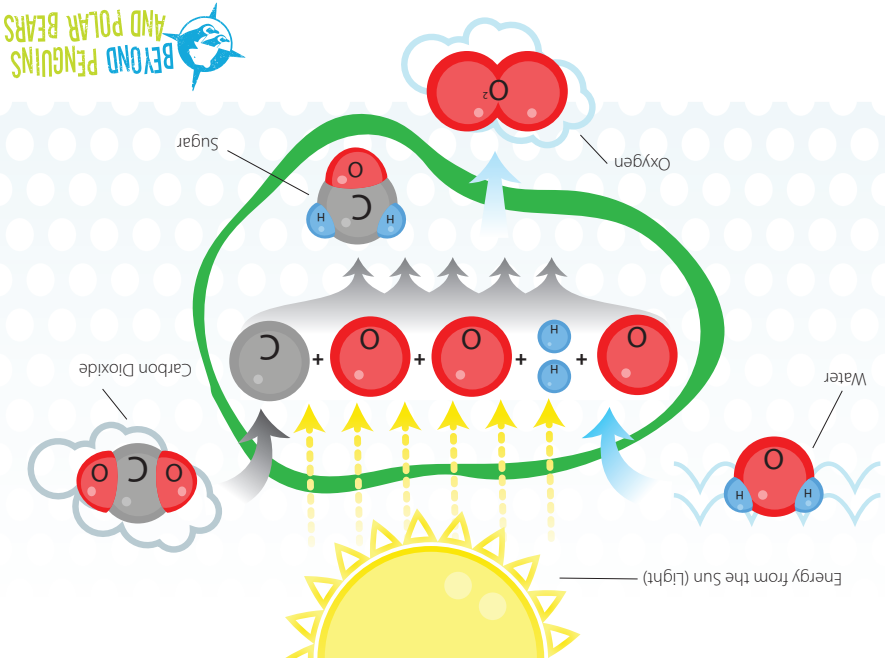

Plants and algae use the energy of sunlight to split the water molecule. Two gases, hydrogen gas and oxygen gas, come from the water molecule. The oxygen escapes as waste. But it isn't waste to us! The oxygen we breathe is made by plants and their relatives. We can thank them for not only the food we eat but also the air we breathe.

Plants and algae build sugar from carbon dioxide and hydrogen. Sugar is fantastic at storing energy. Have you ever burned a marshmallow? Marshmallows burn easily because they're made of sugar. Plants and algae use sugar to grow, to build and repair cells, and to reproduce.

BEYOND PENGUINS AND POLAR BEARS

http://beyondpenguins.nsdl.org

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Stephen Whitt has been with COSI since 1993, performing shows and demonstrations, writing exhibit signs and show scripts, and co-directing COSI's floor faculty. He has written over 40 articles for children's science magazines, and his first book, called The Turtle and the Universe was published by Prometheus Books in 2008.

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BEYOND PENGUINS AND POLAR BEARS

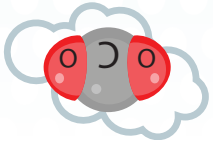
PARTNERS

BY STEPHEN WHITT

MARCH 2009

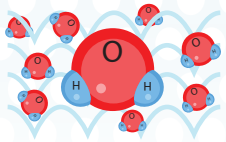
It sounds crazy, but there are organisms on Earth that live this kind of life. They are called **lichens**. Lichens are living things that contain two separate organisms. Lichens are made of both a fungus and an alga. This strange combination is very successful. In fact, lichens are among the few organisms that thrive in the cold regions of both the Arctic and the Antarctic.

This is one type lichen. Photo courtesy of Tigerente, Wikipedia.



Carbon Dioxide is found in the air.

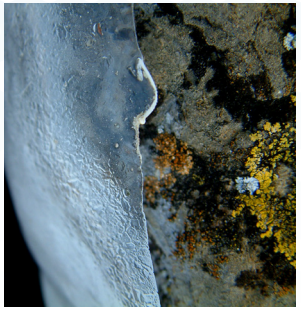
It starts with carbon dioxide, a gas found in air. You know about carbon dioxide if you've ever had a drink of pop. The bubbles in pop are made of carbon dioxide gas. When the bubbles burst, carbon dioxide escapes into the air.



Hydrogen is found in water.

Plants and algae combine carbon dioxide from the air with a gas called hydrogen. But hydrogen isn't found in the air. Instead, it comes from water.

Lichens grow slowly. They can stand long periods with no water. Also, they can withstand very cold weather. They even keep growing when covered in snow! Lichens are able to take water right out of extremely cold air. Russian **cosmonauts** have found that some lichens can even survive exposure to outer space!



Lichen growing under ice courtesy of ellengwallace via Flickr.

GLOSSARY

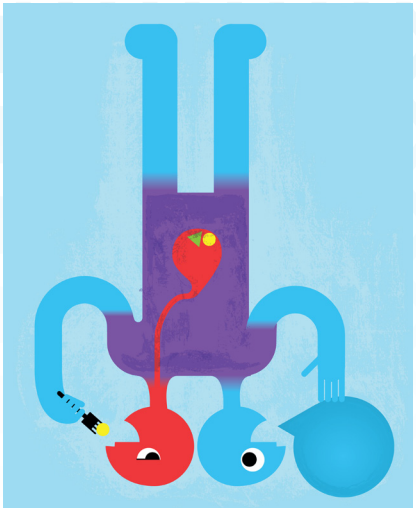
ALGAE: plantlike living things

COSMONAUTS: Russian astronauts

DORMANT: a state of low activity that some plants enter to survive cold weather

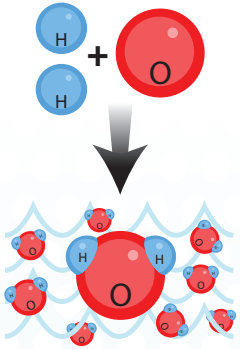
FUNGI: living things such as mushrooms that look like plants but cannot make their own food

LICHEN: a fungus and an alga living together

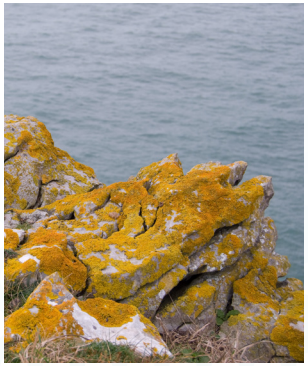


Imagine sharing your body with another person. Perhaps you'd each have a job. Your job might be to move and talk. The other person's job might be to eat and drink.

You may have heard the scientific name for water, H2O. What does that name mean? Water is made of two different atoms. Those atoms are hydrogen (letter H) and oxygen (letter O). The 2 tells us that in every water molecule there are two atoms of hydrogen attached to one atom of oxygen.



Two hydrogen and one oxygen atom make up one molecule of water.



Lichen growing on rocks on a cliff. Photo courtesy of Stuart Atkins, Flickr.

In lichen, the alga makes sugar, and uses some of it. The fungus also uses the alga's sugar. In return, the fungus provides the structure and the protection that helps keep the alga alive.

Lichens have no roots. Because of this, lichens can grow in strange places. Rocks, cliffs, and tree trunks are some of their favorite spots all over the world. In the Arctic and the Antarctic, there are no trees. Lichens survive there by clinging to rocks.

Fungi (the plural of fungus) include mushrooms and toadstools. You might think of these as plants. In fact they are much more like animals than plants. Like animals, fungi must eat. And like animals, fungi can't make their own food, but must find it somewhere else.

Toadstools are a type of fungus. Photo courtesy of Wikipedia.

That's where the algae come in. **Algae** (the plural of alga) are very simple relatives of plants. But "simple" is misleading. Green plants and algae perform perhaps the most amazing miracle on Earth. They make their own food.

Seaweed is a type of alga. Photo courtesy of Wikipedia.

Cross-section through the lichen. The visable layer of green is algae under the surface. Photo courtesy of Dr. Ralf Wagner, Wikipedia.

How? Deep inside these organisms, air and water turn into sugar. Without this miracle, none of us could eat or even take a breath. Let's take a closer look at this amazing event.

Lichens are important. Caribou depend on lichens for food. Humans have made colorful dyes from lichens. We've also made powerful medicines from them. Scientists are now studying how lichens can warn us about pollution. But most of all, lichens are an amazing example of cooperation. By working together, two separate organisms survive in some of the most difficult places on (or off!) Earth.

Caribou like this one depend on lichen for food. Photo courtesy of Ludovic Hirlimann, Flickr.

The center of this lichen has crumbled and has blown away. Photo courtesy of Barbara Page, Wikipedia.

Lichens are tough. Many lichens reproduce simply by falling apart. Suppose a lichen gets particularly dry and cold. It might crumble and blow away in the wind. But the lichen isn't dead. Instead, it is **dormant**. When warmer or wetter conditions return, the lichen might start growing again. Where once there was one lichen, now there are many, scattered by the wind. As long as just a little bit of the fungus and a little bit of the alga survive, the lichen can return.