The Cycle of Materials: Nature’s Way

Consider, for a moment, one of the molecules of carbon dioxide that you exhaled just as you began reading this. Carbon dioxide is made up of one atom of carbon and two atoms of oxygen. It is colorless, odorless, tasteless, and has a molecular weight of approximately 44 g/mol. You exhale millions upon millions of molecules of this substance every day, but have you ever considered what happens to it after it leaves your lungs? You may already be familiar with the physiological processes of the body that resulted in you having to exhale that carbon dioxide molecule. You may already understand the processes of photosynthesis and respiration, how they work together and complement each other. Let’s zero in on one of those two oxygen atoms for a moment and think about where it might have been during its very long existence on this planet. Could it have possibly been inside another person’s lungs before yours? In his book An Introduction to the Kinetic Theory of Gases, scientist James Jean once calculated the following:

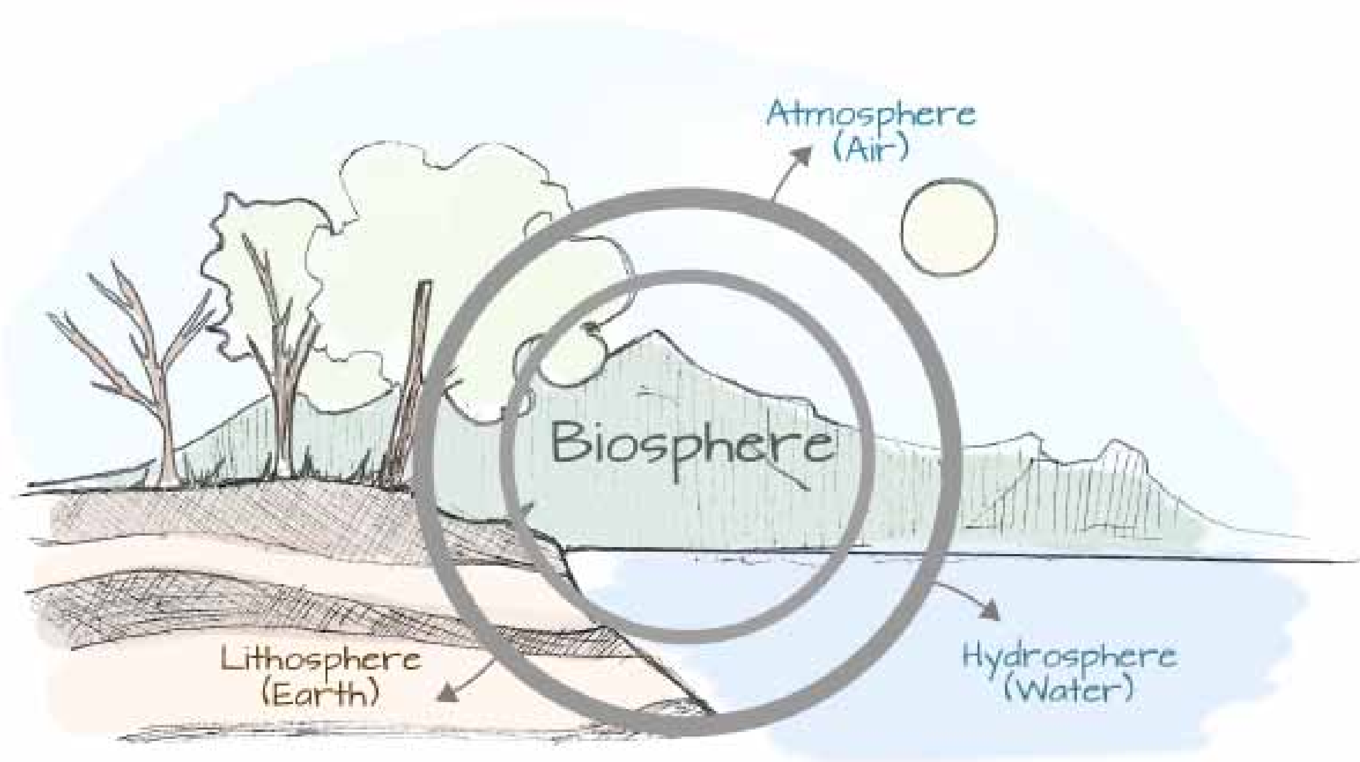
> Again, a man is known to breathe out about 400 c.c. of air at each breath so that a single breath of air must contain about 1022 molecules. The whole atmosphere of the earth consists of about 1044 molecules. Thus one molecule bears the same relation to a breath of air as the latter does to the whole atmosphere of the earth. If we assume that the last breath of, say, Julius Caesar has by now become thoroughly scattered through the atmosphere, then the chances are that each of each us inhales one molecule of it with every breath we take. A man’s lungs hold about 2000 c.c. of air, so that the chances are that in the lungs of each of us there are about five molecules from the last breath of Julius Caesar.

Are you surprised to learn that molecules coming in and out of your body have been used by other people? You should not be because this is nature’s way. Every atom of matter on Earth gets used over and over and over through biogeochemical cycles. If you were to trace an atom of oxygen through its cycle, you might find it in a molecule of water (H^2O) at one point, in a molecule of carbon dioxide (CO^2) at another, in a molecule of glucose (C6H12O6) later, and finally as a diatomic molecule (O^2) of atmospheric oxygen.

Recall that the Law of Conservation of Matter states that “matter is neither created nor destroyed.” This means that all of the matter that was on our planet from when it first formed is still here is circulating throughout the planet in different forms. Therefore, there is a very good chance that every atom in your body has been used by another living organism before you acquired it. Furthermore, much of the matter in your body was acquired from the food and drinks that you have consumed. In nature, elements essential for life pass back and forth between the abiotic part of the environment and the biotic part. In other words, an atom of any element is either in the nonliving portion of the world or in a living thing. An atom that is in your body today may be in another living thing tomorrow and vice versa. Matter may change forms either physically (water can be a solid, liquid, or gas) or chemically (oxygen can be in water, glucose, or the atmosphere) but it never disappears.

A handy acronym for remembering the six most common elements in living things is "N-CHOPS": nitrogen, carbon, hydrogen, oxygen, phosphorus and sulfur. These elements are more commonly found in living organisms than all other elements. Tracing the cycles of these elements as they pass in and out of the biotic and abiotic parts of the environment help us to understand how they move through the atmosphere, ecosphere, hydrosphere, and lithosphere.

The cycles that each of the elements goes through as they pass in and out of the biotic/abiotic parts of the environment help us to understand how they move through the atmosphere, hydrosphere, lithosphere and ecosphere. Each of the cycles is well-documented by scientists; understanding the processes involved in these cycles is important in understanding why green buildings involve reducing, reusing, and recycling of materials. See below for diagrams that illustrate each of these cycles.



Discussion Questions

After reading, discuss the following questions with your partner and record the responses in your notebook.

1. What was the most interesting or surprising thing you learned in this article?

2. Based on this article, what is “nature’s way?”

3. In nature, elements pass back and forth between what two parts of the environment?

4. Based on what you read, how long do you think these natural cycles last?

5. “Nature’s cycles are sustainable” – what do you think this means?

6. In what ways are human activities a part of these cycles? In what ways do they interrupt these cycles?