Oxygen cycle

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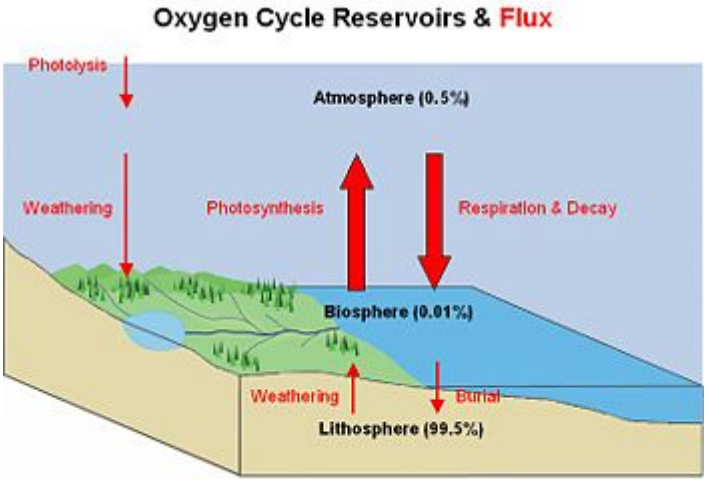
Jump to: navigation, search



The **oxygen cycle** is the biogeochemical cycle that describes the movement of oxygen within and between its three main reservoirs: the atmosphere (air), the biosphere (living things), and the lithosphere (Earth's crust). The main driving factor of the oxygen cycle is photosynthesis, which is responsible for the modern Earth's atmosphere and life.

[edit] Reservoirs and Fluxes

By far the largest reservoir of Earths oxygen is within the silicate and oxide minerals of the crust and mantle (99.5%). Only a small portion has been released as free oxygen to the biosphere (0.01%) and atmosphere (0.36%). The main source of atmospheric oxygen is photosynthesis, which produces sugars and oxygen from carbon dioxide and water:

$$6CO_2 + 6H_2O + \text{energy} \rightarrow C_6H_{12}O_6 + 6O_2$$

Photosynthesizing organisms include the plant life of the land areas as well as the phytoplankton of the oceans. The tiny marine cyanobacterium Prochlorococcus was discovered in 1986 and accounts for more than half of the photosynthesis of the open ocean.[1]

An additional source of atmospheric oxygen comes from photolysis, whereby high energy ultraviolet radiation breaks down atmospheric water and nitrite into component atoms. The free H and N atoms escape into space leaving O_2 in the atmosphere:

$$2H_2O + \text{energy} \rightarrow 4H + O_2$$
$$2N_2O + \text{energy} \rightarrow 4N + O_2$$

The main way oxygen is lost from the atmosphere is via respiration and decay, mechanisms in which animal life and bacteria consume oxygen and release carbon dioxide.

Because lithospheric minerals are oxidised in oxygen, chemical weathering of exposed rocks also consumes oxygen. An example of surface weathering chemistry is formation of iron-oxides (rust):

$4FeO + O_2 \rightarrow 2Fe_2O_3$

Main article: Mineral redox buffer

Oxygen is also cycled between the biosphere and lithosphere. Marine organisms in the biosphere create calcium carbonate shell material ($CaCO_3$) that is rich in oxygen. When the organism dies its shell is deposited on the shallow sea floor and buried over time to create the limestone rock of the lithosphere. Weathering processes initiated by organisms can also free oxygen from the lithosphere. Plants and animals extract nutrient minerals from rocks and release oxygen in the process.

[edit] Ozone

The presence of atmospheric oxygen has led to the formation of ozone and the ozone layer within the stratosphere. The ozone layer is extremely important to modern life as it absorbs harmful ultraviolet radiation:

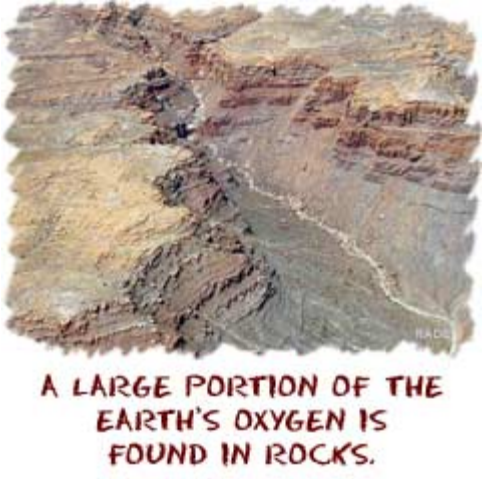
$O_2 + \text{uv energy} \rightarrow 2O$
$O + O_2 \rightarrow O_3$

[edit] References

1. ^ Steve Nadis, *The Cells That Rule the Seas*, Scientific American, Nov. 2003 [1]

- Cloud, P. and Gibor, A. 1970, The oxygen cycle, Scientific American, September, S. 110-123
- Fasullo, J., Substitute Lectures for ATOC 3600: Principles of Climate, Lectures on the global oxygen cycle, http://paos.colorado.edu/~fasullo/pjw_class/oxygencycle.html
- Morris, R.M., OXYSPHERE - A Beginners' Guide to the Biogeochemical Cycling of Atmospheric Oxygen, http://seis.natsci.csulb.edu/rmorris/oxy/Oxy.htm

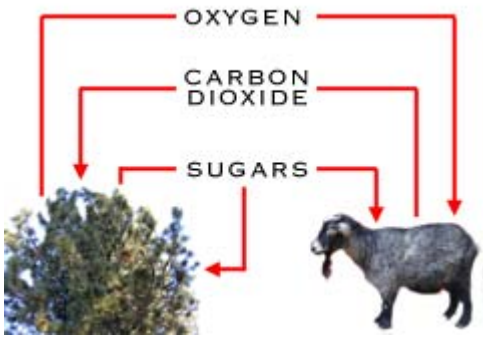
Biogeochemical cycles
Carbon cycle - Hydrogen cycle - Nitrogen cycle
Oxygen cycle - Phosphorus cycle - Sulfur cycle - Water cycle



http://en.wikipedia.org/wiki/Oxygen_cycle

Oxygen Cycling

Oxygen (O) atoms cycle through the **ecosystem** and the biosphere the way other elements do (especially carbon). The Earth has a fixed supply of the element even though it can be found everywhere, including the atmosphere, the oceans, rocks, and all living organisms. While not all organisms need to breathe oxygen, there is definitely oxygen inside of every organism.



Oxygen Rarely Alone

Oxygen is one of the major compounds found in the **atmosphere** of the Earth. You never find oxygen floating around as individual atoms. Oxygen is always with other elements. You may find an oxygen molecule that has two oxygen atoms. There are molecules with three oxygen atoms called ozone. You will also find oxygen bound in water molecules and carbon dioxide. That oxygen floats through the atmosphere until it comes down to Earth and starts one of many cycles.

Dissolved In Water

There is a large amount of oxygen dissolved in the water of oceans, lakes, and streams. As water moves, the oxygen is forced into **solution**. The organisms that live in the water breathe that oxygen by filtering it out of solution the way we do with the air. Over millions of years oxygen has also become an integral element in our rocks and land. Oxygen bonds with silicon (silicates), iron, and carbon (carbonates) to form many of the compounds in rock. Creatures like lichen are able to break down the rocks over thousands of years and release **nutrients** into the soil.

We Need Oxygen To Survive

Last are the organisms of the world. They use oxygen in many forms. Their role in the cycle begins with carbon dioxide in the atmosphere. Plants take in that carbon dioxide and combine it with water to create sugars and oxygen molecules. Animals breathe that oxygen and both plants and animals

use the sugars for energy. Through the process of **metabolism**, the sugars are broken down into water and carbon dioxide. Then the cycle begins again.

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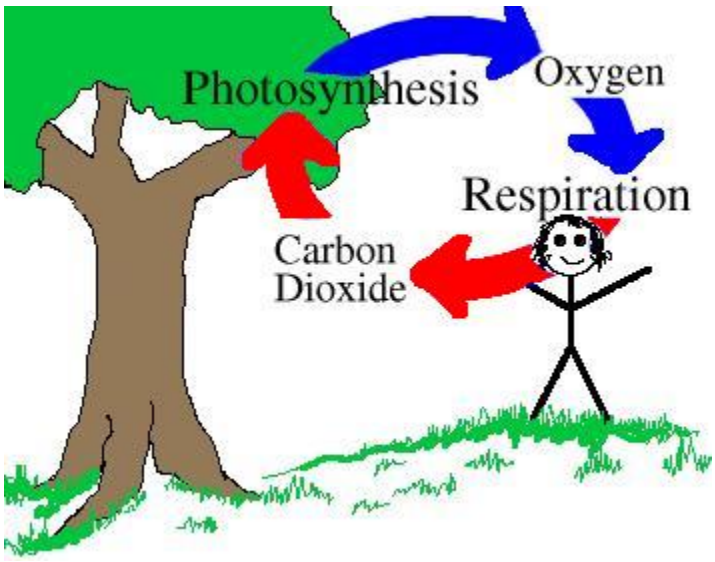
The Oxygen Cycle

Almost all living things need oxygen. They use this oxygen during the process of creating energy in living cells.



Just as water moves from the sky to the earth and back in the hydrologic cycle, oxygen is also cycled through the environment. Plants mark the beginning of the oxygen cycle. Plants are able to use the energy of sunlight to convert carbon dioxide and water into carbohydrates and oxygen in a process called photosynthesis.

$$O_2 + \text{carbohydrates} \rightarrow CO_2 + H_2O + \text{energy}$$

This means that plants "breathe" in carbon dioxide and "breathe" out oxygen.

Animals form the other half of the oxygen cycle. We breathe in oxygen which we use to break carbohydrates down into energy in a process called respiration.

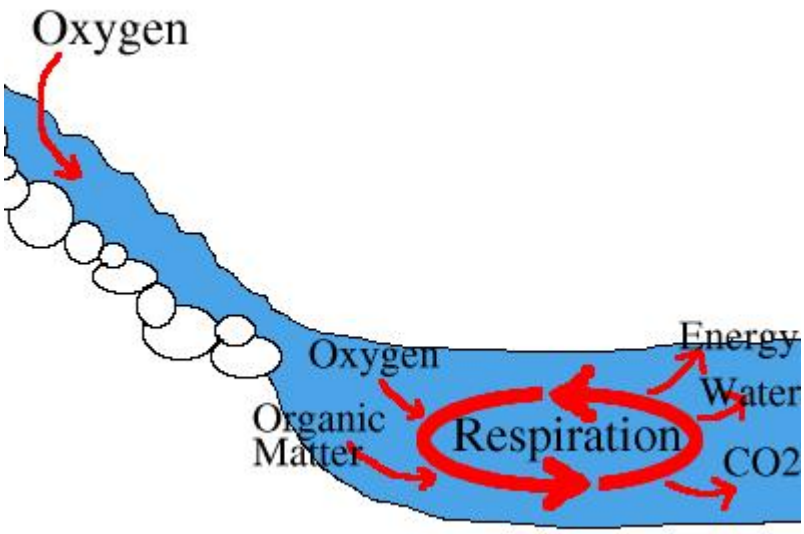
$$O_2 + \text{carbohydrates} \rightarrow CO_2 + H_2O + \text{energy}$$

Carbon dioxide produced during respiration is breathed out by animals into the air.

So oxygen is created in plants and used up by animals, as is shown in the picture above. But the oxygen cycle is not actually quite that simple. Plants must break carbohydrates down into energy just as animals do. During the day, plants hold onto a bit of the oxygen which they produced in photosynthesis and use that oxygen to break down carbohydrates. But in order to maintain their metabolism and continue respiration at night, the plants must absorb oxygen from the air and give off carbon dioxide just as animals do. Even though plants produce approximately ten times as much oxygen during the day as they consume at night, the night-time consumption of oxygen by plants can create low oxygen conditions in some water habitats.

Oxygen in Water

Oxygen in water is known as dissolved oxygen or DO. In nature, oxygen enters water when water runs over rocks and creates tremendous amounts of surface area. The high surface area allows oxygen to transfer from the air into the water very quickly.



When the water in a stream enters a pond, microorganisms in the pond begin to metabolize (break down) organic matter, consuming oxygen in the process. This is another form of oxygen cycle - oxygen enters water in rapids and leaves water in pools.

Oxygen uptake rate (O.U.R.) is the rate at which oxygen is consumed by living organisms in the water. Since organisms are constantly using up oxygen in the water and oxygen is constantly reentering the water from the air, the amount of oxygen in water remains relatively constant. In a healthy ecosystem, the rates of oxygen transfer (being used up) and oxygen uptake are balanced in the water.

http://water.me.vccs.edu/concepts/oxycycle.html