Hypoxia” in the Gulf of Mexico due to agricultural run-off
 - *drinking water w/ high levels of nitrates decrease O₂ carrying capacity of blood
 - Inorganic Chemicals (lack Carbon)
 - **Lead** from pipes/pipe fixtures → neurological damage
 - **Mercury** from coal burning cooling power plants bioaccumulate in food webs → neurological damage (ex. mental retardation)
 - Acid mine drainage → decrease pH of aquatic systems → species w/ a low tolerance die
 - Organic Chemicals (contain carbon)
 - Chemicals in pesticides (ex. roundup by Monsanto) → cancer? Wheat/gluten allergies?
 - **PPCP's** from humans → endocrine disruptors
 - **Perchlorates** from rocket manufacturing → disrupts thyroid gland
 - **PCB's** from plastics → carcinogenic
 - **PBDE's** from flame retardants → neurological damage
 - Sediments
 - Soil & silt from erosion/runoff → increase in turbidity = decrease in photosynthesis
 - Be able to analyze the O₂ sag curve (DO & BOD are inversely related)
- **Water Treatment**
 - Rural: Septic Tanks
 - Municipal: Wastewater Treatment Facility
 - *Primary (Physical) Treatment*- uses screens to remove debris

- *Secondary (Biological) Treatment*- bacteria break down organic materials; activated sludge tanks; a floccing agent (ie. alum) is added to the water
 - *Tertiary (Chemical) Treatment*- pathogenic organisms are killed by chlorination, UV, or ozone
- **Laws**
 - Clean Water Act- “fishable swimmable waters”
 - Safe Drinking Water Act- Sets minimum safety standards for drinking water
- **Solutions to decrease water pollution**
 - Decrease soil erosion (soil conservation practices)
 - Decrease fertilizers/run-off (use compost, mulch)
 - Decrease pesticides/run-off (use IPM, biological & chemical controls; polyculture)
 - Decrease manure/run-off (plant buffer zones)
 - Use natural ingredients for personal care products (ex. Dr. Bronners castile soap, baking soda & essential oils for toothpaste)
 - Use natural ingredients for home cleaning solutions (ex. vinegar & water- may add essential oils for added disinfectant & pleasant smelling qualities)
- **Solutions to decrease water use**
 - Drip irrigation
 - Plant native species
 - Low flow showers/toilets
 - Turn off water when brushing teeth, washing hands, & shaving
 - Only run full loads of the dishwasher & washing machines
 - Soil conservation (ex. mulch to reduce evaporation & run-off)

FRQ's

- 2001 Q4
- 2007 Q1
- 2009 Q3
- 2010 Q1
- 2012 Q3
- 2012 Q4
- 2013 Q1
- Chapter 14 FRQs

Air Pollution ch. 15

- Clean Air Act- regulates SO₂, NO_x, CO, PM, O₃, Pb, & VOCs
- **SO₂**
 - From volcanic eruptions & coal burning power plants
 - Forms industrial (grey air) smog
 - + H₂O = H₂SO₄ (sulfuric acid) → acid deposition
 - Aggravates bronchitis & asthma
 - *Wet Scrubber Units reduce SO₂
- **NO_x**

- From combustion of fossil fuels
- $\text{NO}_x + \text{VOC} + \text{sunlight} = \text{photochemical (brown air) smog} \rightarrow \text{Ozone (O}_3\text{)}$
- Disrupts photosynthesis in plants
- $+ \text{H}_2\text{O} = \text{HNO}_3$ (nitric acid) \rightarrow acid deposition
- Aggravates bronchitis & asthma
- **VOC's (volatile organic compounds)**
 - Sources: hydrocarbons from transportation; formaldehyde
 - $\text{NO}_x + \text{VOC} + \text{sunlight} \rightarrow \text{photochemical smog}$
- **Ozone (O₃) "bad nearby" in troposphere**
 - Secondary pollutant forms photochemical smog
 - Aggravates bronchitis & asthma; disrupts photosynthesis
 - Greenhouse gas in the troposphere (absorbs outgoing IR radiation)
- **CO**
 - Sources: cigarette smoke, exhaust from cars; incomplete combustion, unvented gas or wood stove, faulty furnace
 - Attaches to red blood cells and decreases oxygen in body. Short term effects: fatigue/dizziness \rightarrow can cause death if don't get to a ventilated area/oxygen
- **Particulates (PM)**
 - Dust, volcanic ash, pet dander, pollen
 - Aggravates bronchitis & asthma
 - *Baghouse filters & Electrostatic precipitators reduce PM in power plants
- **Lead (Pb)**
 - Sources: old paint, plumbing fixtures, ceramic glazes, leaded gasoline, metal refineries
 - Neurotoxin- can cause mental retardation
- **Asbestos**
 - Sources: pipe insulation
 - Effect: lung disease (ex. mesothelioma)
- **Radon-222**
 - Source: underlying bedrock
 - Effect: Lung Cancer
 - Solution: seal cracks in foundation of houses
- **Formaldehyde (type of VOC)**
 - Source: furniture stuffing, carpeting glue
 - Effects: eye, throat, lung irritation
- **Thermal inversion**
 - Layer of cool air trapped under a layer of warm air \rightarrow can cause buildup of air pollutants
- **Acid Deposition**
 - $\text{pH} < 5.6$ (normal rainfall)
 - Primary pollutants SO_2 & NO_x combine with water to form sulfuric acid (H_2SO_4) and nitric acid (HNO_3) \rightarrow
 - H^+ dissociates (acid = contributes H^+ to solution)
 - Aggravates bronchitis & asthma

- Decreases pH of aquatic systems → species w/ a low range of tolerance (trout) die → disrupts food webs → decreases biodiversity
- Increases solubility of heavy metals (Al, Pb, Hg, Cd)
 - Interferes w/ enzyme activity; decreased reproductive rates
- Damages statues, buildings, metals (acids corrode)
- **Solutions for Air Pollution**
 - Reduce fossil fuel use and utilize more renewable energy (ex. wind, solar)
 - Install/improve pollution control devices
 - Wet scrubber units: SO₂
 - Electrostatic Precipitators & Baghouse filters: PM
 - Catalytic Converters: cars
 - Improve mpg (mile per gallon)/CAFÉ standards in vehicles
 - Use public transportation, carpool, bike, walk
 - Change filters in AC units in households
 - Reduce/ban smoking
- Noise Pollution
 - Hearing damage at 85 decibels

Waste Generation & Disposal: ch. 16

- Most of our MSW is compostable/recyclable (31% paper)
- E-Waste (electronic) → take to E-Waste recycling b/c contains toxic metals
 - **Lead**: neurotoxin (ex. birth defects, brain damage, learning disabilities, mental retardation)
 - **Mercury**: neurotoxin (ex. birth defects, brain damage, learning disabilities, mental retardation)
 - **Cadmium**: can cause cancer
- Open Dumps
 - Human Health Concerns: infectious diseases; exposure to toxins (ex. heavy metals)
 - Environmental Concerns: leachate contamination → contaminates groundwater
- Landfills
 - Sanitary (“Modern”) landfills used in developed countries
 - Clay liner used to prevent contamination
 - Collect leachate (rainwater that gets contaminated from percolating through water) → sent to wastewater treatment facility
 - Methane (CH₄) produced from anaerobic decomposition of waste.
 - Greenhouse gas → global climate change
 - Combustible: heat water → steam → turbine (mechanical energy) → generator (electrical energy) → electricity to grid
 - CNG (compressed natural gas) used to run vehicles
 - *covered daily & when at full capacity
- Incinerators
 - Burn trash
 - Can also be used to heat water → steam → turbine → generator

- ****Lots of pollutants
 - Dioxins
 - Come from chlorinated plastics = persistent in environment
 - Bioaccumulate in food chain in fatty tissues
 - Cause reproductive and developmental problems, damage the immune system, interfere with hormones and also cause cancer
- Hazardous Waste
 - Regulated by RCRA
 - CERCLA: identifies hazardous wastes sites & cleans them on a priority basis
 - Vocab:
 - Brownfield- abandoned industrial sites contaminated often w/ wastes
 - **Bio**remediation- bacteria & enzymes destroy hazardous substances
 - **Phyto**remediation- **plants** absorb/filter contaminants from polluted soil & water
 - Ex. Indian Mustard & Brake Ferns can absorb toxic metals such as lead & arsenic
- Solutions
 - REFUSE, Reduce, Reuse, Recycle!
 - Compost, e-waste recycle
 - Reusable bags
 - Bring lunch in reusable containers
 - Cloth vs. paper napkins
 - Use non-toxic cleaners (ex. vinegar & water)
 - Baghouse Filters- remove air pollutants (ex. particulates)

FRQ's

- 2000 Q2 Recycling
- 2004 Q3 Radioactive Waste
- 2006 Q3 Hazardous Waste on industrial site/Brownfield
- 2008 Q2 Landfill (w/ math)
- 2010 Q1 Deadly pollutants
- Chapter 16 FRQ's

Human Health & Environmental Risks

- *see Google Doc made with group during POGIL activity
- Types of Hazards
 - Biological
 - Bacterial: Tuberculosis (TB), (bubonic) Plague, Cholera
 - Virus: Ebola, SARS, bird flu, West Nile Virus, HIV
 - Parasite: Malaria
 - Chemical
 - Neurotoxic Heavy metals: Pb, Hg, Cd
 - Endocrine Disruptors: Phthalates (from plastics & cosmetics), DDT
 - Carcinogenic: PCB's, asbestos, arsenic, radon
 - Teratogen: Alcohol

- Physical
 - Earthquakes, fires, floods, hurricanes
- Cultural
 - Smoking, sex, alcohol, drug use, poor diet, assault
- LD-50 → Lethal Dose - 50(%)
 - Amount of a substance that kills 50% of the test population in a 14 day period
 - *Review 2002 Q3 FRQ