

Water and the Five Spheres of the Environment

Water

The Hydrosphere

The Geosphere and the Hydrosphere

The Atmosphere and the Hydrosphere

The Biosphere and the Hydrosphere

The Anthrosphere and the Hydrosphere

Water and Biogeochemical Cycles

Water and Environmental Chemistry

Water and Green Chemistry

Literature Cited

Supplementary References

Questions and Problems

Properties of Water and the Hydrosphere

The Fantastic Water Molecule

Water as an Essential Resource

The Hydrological Cycle

Standing Bodies of Water

Flowing Water

Groundwater

Water Utilization

Impoundment and Transfer of Water

Water: A Very Useful Green Substance

Aquatic Life

Global Warming and Water

References

Supplementary References

Questions and Problems

Fundamentals of Aquatic Chemistry

Introduction to Aquatic Chemistry

Gases in Water

Water Acidity and Carbon Dioxide in Water

Alkalinity

Calcium and Other Metals in Water

Complexation and Chelation

Bonding and Structure of Metal Complexes

Calculations of Species Concentrations

Complexation by Deprotonated Ligands

Complexation by Protonated Ligands

Solubilization of Lead Ion from Solids by NTA

Polyphosphates and Phosphonates in Water

Complexation by Humic Substances

Complexation and Redox Processes

Literature Cited

Supplementary References

Questions and Problems

Oxidation–Reduction in Aquatic Chemistry

The Significance of Oxidation–Reduction

Electron and Redox Reactions

Electron Activity and pE

The Nernst Equation

Reaction Tendency: Whole Reaction from Half-Reactions

The Nernst Equation and Chemical Equilibrium.

The Relationship of pE to Free Energy

Reactions in Terms of One Electron-Mole

The Limits of pE in Water

pE Values in Natural Water Systems

pE–pH Diagrams

Humic Substances as Natural Reductants

Photochemical Processes in Oxidation–Reduction

Corrosion

Literature Cited

Supplementary References

Questions and Problems

Phase Interactions in Aquatic Chemistry

Chemical Interactions Involving Solids, Gases, and Water

Importance and Formation of Sediments

Solubilities

Colloidal Particles in Water

Colloidal Properties of Clays

Aggregation of Particles

Surface Sorption by Solids

Solute Exchange with Bottom Sediments

Interstitial Water

Phase Interactions in Chemical Fate and Transport

Literature Cited

Supplementary References

Questions and Problems

Aquatic Microbial Biochemistry

Aquatic Biochemical Processes

Algae

Fungi

Protozoa

Bacteria

The Prokaryotic Bacterial Cell

Kinetics of Bacterial Growth

Bacterial Metabolism

Microbial Transformations of Carbon

Biodegradation of Organic Matter

Microbial Transformations of Nitrogen

Microbial Transformations of Phosphorus and Sulfur

Microbial Transformations of Halogens and Organohalides

Microbial Transformations of Metals and Metalloids

Literature Cited

Supplementary References

Questions and Problems

Water Pollution

Nature and Types of Water Pollutants

Elemental Pollutants

Heavy Metals

Metalloids

Organically Bound Metals and Metalloids

Inorganic Species

Algal Nutrients and Eutrophication

Acidity, Alkalinity, and Salinity

Oxygen, Oxidants, and Reductants

Organic Pollutants

Pesticides in Water

Polychlorinated Biphenyls

Emerging Water Pollutants, Pharmaceuticals, and Household Wastes

Radionuclides in the Aquatic Environment

Literature Cited

Supplementary References

Questions and Problems

Water Treatment

Water Treatment and Water Use

Municipal Water Treatment

Treatment of Water for Industrial Use

Sewage Treatment

Industrial Wastewater Treatment

Removal of Solids

Removal of Calcium and other Metals

Removal of Dissolved Organics

Removal of Dissolved Inorganics

Sludge

Water Disinfection

Natural Water Purification Processes

Green Water

Water Conservation

Protecting Water Supplies from Attack

Literature Cited

Supplementary References

Questions and Problems

Chemical Analysis of Water and Wastewater

General Aspects of Environmental Chemical Analysis

Classical Methods

Spectrophotometric Methods

Electrochemical Methods of Analysis

Chromatography

Mass Spectrometry

Analysis of Water

Automated Water Analyses

Speciation

Emerging Contaminants in Water Analysis

Chiral Contaminants

Literature Cited

Supplementary References

Questions and Problems

Sustainable Energy: The Key to Everything

The Energy Challenge

Nature of Energy

Sources of Energy Used in the Anthroposphere

Energy Devices and Conversions

Green Technology and Energy Conversion Efficiency

Energy Conservation and Renewable Energy Sources

Petroleum and Natural Gas

Coal

Carbon Sequestration for Fossil Fuel Utilization

Industrial Ecology for Energy and Chemicals

Nuclear Energy
Geothermal Energy
The Sun: An Ideal, Renewable Energy Source
Energy from Moving Air and Moving Water
Biomass Energy
Hydrogen as a Means to Store and Utilize Energy
Combined Power Cycles
A System of Industrial Ecology for Methane Production

Literature Cited

Supplementary References

Questions and Problems

Fundamentals of Chemistry

The Science of Matter
Elements
Chemical Bonding
Chemical Reactions and Equations
Solutions

Literature Cited

Supplementary References

Questions and Problems

Organic Chemistry

Organic Chemistry
Hydrocarbons
Organic Functional Groups and Classes of Organic Compounds
Synthetic Polymers

Supplementary References

Questions and Problems

Index