

# Chapter 1

## The Fundamentals of Water and Natural Waters

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### **ABSTRACT**

*This chapter provides information on the fundamental concepts needed to understand water and water pollution, enabling better comprehension of the subsequent material. Examining the molecular structure of water provides context for understanding its most important properties. The reader explores the various types of natural waters and learns how they are tied together in the global water cycle. An examination of the contents of natural waters reveals the presence of dissolved solids, liquids and gases and the intimate relationship between these substances and the community of life that dwells in aquatic systems. The chapter introduces basic concepts of the chemistry of water and discusses the action and distribution of pollutants. Readers also learn about the basic interaction between various pollutants and the aquatic food chain.*

### **INTRODUCTION**

This book is about the complex relationship between people, water and health. It will explore how the health of humans is intimately tied to the health of natural water systems. The first chapter will prepare the reader for a fuller understanding of the topics covered in the rest of the book. The objective of this chapter is to examine the fundamental properties of water beginning with molecules and finishing with the ocean. Life, water, and the atmosphere of Earth function together in a highly interdependent way. One cannot understand one single component without having some appreciation for the entire system. So this chapter is organized in a holistic way, with topics often blending together in order to give a fuller understanding.

DOI: 10.4018/978-1-4666-9559-7.ch001

## **BACKGROUND**

When viewed from a spacecraft, the Earth appears as a shining blue and white orb. The blue light is reflected from the water of the ocean and the white light from the condensed water vapor of the clouds. Water is the dominant and defining feature of our planet. Not surprisingly, water is also one of the defining features of life.

The Earth formed some 4.5 billion years ago. The ocean appeared about 1 billion years later (Stanley, 2009). From that primordial sea evolved the first forms of life about a half a billion years later. So for most of its existence Earth has been wet and alive. Water shaped the forms of life that evolved in the sea and eventually invaded the land. And as life developed it reshaped the nature of the ocean and atmosphere above. About three billion years ago the process of photosynthesis developed in certain bacteria and algae. This new type of metabolism used energy from sunlight to fuel these early plant-like creatures. To access the energy in sunlight, photosynthesis splits water molecules resulting in the release of free oxygen as a waste product. That oxygen changed the chemistry of the sea and the air. The splitting of water also produces high-energy electrons and protons that are used in photosynthesis to do the work of the cell, including building sugars from atmospheric carbon dioxide (Garrison, 2001). Algae use sugars made in photosynthesis as the basis to create a huge variety of organic compounds. Those organic molecules fuel the rest of the ocean food chain, and a portion of them is buried in the ocean sediments. Over time those buried organic molecules transform into petroleum and natural gas that now fuel much of our economy. Indeed, it is the burning of millions of years' worth of fossil fuels over the last two centuries that is once again changing the atmosphere and the global climate (Miller & Spoolman, 2014).

*Figure 1. View of Earth from space taken by Apollo astronauts on December 7, 1972.  
[http://en.wikipedia.org/wiki/The\\_Blue\\_Marble#mediaviewer/File:Apollo17WorldReversed.jpg](http://en.wikipedia.org/wiki/The_Blue_Marble#mediaviewer/File:Apollo17WorldReversed.jpg)*



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