### Chapter 14 – Water Pollution

### Reading Guide

**Vocabulary**

Learn the definition of each term. The *italicized* words are not necessarily in the textbook (Check the lecture). The **bold** words require you to know more than just the definition. For example: Ecosystem service - you should what they are, be able to name several types and describe how we benefit from those services.

**Terms**

Point sources

Nonpoint sources

Wastewater

Dead zones

Eutrophication

Septic tank

Leach field

Primary treatment

Secondary treatment

Tertiary treatment

Disinfection (Chlorine/UV/ozone)

Sewage sludge

Manure lagoon

Acid mine drainage

Clean zone

Recovery zone

Decomposition zone

Oxygen-depleted zone (Septic Zone)

Dissolved oxygen (DO)

Biochemical oxygen demand (BOD)

Escherichia coli (E. Coli)

Fecal coliform bacteria

Indicator species

Oxygen sag curve

Safe Drinking Water Act

Maximum Contaminant Level

Clean Water Act

Thermal pollution

Turbidity

**Pollutants**

Nitrate

Phosphate

Thermal Pollution

MTBE

Cholera

Cryptosporidium

Giardia

Pathogens

Oil

Sediment

Endocrine disruptors

Oxygen demanding waste

Lead

Arsenic

Mercury

PCBs

Acid Mine Drainage

Acid Rain

Noise pollution

**Reading Outline**

The Chesapeake Bay

1. What are the challenges faced by Chesapeake Bay?
2. Where are the nutrients entering the Bay coming from? What are they causing?
3. Where is the sediment coming from? How does it harm the Bay?
4. What chemicals are entering the Bay? How do they harm the Bay?
5. The Chesapeake Bay Action Plan was developed to clean-up the Bay. Describe THREE things that might be part of that action plan (not in the reading – you will have to think)

**14.1 Pollution can come from specific sites or broad areas**

1. What is the difference between a point source and a non-point source? Provide a few examples of each. Which is easier to control?

**14.2 Human wastewater is a common pollutant**

1. Where does wastewater come from? Why is it difficult to prevent it from contaminating drinking water?

There are three problems caused by human wastewater:

1. **Oxygen-demanding waste**
   1. What is oxygen demanding waste and why does it demand oxygen? Be specific.
   2. What does a low BOD indicate? A high BOD?
   3. Explain how oxygen demanding waste can lead to a dead zone.
2. **Nutrients**
   1. How do nitrogen and phosphorus get into human waste water? (since we don’t put fertilizer down the toilet)
   2. Explain what eutrophication is.
   3. Where in the US do we have a large dead zone? When does it form?
3. **Disease Causing Organisms**
   1. List some diseases that can be caused by drinking water contaminated with human waste.
   2. How many people worldwide do NOT have access to safe drinking water?
   3. What indicator specie do we use to test for the presence of human waste in drinking water? Name one specific bacteria in this group. Are the indicator species themselves harmful?

**14.3 We have technologies to treat wastewater from humans and livestock**

1. What is a septic system and how does it work?
2. How does a septic system get rid of disease causing organisms?
3. List an advantage and a disadvantage of a septic system.
4. What is the goal of primary treatment? What happens to the sludge?
5. What is the goal of secondary treatment? Why does it require aeration?
6. How can you disinfect waste water?
7. What additional benefit does tertiary treatment provide?
8. In what circumstances might it be legal to dispose of raw sewage directly into a waterbody?
9. CAFO generates lots of animal manure. How does a manure lagoon treat animal manure?
10. What are the risks and benefits of manure lagoon?

**14.4 Heavy metals and other substances can pose serious threats to human health and the environment**

1. Fill out the chart below for section 14.4. **Keep it BRIEF** – you can always re-read the section

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Pollutant** | **Sources** | **Effects** | **Solutions** | **Examples or Additional Info** |
| Lead |  |  |  |  |
| Arsenic |  |  |  |  |
| Mercury |  |  |  |  |
| Acids |  |  |  |  |
| Synthetic organic compounds |  |  |  |  |
| Pesticides |  |  |  |  |
| Inert Ingredients |  |  |  |  |
| Pharmaceuticals |  |  |  |  |
| Hormones |  |  |  |  |
| Military Compounds |  |  |  |  |
| Industrial compounds |  |  |  |  |

**14.5 Oil pollution can have catastrophic environmental impacts**

1. Why are oil spills such a problem?
2. List the places oil can spill from and give a specific example for each.
3. Describe the three ways surface oil be cleaned up. Include a pro and con for each method.
4. Why is it difficult to clean up underwater oil spills?
5. Why is it difficult to clean up rocky coastlines?

**14.6 Not all water pollutants are chemicals**

1. How does solid waste threaten aquatic ecosystems?
2. Where does sediment pollution come from?
3. How does sediment impact aquatic ecosystems?
4. Why is heat considered a water pollutant?
5. Why is a summer a particularly bad time for thermal pollution?
6. How can noise pollution impact aquatic ecosystems?

**14.7 A nation’s water quality is a reflection of the nation’s water laws and their enforcement**

1. What is the Clean Water Act? What kinds of water does it apply to?
2. What is the Safe Drinking Water Act? What kinds of water does it apply to?
3. What is an MCL and how are they determined?
4. Why is clean, safe water a challenge in less developed countries?

**Working towards sustainability: Building Green Solutions to Wastewater Treatment**

1. What were the characteristics of the facilities desired by Ashfield and New England BioLabs?
2. List the steps in their green waste water treatment design and relate them to the steps in industrial treatment (primary, secondary, etc).
3. What are the pros and cons of these green waste water treatment plants?

Additional Work: Answer the **MC questions** at the end of the chapter and review the FRQs.

### Chapter 15 – Air Pollution and Stratospheric Ozone Depletion

### Reading Guide

**Vocabulary**

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**Terms**

**Air pollution**

Ground level pollution

**Tropospheric ozone**

Haze

**Photochemical smog**

Gray smog

Atmospheric Brown Cloud

Primary pollutant

Secondary pollutant

**National ambient air quality standards (NAAQS)**

**Clean Air Act**

**Thermal inversion**

**Acid deposition**

Low sulfur coal

Fluidized bed combustion

Catalytic converter

**Baghouse filters**

**Scrubber**

**Electrostatic precipitator**

Pollution permits

**Ozone layer hole**

**Sick building syndrome**

**Stratospheric ozone**

Polar Vortex

**Montreal Protocol**

*Mobile sources*

*Stationary sources*

*Cataracts*

*UV radiation*

*Melanoma*

*Copenhagen Protocol*

**Pollutants**

Asbestos (--)

Carbon Dioxide (CO2)

Chlorofluorocarbons (CFCs)

Fine particles (PM10)

Formaldehyde (--)

Lead (Pb)

Mercury (Hg)

Nitric Acid (HNO3)

Nitric Oxide (NO)

Nitrogen dioxide (NO2)

Radon (Rn-222)

Sulfur dioxide (SO2)

Sulfuric acid (H2SO4)

Tropospheric Ozone (O3)

Ultrafine particles (PM2.5)

Volatile organic compounds (VOCs)

**Reading Outline**

Cleaning Up in Chattanooga

1. How did Chattanooga’s geography contribute to its air pollution problem?
2. List the things Chattanooga did to clean up air pollution.
3. Why did Chattanooga continue to have an ozone problem even after cleaning up other types of air pollution?

**15.1 Air pollutants are found throughout the entire global system**

1. Name a few natural and a few anthropogenic sources of air pollution.
2. Why is air pollution a global problem? Support your answer with examples.
3. List the 6 criteria air pollutants and their chemical formulas. What law allows the EPA to regulate these pollutants?
4. What pollutants have been added to the list of pollutants covered by the Clean Air Act? Which ones probably should be added?
5. You should memorize the Table 15.1: Major Air Pollutants. You should also know any NATURAL SOURCES of each air pollutant. i.e. volcanoes produce PM, SO2, CO­2, CO, etc. Covered in next section.
6. What is the difference between photochemical/brown smog, sulfurous/gray smog and atmospheric brown cloud?

**15.2 Air pollution comes from both natural and human sources**

1. List the air pollutants created by the following natural sources of air pollution:
   1. Volcanoes -
   2. Lightning -
   3. Forest Fires -
   4. Plants –
2. Fill in the chart below using Figure 15.5.

|  |  |  |
| --- | --- | --- |
| **Pollutant** | **Top 3 Sources** | **Is source natural or anthropogenic?** |
| Carbon monoxide |  |  |
|  |  |
|  |  |
| Nitrogen oxides |  |  |
|  |  |
|  |  |
| Sulfur dioxide |  |  |
|  |  |
|  |  |
| PM2.5 |  |  |
|  |  |
|  |  |

**15.3 Photochemical smog is still an environmental problem in the US**

1. What two air pollutants are major contributors to smog formation?
2. How does temperature influence smog formation? Why?
3. How does an inversion layer influence smog formation? Why?

**15.3 Acid deposition is much less of a problem than it used to be**

1. How has the US reduced acid deposition?
2. Is acid deposition a local, regional or global problem? Explain.
3. List the environmental, economic and human health impacts associated with acid rain.

**15.4 Pollution control includes prevention, technology, and innovation**

1. List some ways to PREVENT air pollution.
2. How can we control sulfur dioxide emissions? Include any drawbacks to the control methods.
3. How can we control nitrogen oxide emissions? Include any drawbacks to the control methods.
4. How can we control particulate matter emissions? Include any drawbacks to the control methods.
5. How does a baghouse/fabric filter work? What does it remove?
6. How does an electrostatic precipitator work? What does it remove?
7. How does a scrubber work? What does it remove?
8. List 5 or 6 other ways to reduce pollution.

**15.5 The stratospheric ozone layer provides protection from UV solar radiation**

1. Ozone is often described as “good uphigh, but bad nearby”. Explain why.
2. What are the benefits of stratospheric ozone?
3. What chemicals cause ozone loss?
4. Where and when (months and season) does the ozone hole form?
5. What is the Montreal Protocol? Has it been effective?

**15.5 Indoor air pollution is a significant hazard, particularly in developing countries**

1. Why is indoor air pollution a bigger problem in developing countries?
2. Why is indoor air pollution a problem in developed countries?
3. Fill out the chart below for indoor air pollutants

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Pollutant** | **Formula** | **Description** | **Sources** | **Impacts** |
| Asbestos | N/A |  |  |  |
| Carbon Monoxide |  |  |  |  |
| Radon |  |  |  |  |
| Volatile Organic Compounds |  |  |  |  |

**15.6 Working towards sustainability: A New Cook Stove Design**

1. How do households in China, India and sub-Saharan Africa typically cook food? What problems do this cause?
2. Describe some of the options for better cook stoves. Include any trade-offs.

Additional Work:

Answer the **MC questions AND FRQ #1** at the end of the chapter.

**Chapter 16 : Solid Waste**

**Reading Guide**

**Vocabulary**

Learn the definition of each term. The **bold** words require you to know more than just the definition. *Italicized* words are not in the book.

Throw-away society

Municipal Solid Waste (MSW)

Waste stream

**E-Waste**

Reduce

Reuse

Recycle

Closed-loop recycling

Open-loop recycling

Composting

**Leachate**

**Sanitary landfill**

Cap

Liner

Leachate Collection System

Methane Collection System

Tipping fee

**Landfill siting**

Incineration

Bottom ash

Fly ash

**Waste-to-energy system**

**Hazardous waste**

**RCRA**

**CERCLA (Superfund)**

Love Canal

National Priorities List

Brownfield

Life-cycle analysis

**Integrated Waste Management**

*Bioremediation*

*Dump*

***Materials Recovery Facility***

***Phytoremediation***

***NIMBY***

***Planned obsolescence***

**Reading Outline**

Paper or Plastic

1. Covered in a warm-up

**16.1 Humans generate waste that other organisms cannot use**

1. In nature, most waste products become another organism’s inputs. Provide 3 examples of this. How are human different from other species in this respect?
2. Define the following words and provide an example of each from your own life:
   1. Throw-away society
   2. Planned Obsolescence
   3. Single Use item
3. How much trash does the average American produce each day? What factors influence how much waste you produce?
4. List the percentage of MSW by composition IN ORDER from highest percentage to lowest percentage. You need to memorize the top 4 in order.
5. List the four source of MSW and provide 2 examples of waste from each source.
6. What is e-waste? Why is e-waste a serious environmental concern? Why don’t we recycle e-waste more often?

**16.2 The three Rs and composting divert materials from the waste stream**

1. List the three Rs. Give an example of each. Which one is the most important? Why?
2. What is source reduction? Give 3 specific examples.
3. What is the main difference between closed loop recycling and open loop recycling?
4. Why is recycling the last choice of the Rs?
5. What problems do organic wastes like food waste cause in landfills?
6. You are trying to convince your parents to compost. How would you respond to the following arguments?
   1. We are not composting because I don’t want our yard to smell like rotting food!
   2. We make you clean your plates, so there isn’t any food waste in this house.
   3. We don’t have a big enough yard to set-up a compost bin.
   4. It will attract animals and vermin.
   5. I heard you have to do lots of math to have the correct ratio or the whole thing will fail.

**16.3 Currently, most solid waste is buried in landfills or incinerated**

1. What is the difference between a landfill and a dump (you may need to read further to give a proper answer to this question)
2. Describe the purpose of each of the following landfill parts:
   1. Leachate collection system
   2. Liner
   3. Methane collection pipes
   4. Cap
3. What types of waste can safely be discarded in a landfill? What types of waste should not go in a landfill and what should we do with them instead?
4. What are suitable uses for a closed landfill?
5. What characteristics should a proper landfill site have?
6. What is incineration? What kind of waste can be incinerated?
7. List some of the environmental concerns of incineration.
8. How can waste be turned into energy? Describe the process.

**16.4 Hazardous waste requires special means of disposal**

1. What should you do with your household hazardous waste? What happens to it after you dispose of it?
2. Explain how the Superfund law came into effect and what it does.
3. Explain what RCRA does.

**16.5 There are newer ways of thinking about solid waste**

1. Give some specific examples of the challenges faced by someone trying to do a life cycle analysis.
2. Briefly describe the concept of integrated waste management. How does it connect to the first question from this reading guide?

Additional Work:

Answer the MC questions and complete FRQ#2

**Chapter 17 : Health and Toxicity**

**Reading Guide**

**Vocabulary**

Learn the definition of each term. The **bold** words require you to know more than just the definition. *Italicized* words may not be in the book, but should be in the lecture.

**Infectious** **disease**

Chronic disease

Acute disease

Epidemic

**Plague**

**Malaria**

**Tuberculosis**

**HIV/AIDS**

**Ebola**

**Mad Cow Disease**

**Bird Flu**

**West Nile Virus**

Emergent infectious disease

Toxicology

**Neurotoxin**

**Carcinogen**

**Mutagen**

**Teratogen**

**Allergen**

**Endocrine disruptor**

Dose-response study

**Dose-response curve**

LD50

ED50

Toxic Substances Control Act of 1976

Synergistic interaction (also called synergy)

**Biomagnification**

Persistence

Risk assessment

Risk acceptance

Risk management

Precautionary principle

Stockholm convention

*NOEL (No observable effect level)*

**Reading Outline**

Citizen Scientists

1. List some examples of risks the residents of the Old Diamond neighborhood in Norco, LA have faced.
2. What did Margie Richard do about the situation?
3. How did Shell react?
4. Would you call this an environmental justice movement? Why or why not?

**17.1 Human health is affected by a large number of risk factors**

1. What are the 3 leading causes of death worldwide? (Use Figure 17.1)
2. Compare the list of risk factors for people in low income countries versus people in high income countries (Figure 17.2). What do you notice?

**17.2 Infectious diseases have killed large numbers of people**

1. Complete the following chart for major infectious diseases.

|  |  |  |  |
| --- | --- | --- | --- |
| **Disease** | **How do you get it?** | **Describe the disease and the symptoms.** | **How do you prevent and/or treat the disease?** |
| Plague |  |  |  |
| Malaria |  |  |  |
| Tuberculosis |  |  |  |
| HIV/AIDS |  |  |  |
| Ebola Fever |  |  |  |
| Mad Cow |  |  |  |
| Bird Flu |  |  |  |
| West Nile Virus |  |  |  |

1. What do we need to do to combat disease in a. low income countries and b. high income countries?

**17.3 Toxicology is the study of chemical risks**

1. List 2-3 examples of each of the following types of chemicals:
2. Neurotoxins –
3. Carcinogens –
4. Teratogens –
5. Allergens –
6. Endocrine disruptors –

**17.4 Scientists can determine the concentrations of chemicals that harm organisms**

1. What is the Toxic Substances Control Act and what does it regulate?
2. What is the Federal Insecticide, Fungicide, and Rodenticide Act and what does it regulate?
3. What is the difference between water soluble and oil soluble chemicals? How do they react differently in the environment?
4. Use DDT to explain how biomagnification happens? What were the impacts of the biomagnification of DDT?

**17.5 Risk analysis helps us assess, accept, and manage risk**

1. BEFORE YOU READ SECTION 17.5, rank each activity below in order of how dangerous they are in terms of loss of life (10 = most dangerous, 1 = least dangerous):

|  |  |  |
| --- | --- | --- |
| **Activity** | **Your Risk Ranking** | **Actual Risk Ranking** |
| Being a pedestrian |  |  |
| Cancer |  |  |
| Car accident |  |  |
| Earthquake |  |  |
| Falling |  |  |
| Fire |  |  |
| Firearm |  |  |
| Flying in an airplane |  |  |
| Heart disease |  |  |
| Struck by lightening |  |  |

1. Summarize the three steps in the process of risk analysis (Figure 17.22)
2. Global Malaria Fight
3. What is malaria? Where is mostly found? How many people does it kill each year?
4. Why is it hard to get rid of malaria?
5. Why is there new hope in the fight against malaria? What is required to ensure success?

Additional Work:

Answer the MC questions and review the FRQs.