COMMENTARY

Cycles in Nature – Part 1

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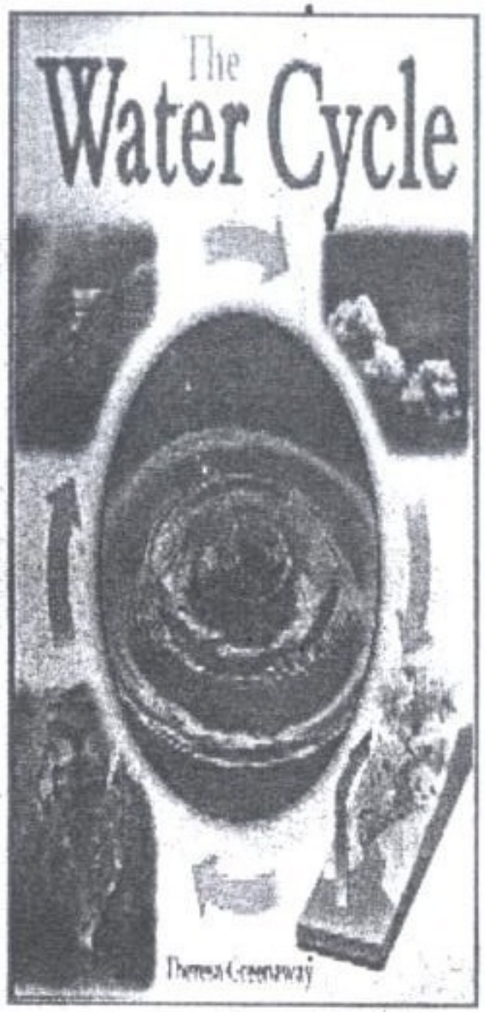
THE way our environment sustains itself has been the topic of much research. When our natural resources are low, we must learn how to use these resources sustainably, and emulate way the environment produces and maintains its' resources.

Certain natural substances in our environment are finite, whereas the supply of others appear to be endless; for example, oxygen and water. However, their continued presence on the planet is not due to magic but a process called nutrient cycling. There are six main cycles, or six substances that are necessary to our ecosystem; Carbon, Water, Oxygen, Phosphorous, Nitrogen and Sulphur. These are too many to address in one article, so I will discuss them in two parts. This week I will look at the first three and some of the factors that affect them.

Before we begin, an important point one must note with nutrient cycles is that the elements are not directly cycled; molecules from one source are broken apart and can sometimes be integrated to form another needed substance.

The first cycle is the Hydrogen or water cycle, which many people would have studied in primary school, but here is a short recap. This cycle has no real starting point but for simplicity let's start with the oceans as they are the largest bodies of water on the planet. Heat from the sun causes the water to evaporate and enter the atmosphere as water vapour. Water also enters the atmosphere from freshwater sources, as well, for example, rivers and streams. Ice and snow also act as sources but when heated they sublime, that is, they go directly from a solid state to a gaseous state without turning to a liquid. Therefore there is concern about the sources of frozen water in the world especially on mountain tops; if global temperatures are allowed to rise they may cease to exist. This scenario would not only decrease the amount of water entering the cycle from this source, which is quite small to begin with, but also limits the amount of freshwater available to humans. As the ice and snow melts, it flows down hill into rivers and streams. In the atmosphere, the water vapour cools and condenses to form clouds. As more and more water enters the atmosphere, the water droplets in the clouds accumulate and become so large that they can no longer defy gravity and fall to the Earth's surface as rain, snow, or ice in the form of hail. Some of this water runs off and enters our rivers and streams, and will eventually flow to the ocean. Some will percolate through the soil and be stored in underground aquifers, and then the cycle starts all over again.

However, unlike the water cycle, the Oxygen cycle has a starting point that begins with plants. They take in carbon dioxide from the atmosphere via photosynthesis; plants use energy from sunlight to convert CO2 into carbohydrates, which is how energy is stored and is also used to form the structural components of cells and tissues. During this process, oxygen is given off as a



by-product. Animals do the reverse and breathe in oxygen and use it to break down carbohydrates into energy; this process is called respiration and here carbon dioxide is given off as a by-product. However, the oxygen cycle is not so simple; as plants need energy to break down the carbohydrates they have formed to get energy, they take up oxygen from the atmosphere usually during the night time hours. This does not negatively affect the overall amount of oxygen in the atmosphere as they produce about ten times more oxygen than they remove.

Oxygen is not only cycled in terrestrial ecosystems, but in aquatic ones as well. Oxygen enters the water when it passes rapidly over rocks which create a large surface area that makes it easy for oxygen to enter the water quite quickly. This oxygen is used in aquatic ecosystems by micro organisms to break down organic matter, giving off carbon dioxide, which in turn is taken up by plants.

Almost all of the oxygen in our atmosphere is produced by this cycle as a result of photosynthesis of green plants. However, not all of the oxygen in the atmosphere is available to living organisms. Our atmosphere contains about 1.3 1014 tons of free oxygen, while about 100 times more oxygen is contained in the lithosphere. Here the oxygen is bound to other elements to form, substances such as oxides, sulphates and silicates. Examples would be water, which is a mixture of hydrogen and oxygen molecules, and ozone which is formed through the combination of three oxygen molecules, this gaseous layer protects the planet's surface from harmful UV rays. A key characteristic of the oxygen cycle is that it has a connection with the carbon cycle.

The final cycle I will deal with in this part is the Carbon cycle; like oxygen it take place both on land and in water. Carbon is absorbed by water and taken up by plants. These plants in turn are eaten by herbivores and passed along by consumption. This means that larger organisms consume the smaller ones. These release carbon dioxide into their surroundings through respiration and when they die and decay. Organisms called detritivores break down these decaying bodies into sediments thus releasing the carbon trapped in them, this process is called sedimentation.

On land, a similar cycle occurs. When terrestrial animals die and their bodies decompose, carbon becomes trapped in the earth and over the millennia the formation of layers of rock over them causes them to be put under tremendous pressure and converts to fossil fuels. However, this is a delicate cycle; humans burning of these fuels releases enormous amounts of carbon dioxide into the atmosphere, more than can be removed naturally by this cycle. This has led to carbon dioxide in the atmosphere combining with water sources such as rain and the bodies of water both freshwater and saltwater to form a dilute carbonic acid. This raised PH level cannot be tolerated by all aquatic species and can cause the extinction of populations of species or the entire species themselves.

Therefore, we can see that in order to provide some of the most vital substances needed for life on this planet, cycling through our environment is the method used. We also see that some of these cycles are connected, such as the oxygen and carbon cycles. However, through human activities some of these sensitive cycles can be thrown off; such as with the carbon cycle where our burning of fossil fuel is putting more carbon dioxide into the atmosphere than can be removed naturally. In next week's article I will look at three more nutrient cycles vital to the well-being of our environment.