

# stemworks: RESPIRATION

Using Oxygen

You take in (inhale) Oxygen and you exhale CO<sub>2</sub> - that's Respiration. You use fuel as energy, 'burn' it (without fire) using Oxygen and make CO<sub>2</sub> and water - just like the propane burning activity in MOLECULES. Respiration IS combustion, except that Biology figured out how to do it without a match or flame.

Here's the process of Respiration:

Fuel (made by plants) + O<sub>2</sub> -->  
CO<sub>2</sub> + H<sub>2</sub>O + heat (energy)



Respiration is the other half of the Grand Balance - the Grand Yang. Plants make Oxygen, we use it; we produce CO<sub>2</sub>, plants use it. What a system - the great balance of Planet Earth. Oh, and Yes, you are like a Plant running backwards!

Another balance:  
Energy IN = Energy OUT

You take Energy in as fuel (food), you use it to move: If you take in more than you use, guess what happens?!

#### ACTIVITIES IN THE RESPIRATION EXHIBIT INCLUDE:

- More O<sub>2</sub> and CO<sub>2</sub> detection - inhale, exhale -- deeply!
- Burn a peanut - how many Calories, how much energy?
- Visual pedometer - how many steps to 'burn' a peanut? A donut? A candy bar?

# stemworks: PHOTOSYNTHESIS

Using Carbon Dioxide

Life evolved several billion years ago. It really took off when early cells captured sunlight as energy to make molecules - the stuff needed for living things. Using CO<sub>2</sub> (Carbon dioxide) and H<sub>2</sub>O (Water) photosynthetic cells make biochemicals - and throw away oxygen in the process.

Plants grow from the air - using the carbon in CO<sub>2</sub> as the major building block for all plant stuff - including the fuels you and the rest of the Animal Kingdom use as food. The Grand Balance of Planet Earth - our Grand Yin-Yang - is:

Photosynthesis (Plants) and Respiration (You!).

Here's the process of Photosynthesis:

H<sub>2</sub>O + CO<sub>2</sub> + light --> molecules + O<sub>2</sub> (Oxygen)

It's easy to see that plants produce Oxygen by looking at healthy green plants under water in bright light - see the tiny bubbles on the leaves and stems?

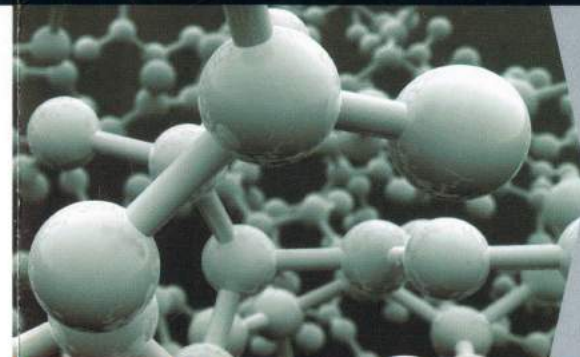


#### ACTIVITIES IN THE PHOTOSYNTHESIS EXHIBIT INCLUDE:

- Measuring YOUR CO<sub>2</sub> and O<sub>2</sub> with two cool sensors: inhale, exhale -- keep it up!
- Watching aquatic (aquarium) plants make oxygen

# stemworks: BIOTECHNOLOGY

an outreach program of eRI Leonardo



# stemworks: MOLECULES

Life's Building Blocks

Some 5 Billion years ago 92 elements (made by stars and supernova) coalesced into Planet Earth. You and all the stuff in and on the planet are made of those elements - star-stuff. All 92 have their special place in the Periodic Table - the 'Mona Lisa' of Chemistry. Here's a simple version:

A key part of STEM is Chemistry. Biology uses Elements to produce Molecules (Chemists do that, too, but Biology figured it out 3 to 4 Billion years ago!).



All living things use these elements to make molecules, and these molecules are cycled throughout ecosystems. The simplest molecules necessary for living things include oxygen ( $O_2$ ), carbon dioxide ( $CO_2$ ), and water ( $H_2O$ ).

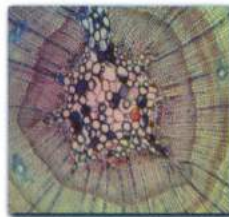
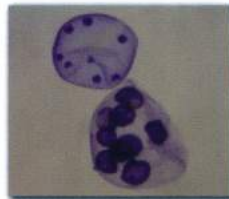
#### ACTIVITIES IN THE MOLECULES EXHIBIT INCLUDE:

- Making oxygen and hydrogen out of water --and putting them back together to make water again!
- Burning propane and forming water and carbon dioxide

# stemworks: CELLS

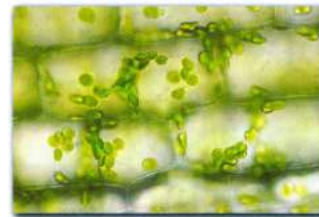
Life's Basic Units

Cells consist of molecules. Cells are the basic units of all Life. They are usually so small you need microscopes to see them. There are also some very large cells, maybe you had one or two for breakfast? Whether they are simple or complex, they create all life, one cell at a time.



Many Biotech careers involve plant and animal cells: analyzing them, growing them, counting them, sorting them, and even killing the bad ones (like bad bacteria and cancer cells). Microbes, such as bacteria, are cells, but you contain many others that have specific functions in your body.

These pictures are a few of the (larger) cells you might have seen with the digital microscope. What else did you see?



# stemworks: BIOTECHNOLOGY

an outreach program of the Leonardo

## ABOUT STEMWORKS

STEM stands for Science, Technology, Engineering and Math - the basis of much of our modern economy.

BIOTECHNOLOGY is the application of biological knowledge, processes, organisms, or systems. People with STEM skills and interests will be able to find good and interesting jobs.

## JOBS AND CAREERS FOR YOU IN STEM!

Depending on your goals and needs, you can qualify for STEM jobs straight out of high school. Other STEM jobs require vocational training, certificates, associates degrees, and university degrees. The general rule is the more education you get, the more choices you will have, and the more money you can make.

### STEM CAREERS

Anatomy  
Biomufacturing  
Botany  
Cell Biology  
Ecology  
Energy  
Genetics

Marine Biology  
Microbiology  
Paleontology  
Pharmacy  
Physiology  
Zoology

And you already know a lot of Biology - we all do: our own cells and tissues, our breathing and respiration, our nutrition and movement.

The four STEM Works exhibits give you a hands on, personal, and interesting introduction to some of the basics of Biology - the rest is up to you.

Resources: [www.theleonardo.org](http://www.theleonardo.org)  
[www.tinyurl.com/abigpicture](http://www.tinyurl.com/abigpicture); click Biology  
[www.utahfutures.org](http://www.utahfutures.org)