# OXYGEN • THE STORY



"Oxygen is the key to life, health and longevity. As our oxygen supply is diminished and contaminated because of pollution, our immune system is compromised and disease organisms, which were held in "check" become more resistant and deadly. Only oxygen can control these pathogens while providing the spark to creating the energy we need for all cellular energy."

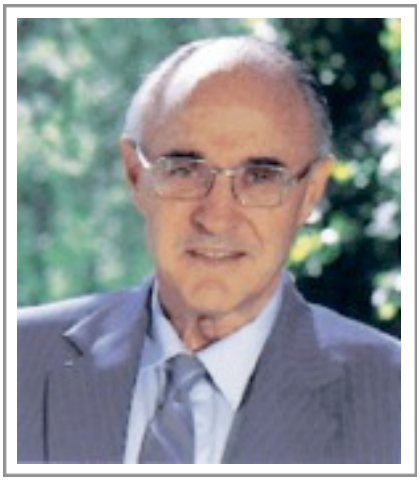
Stephen R. Krauss, Ph.D.
President/C.E.O.
Oxigenesis, LLC


## ALL CHRONIC PAIN, SUFFERING AND DISEASES ARE CAUSED BY A LACK OF OXYGEN

Dr. Arthur C. Guyton, M.D. included this statement in The Textbook of Medical Physiology: "...all chronic pain, suffering and diseases are caused from a lack of oxygen at the cell level." (1) In order for our cells to get their oxygen from the blood stream, the cells must be in what he described as a "dry state". In this condition there will be "...no excess fluid around the cells. There is only enough fluid to fill the crevices around the cells."

Dr. Guyton believed, as well as most of the medical profession, that as long as the fluid around the cells was at the proper water level, contained the right mineral balance, and was free of toxic wastes, the cells would continue to live, function and grow in a healthy manner.

Dr. Guyton explains that blood proteins in our blood stream, (which is 91% water,) make sure that the current



Dr. Arthur Guyton, M.D.

amount of water is kept in our blood stream so that no excess fluids can seep around the cellular walls. If our blood proteins escape out of our blood stream, and find their way into the spaces between the cells, then our lymphatic system must immediately remove these proteins from these spaces. The proteins' present in this altered condition will pull both sodium and water out of the blood stream. This reverse transfer causes a water and sodium-potassium imbalance, alters the cells' "dry state", inflames the cells and reduces the cells' ability to produce energy. When this situation occurs, the presence of excess water between the cells pulls oxygen as well from the bloodstream. This reduces the

# THE EXPERTS SPEAK OUT

## WHY OXYGEN IS THE KEY TO HEALTH

"Oxygen is the source of life to all cells."
Dr. Stephen Levine, Ph.D., Molecular Biologist and Geneticist

"All chronic pain, suffering and diseases are caused from a lack of oxygen at the cell level."
Dr. Arthur C. Guyton, M.D.: The Textbook on Medical Physiology

"Oxidation is the source of life. Its lack causes impaired health or disease; its cessation, death."
Dr. Eugene Blass, Ph.D.: Oxygen Therapy: Its Foundation, Aim & Result

"Rubble, garbage, toxins, refuse, debris and anything useless are destroyed by oxygen and carried out of the system. Just as a clean house holds little interest to passing flies, likewise an oxygen rich body is a difficult fortress to assail."
Brian Goulet, Certified Herbalist: Canadian Journal of Health and Nutrition

"Oxygen plays a pivotal role in the proper functioning of the immune system."
Dr. Parris M. Kidd, Ph.D.: Antioxidant Adaptation

"Oxygen is needed in the body. We can be without food and water for a lengthy time. We can be without oxygen only for a few seconds...it is the spark of life."
Dr. Charles H. Farr, M.D., Ph.D.: O2 Therapies

"Cancer has only one prime cause. It is the replacement of normal oxygen respiration of the body's cells by an anaerobic (i.e.., oxygen-deficient) cell respiration".
Dr: Otto Warburg: Two-time Nobel Laureate, Winner of the Nobel Prize for Cancer Research:

“Oxygen levels are decreasing globally due to fossil-fuel burning. The changes are too small to have an impact on human health, but are of interest to the study of climate change and carbon dioxide. These plots show the atmospheric O2 concentration relative to the level around 1985. The observed downward trend amounts to 19 'per meg' per year. This corresponds to losing 19 O2 molecules out of every 1 million O2 molecules in the atmosphere each year.”
The Scripps Institute, University of San Diego, CA

“Business and other travelers are often tired, worn out and physically weak from coping with growing airport security measures, increased flight delays, bad food, layovers and sometime excess consumption of alcohol or caffeine products. At cruising altitude, airline cabins have lower-than-normal air pressure and oxygen levels5 - with blood oxygen saturation up to 10% lower than normal.”
Excerpts from Boosting Your Energy,
Special Health Report from Harvard Medical School

“Intense exercise demands more oxygen, which fuels the cells, producing energy and aiding in muscle recovery. Muscles use glycogen from carbohydrates, and when glycogen is burnt in the absence of oxygen, it produces lactic acid, which results in muscle fatigue. Olympic athletes, as well as professional football players and other elite athletes, have long used supplemental oxygen to restore depleted blood-oxygen-levels and recover from muscle fatigue3. Anaerobic exercise and workouts that produce high levels of lactic acid are the most responsive to supplemental oxygen.”
Wilbur RL, Holm PL, Morris, DM, Dallam GM, Subudhi AW, Murray DM, Callan SD, “Effect of $FIO_2$ on oxidative stress during interval training at moderate altitude,” Medicine and Science in Sports and Exercise, 2004 Nov;36(11):1888-94

"Starved of oxygen, the body will become ill, and if this persists, it will die. I doubt if there is any argument about that."
Dr. John Muntz, M.D.
Internationally Recognized Nutritional Scientist

“Oxygen is a nutrient, and life can be over if deprived of this nutrient for more than four minutes! Oxygen is needed by immune cells to attack bacteria, viruses and parasites. It burns our food to make energy. Our liver uses oxygen to detoxify poisons, drugs and waste products. Fiber-making cells need oxygen to repair damaged and worn-out tissues. Everything on earth would either rust or burn without oxygen.”
Dr. Neil McKinney, N.D.
Naturopathic Physician
Canadian Journal of Health and Nutrition

"That oxygen is a vital part of life is beyond dispute; beginning with the role it plays in animal and plant respiration and ending, as to our knowledge, with it's gift to feed the cells of organized tissue... Oxygen disinfects, it purifies and it bleaches...In the full recognition of this feature lies the greater part of the future of the chemistry of oxygen."
American Electrochemical Society

“...I think we have to go back and look at oxygen and its role in evolution and how different species developed. You can go without food for a couple of weeks. You can go without water for a few days. How long can you go without oxygen, a couple of minutes? There's nothing with a greater evolutionary effect than oxygen."
Dr. Peter Ward, Ph.D., Paleontologist
University of Washington

“Oxygen plays a pivotal role in the proper functioning of the immune system. We can look at oxygen deficiency As the single greatest cause of all diseases.”
Dr. Stephen Levine, Ph.D., Molecular Biologist

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## WHY OXYGEN IS THE KEY TO HEALTH

"Oxygen is a nutrient, and life can be over if deprived of this nutrient for more than four minutes! Oxygen is needed by immune cells to attack bacteria, viruses and parasites. It burns our food to make energy. Our liver uses oxygen to detoxify poisons, drugs and waste products. Fiber-making cells need oxygen to repair damaged and worn-out tissues. Everything on earth would either rust or burn without oxygen."
Dr. Neil McKinney, N.D., Naturopathic Physician
Canadian Journal of Health and Nutrition

"Lack of oxygen clearly plays a major role in causing cells to become cancerous."
Dr. Harry Goldblatt, Journal of Experimental Medicine:

"Cancer is a condition within the body where the oxidation has become so depleted that the body cells have degenerated beyond physiological control. Similarly, the true cause of allergy is lowered the oxidation process within the body, causing the affected individual to be sensitive to foreign substances entering the body. Only when the oxidation mechanism is restored to its original high state of efficiency can the sensitivity be eliminated."
Dr. Wendell Hendricks, Hendricks Research Foundation

"Simply put, disease is due to a deficiency in the oxidization process of the body, leading to an accumulation of the toxins. These toxins would ordinarily be burned in normal metabolic functioning."
Dr. Albert Wahl

"A lack of oxygen (hypoxia) is the prime cause of 1.5 million heart attacks each year."
Dr. Richard Lippman, renowned researcher

"The Body is 75% water, and Oxygen accounts for 90% of the weight of water. Oxygen may be considered a yang force; without it, fuel in the Body cannot burn for energy or heat. The red blood cells carry Oxygen to every part of the Body, and anemia is sometimes a result of insufficient Oxygen. The qi of Oriental medicine has a direct relationship to oxygen; in fact, qi is sometimes translated as "breath." Modern perspectives on Oxygen give it several functions identical to those of qi: it energizes the Body, clears obstructions, and overcomes stagnancy. Lacking in Oxygen, one feels heavy, depressed, and without vitality."
Paul Pitchford, Healing with Whole Foods: Asian Traditions and Modern Nutrition

"Hypoxia is a characteristic of many solid tumors, can lead to the development of an aggressive phenotype and acquired treatment resistance, and is an independent, adverse prognostic indicator. In this literature review, we show that hypoxia is also a typical feature in prostate cancer (PC), the most commonly diagnosed cancer among men in most western countries."
Vaupel P, Kelleher DK.
Department of Radiotherapy and Radio-oncology, Klinikum rechts der Isar, Technische Universität München, Munich, Germany
Blood flow and oxygenation status of prostate cancers

"Tumor hypoxia is probably the most important not yet measurable factor that predicts the outcome of cancer therapy. Hypoxic tumors are resistant to radiation, chemotherapy, and surgery. They signal tumor cells to grow, invade, survive cytotoxic-factor assault, and increase metastatic activity. Therapies aimed at reversing hypoxia-related treatment resistance or normalizing hypoxia are proven effective…"
Okunieff P, O'Dell W, Zhang M, Zhang L, Maguire D.
Department of Radiation Oncology, University of Florida, Gainesville, FL
Tumor oxygen measurements and personalized medicine.

"Since Warburg's discovery, this difference in respiration has remained the most fundamental (and some say, only) physiological difference consistently found between normal and cancer cells. Using cell culture studies, I decided to examine the differential responses of normal and cancer cells to changes in the oxygen environment. The results that I found were rather remarkable. I found that... "High $0_2$ tensions were lethal to cancer tissue, 95 percent being very toxic, whereas in general, normal tissues were not harmed by high oxygen tensions. Indeed, some normal tissues were found to require high $0_2$ tensions. It does seem to demonstrate the possibility that if the 02 tensions in cancer tissues can be elevated, then the cancer tissue may be able to be killed selectively, as it seems that the cancer cells are incapable of handling the 02 in a high $0_2$ environment."
J. B. Kizer, a biochemist and physicist
Gungnir Research, Portsmith, OH

"The body, in its own remarkable way, does not allow all of the red blood cells' oxygen to be consumed as it courses through our bodies. Under normal conditions, 70% to 75% of the oxygen that started the journey in the red cells completes the return trip to the lungs. Thus, from 25% to 30% of the oxygen is consumed by normal cellular metabolism. If, however, the body undergoes exertion, stress, or any other prolonged physical activity, this "reserve" can drop to 20% to 25%. So, if you can raise the amount of oxygen dissolved in the plasma, you will increase the amount of oxygen that gets to the cells and that can become a part of the oxygen "reserve". The red blood cells, as carriers, gather oxygen from the plasma and transport this oxygen to the capillaries where it is released again into the plasma for the cells to use for metabolism. In order to regain sound health, the body must be supported in its efforts to ingest sufficient oxygen. This will lead to a revitalized energy, the production of heat and strength, and cleansing of all foreign substances. All important metabolic processes are dependent upon oxygen, and are only possible with the help of oxygen. Hence, oxygen is the savior in all metabolic illnesses."
Dr. Bernard Friedlander, D.C

"Oxygen can enhance self-esteem, self-reliance, decrease anxiety, relieve mild depression; improve the efficiency of the heart; improve muscular strength, flexibility; can lower the risk of cardiovascular disease (1.5 times) and sudden death.
Joseph E. Mario, Anti-Aging Manual
The Encyclopedia of Natural Health

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## WHY OXYGEN IS THE KEY TO HEALTH

**"Modern perspectives on Oxygen give it several functions identical to those of qi: it energizes the Body, clears obstructions, and overcomes stagnancy. Lacking in Oxygen, one feels heavy, depressed, and without vitality. Oxygen is needed for vitamin C utilization, to retard collagen breakdown, and to prevent premature aging. The person with adequate cellular Oxygen has a greater capacity to be outgoing (yang) and socially successful; people are attracted to the charisma that comes from abundant Oxygen. Most of the Oxygen we inhale is utilized by the brain and heart, and the liver also requires Oxygen to rebuild its cells."**
**Paul Pitchford**
**Healing with Whole Foods: Asian Traditions and Modern Nutrition**

**"Many Body problems are from lack of Oxygen al lowing anaerobic bacteria in Candida, yeasts, cancers, and diabetes. Before a storm, low barometric pressure and high moisture molecules, lowering atmospheric and lung Oxygen, inhibit release of toxic lung gases for symptoms of (rheumatic) arthritis. WATER, the most abundant substance, is 8/9ths Oxygen, and consists of small, simple molecules composed of two Hydrogen atoms attached to one Oxygen molecule (H20), with no Calories; each water molecule is bonded on four sides to four other water molecules. Although a person can go without food for five weeks or more, a mere few days without Water, or a few minutes without Oxygen, would be fatal."**
**Joseph E. Mario**
**Anti-Aging Manual: The Encyclopedia of Natural Health**

**"The brain is highly dependent on a constant supply of Oxygen and nutrients. Although it weighs only 3 pounds, the brain utilizes about twenty percent of the Oxygen supply of the entire Body. In dealing with the forgetfulness of menopause, the goal is to improve the supply of blood, Oxygen, and nutrients to the brain. The Role of the Hypothalamus and Endorphins Many of the symptoms of menopause, especially hot flashes, appear to be a result of altered function of the hypothalamus, a mass of nervous tissue at the center of the brain that serves as the bridge between the nervous system and the hormonal (endocrine) system."**
**Michael T. Murray, N.D. and Joseph E. Pizzorno, N.D.,**
**Encyclopedia of Natural Medicine, Revised Second Edition**

**"Many substances are capable of releasing nascent oxygen such as chloride oxides, ozone, hydrogen peroxide and iodine compounds... A comparison may be made of these substances on the basis of their stability and toxicity as well as pharmaconetic properties -- how it reacts in the body. Using the above examples, ozone releases its oxygen very rapidly (short half life) while chlorine oxides remain effective over a much longer period of time. Hydrogen peroxide has a relatively short half-life as stimulating free radical activity. Sodium periodate is a rich source of oxygen however, the byproduct iodine, is highly toxic to the cells."**
**Rodrigo Rodriguez, M.D.**
**Medical Director of American Biologics Hospitalis**
**in a report for the prestigious Robert W. Bradford Research Institute stated:**

**"The so-called stabilized oxygen products are actually salts of oxygen diluted in water. These safe as directed, yet potent oxidizers, sometimes contain various proprietary additives to enhance their effectiveness. They are essentially a formulation mixing a solution of mildly buffered sodium chlorite ($ClO_2$) with deionized water. These products are usually weakly buffered to an alkaline pH of around 12% but unlike highly buffered drain cleaners or other strong alkaline solutions, they immediately lose their alkalinity upon contact with any substance that is of lower pH. Bacteria, viruses, the acid mantle of human skin, and the hydrochloric acid in our stomachs all react with stabilized oxygen to immediately render the alkalinity harmless to humans."**
**Ed McCabe**
**Oxygen, Oxygen, Oxygen**

amount of oxygen that can get to the cells through the blood stream.

A prolonged blood protein imbalance will cause pain, sickness, and disease and, if serious enough, can induce death in just a few short hours. Blood proteins are not the same as the proteins we eat. We eat protein to obtain the amino acids from these proteins. From the amino acids, the body manufactures its own proteins, especially those for the blood stream (called albumins, globulins, and fibrinogens.) For decades, medical professionals and scientists believed that our blood proteins were simply too large to escape through the blood capillary membranes into the cellular spaces.

We now know that, as Dr. Guyton wrote: "The importance of this function of the lymphatics cannot be stressed too strongly, for there is no other route besides the lymphatics through which excess proteins, (which seep out of the blood capillaries into the spaces around our cells,) can return to the circulatory system."

Fluids in the lymphatic system move up the legs, into the large thoracic duct in the chest where the fluids eventually empty into the subclavian vein at the base of the neck. At this point the fluids return to the blood stream with the "captured" blood proteins to re-balance the system. Dr. Guyton explained that the lymphatic vessels have one-way check valves in them. These valves keep the fluids in the system flowing on only one direction.

Approximately three quarts of blood pulses through the capillaries every minute of every day we are alive. (That's over 32,000 gallons of blood pumped through your capillaries each day!) During those same sixty seconds, the heart will beat eighty times and diffuse (pump) water through the tiny capillary pores to supply the cells with minerals, nutrients and oxygen. Fluid

engineers calculate that the pressure is so great, and the pumping action so rapid, that the distance the water actually travels is microscopically small.

In less than one second, the water flow must rapidly exchange its nutrients, minerals and oxygen for toxins and waste products before the blood proteins pull the water back into the blood stream. (2) This is why it is so important for the cells to be in their "dry state". For every cell to take part in this healthy exchange, the cells must be packed as closely as possible together. The cells must be as little distance as possible from the capillaries.

Dr. C. Samuel West, a specialist in the science of lymphology and a distinguished member of the International Society of Lymphology, has proven that food present in cells without enough oxygen will turn into toxic waste and fat. The less oxygen present in the cells, the more pain we experience. Dr. West is a strong advocate of exercise since a lack of exercise reduces circulation and thus the transfer of oxygen to the cells. This leads to high blood pressure and fluid retention (2).

Dr. Samuel West, M.D.

As mentioned previously, it is the lack of A.T.P. (Adenosine Tri-Phosphate) that causes the glucose in the cells to ferment creating an anaerobic (without oxygen) condition. This upsets the metabolic processes of the cell. These cells, lacking sufficient oxygen, start manufacturing improper chemicals and soon these cells and their surrounding cells become weak and unhealthy. If prolonged, the entire immune system may start breaking down.

A lack of cellular A.T.P. drastically alters the body's sodium-potassium balance in the individual cells, in the bloodstream, and in the fluid that surrounds the cells. The chemical change also alters and reduces the "electrical fields" in the cells and the bloodstream. Once this electrical change occurs, minerals begin to "fall out" of the fluids surrounding the cells and the bloodstream and start sticking together in what is called "mineral deposits". If these minerals settle in the joints, arthritis occurs; in the eyes, cataracts occur. When they settle in the arteries, we describe the process as "hardening of the arteries."

Our muscles also respond to electrical charges sent by the brain. These messages tell the muscles to contract and release. Anything that upsets this delicate and intricate electrical transfer of energy, as does a lack of adequate A.T.P., will cause the muscles spasm and work or respond poorly.

The Bohr effect explains how the cells release oxygen and why red blood cells unload oxygen in tissues, while carbon dioxide ($CO_2$) is the key player in $O_2$ transport due to vasodilation and the Bohr effect (or Bohr law). The Bohr effect was first described in 1904 by the Danish physiologist Dr. Christian Bohr, M.D. (father of famous physicist Niels Bohr).

Many people believe that breathing more air increases oxygen content in cells. This is not true. Generally, breathing more even reduces oxygen content even in the arterial blood. Indeed, hemoglobin cells in normal blood for very small normal breathing are about 98% saturated with $O_2$. When we hyperventilate this number is about the same (in real life it gets less since most people make a transition to automatic costal or chest breathing that reduces arterial blood $O_2$ levels), but without $CO_2$ and the Bohr effect, this oxygen is tightly bound with red blood cells and cannot get into the tissues in required amounts. Hence, now we know one of the causes why heavy breathing reduces cell oxygen level of all vital organs.

The Bohr effect is crucial for our survival. Why? During each moment of our lives, some organs and tissues work harder and produce more $CO_2$. These additional $CO_2$ concentrations are sensed by the hemoglobin cells and cause them to release more $O_2$ in those places where it is most required. This is a smart self-regulating mechanism for efficient cells oxygen transport.

Hemoglobin's faster release of oxygen, otherwise described as a lowered oxygen-hemoglobin saturation level, is encouraged by other conditions in an exercising body. As your muscles make extra ATP, the basic unit of energy, they also produce waste products. These are primarily carbon dioxide, or $CO_2$, and hydrogen ions, or $H^+$. Christian Bohr discovered in 1904 that increased concentrations of these substances encourage hemoglobin to release oxygen molecules.

Dr. Christian Bohr, M.D.

This principal, the Bohr effect, makes it easy for exercising muscles and other active tissues to extract the oxygen from the bloodstream in increased amounts -- but it also means you need to replenish your oxygen supplies that much more quickly.

For example, without the Bohr effect, we could not walk or run for even 3-5 minutes. Why? In normal conditions, due to the Bohr effect, more $O_2$ is released in those muscles, which generate more $CO_2$. Hence, these muscles can continue to work with the same high rate.

However, sick people have reduced $CO_2$ blood values. Hence, they are likely to experience symptoms of chronic fatigue, and poor results for physical

fitness tests due to tissue hypoxia (low cells oxygen levels).

## Turning the treatable into the untreatable.

The historical scourge known as the bubonic plague killed up to one-third of Europe's population in the 1300s. But in modern times, it has been controlled handily with the help of antibiotic drugs such as streptomycin, gentamicin and chloramphenical.

That is, until 1995, when a plague infection in a 16-year-old boy from Madagascar failed to respond to the usual antibiotic treatments. This first documented case of an antibiotic-resistant plague, reported in the September 1997 New England Journal of Medicine, eventually succumbed to another antibiotic.

In the United States and globally, many other infectious germs, including those that cause pneumonia, ear infections, acne, gonorrhea, urinary tract infections, meningitis, and tuberculosis, can now outwit some of the most commonly used antibiotics and their synthetic counterparts, antimicrobials. According to the Mayo Clinic in Rochester, Minn., drug resistance may have contributed to the 58 percent rise in infectious disease deaths among Americans between 1980 and 1992.

The scientific campaign against bacteria began in 1865 when Louis Pasteur identified microorganisms as the cause of infectious disease. Soon afterward, Joseph Lister reasoned that clean wounds wouldn't lead to blood sepsis (blood poisoning). With carbolic acid he inaugurated the era of 'antisepsis,' something we take for granted today.

Another pioneer, Robert Koch, developed methodology to identify the specific microbes responsible for disease such as anthrax and tuberculosis. It was Paul Ehrlich, reasoning from the specificity of staining tissues, who devised the idea a 'magic bullet,' and sought one for syphilis. His '606' was Salvarsan, a toxic brew based on arsenic that had many side effects. Then the field was quiet for a quarter century.

In 1932, Gerhard Domagk developed the first sulfa drug; its initial success was with his own daughter who was dying of septicemia. Within 10 years, a whole assortment of sulfa drugs appeared. With them, side effects and microbial resistance occurred once again. The 'bugs' began to fight back.

A chance contamination of a petri dish led to the truly 'perfect' magic bullet, penicillin. A truly precious resource late in World War II, it was used primarily to fight venereal disease in soldiers.

Streptomycin, Chloramphenicol, and the tetracyclines soon emerged. They too soon kindled drug resistance and their own side effects. Chloramphenicol killed hundreds of babies who suffered the 'gray baby syndrome.' Tetracycline stained teeth in their formative period and displayed other side effects.

Only one new family of antibiotics has appeared since the 1960s: the quinolones, which are a synthetic. Side effects caused by them include birth defects, shock, and an occasionally, death. In the meantime, antibiotic resistance by microbes has been increasing, especially in hospitals where some 60,000 hospital-based infections (iatrogenic diseases) now occur annually. Iatrogenic diseases are 'doctor caused' diseases that are the unfortunate consequences of medical care!

## How has all of the drug resistance come about?

When you kill germs with antibiotics, a few germs survive. The germs that survive are tougher than the germs that were killed. When you use antibiotics all the time, you create evolutionary pressure. The surviving germs reproduce and pass their genes for “toughness” (or resistance) on to the next generation.

Germs measure their generations in minutes. Strep and staph, two of the most common bacteria, can produce multiple generations with a matter of hours. That means 20,000 or 50,000 generations of strep are produced for every one human generation. Bacteria also mutate much more easily than humans.

Let’s put it another way, A standard laboratory bacterium divides into two new cells in the course of twenty to thirty minutes, and these two cells are each immediately ready to grow and divide into two more cells in the next twenty minutes. A single bacterium therefore can produce more than a million cells in the course of twelve hours. If some happen to be drug resistant, then they multiply and can overwhelm the host by sheer numbers. You'd call it survival of the fittest, Darwinian fashion. It is natural selection at work.

"What's different now," explains David Bell, M.D., an expert on antimicrobial resistance with the national Centers for Disease Control and Prevention, "is that we've reached a situation where it's no longer an isolated problem of this bug or that bug; virtually all important human pathogens treatable with antibiotics have developed some resistance."

Bacteria, like other infectious microorganisms, mutate at a remarkable rate. Each new generation produces strains that become resistant to what were effective antibiotics. For example, in 1952, penicillin cured nearly all staphylococcus infections. By 1982, the same drug could cure less than 10% of these infections. By 2004, around 40% of life-threatening strep infections (i.e., pneumonia) were resistant to at least two primary antibiotics.

This rapid spread of drug resistance threatens to complicate the treatment of disease such as bacterial pneumonia, meningitis, bacteremia (a blood infection), sinusitis, and otitis media (ear infection in children).

A generation ago, it seemed impossible to overdose with penicillin. Administered intravenously, the amount of penicillin administered is greater than what can be achieved by the oral route. Patients came to demand doses. Doctors would prescribe them for all manners of ailments, even non-bacterial ones. 'Just in case', surgeons would even spray them around operating rooms. They were even dispersed around hospital wards to keep pathogens under control. The point is this: we are constantly exposed to antibiotics.

Forty years ago, there were no statistically identifiable strains of drug-

resistant streptococcal infection (strep throat). From 1997 to 2002 alone, the number of reported incidents tripled.

Experts say that doctors are sometimes too quick to prescribe antibiotics for all sorts of symptoms, even though antibiotics work only against bacterial infections, not against viruses such as the flu or the common cold. More than 50 million of the 150 million antibiotic prescriptions written each year for patients outside of hospitals are unnecessary, according to a recent CDC study.

## The mechanism of drug resistance: PLASMIDS

Microorganisms have many resources in the struggle to survive. They occur in large numbers. A single infection may be caused by millions of individual organisms. Bacterial drug resistance goes far beyond traditional evolutionary mechanisms. Bacteria can pass on drug resistance one to another without having to inherit it. Furthermore, they can pass on drug resistance to an entirely different species of microorganisms. How they do it is a biochemical version of 'computer viruses.' You will find their strategy interesting.

We think of DNA as confined to the cell nucleus or mitochondria. Bacterial contain free- floating rings of DNA called plasmids. Learn that term. These rings of DNA can pass between bacteria when they touch. They can also drift extracelluarly. Some bacteria are actually DNA scavengers. The pneumococci actually consume it and can genetically incorporate it to their benefit.

Bacteria also have 'jumping genes.' These are segments of DNA that can transpose themselves from one part of a chromosome to another--even to those in another cell. Thus, drug resistance can be multiplied and transferred from one bacteria to another.

The mutability of bacteria coupled with their ability to exchange plasmids is steadily decreasing the effectiveness of antibiotics. The rapid spread of drug resistance threatens to complicate the treatment of disease such as bacterial pneumonia, meningitis, bacteremia (a blood infection), sinusitis, and otitis media (ear infection in children).

The last line of defense against some infections is Vancomycin©. Synercid©, a Rhone-Poulenc Rorer antibiotic was announced in March, 1998. A Japanese infant infected with resistant Staph aureus was saved with Synercid. In September, 1999, the FDA approved the use of Synercid to treat hospital-based antibiotic resistant infections. This was none too soon: by 1998, 20% of ICU and non-ICU enterococci bacteria had acquired resistance to Vancomycin. Zyvox© from Pharmacia & Upjohn and Daptomycin© by Cubist Pharmaceuticals were released by 2000 to launch two new drugs against these organisms.

And it's not just bacterial infections, either. Consider HIV, the AIDS virus. There is no drug that is proven to eliminate HIV. At best, HIV drug treatments simply reduce the amount of HIV in the blood. As a result, HIV is continually evolving into tougher and more deadly mutant strains.

As streptococcus A has receded, streptococcus B has stepped in to take its place in bacterial ecology. Strep A has mutated and multiplied behind the scenes until it made headlines in the 1980s. It began striking people of all ages and all classes, almost at random. In 1989 it claimed its most famous victim--Jim Henson, the puppeteer and creator of the Muppets. Do you remember toxic shock syndrome associated with tampons? That is strep A, as well!

The fact is that when you kill germs with antibiotics, a few germs survive. The germs that survive are tougher than the germs that were killed. When you use antibiotics all the time, you create evolutionary pressure. The surviving germs reproduce and pass their genes for “toughness” (or resistance) on to the next generation.

Many bacteria have another technique for dealing with threats to their life: sporulation. When exposed to a toxic environment, these bacteria go dormant, toughening their cell walls to a nearly impermeable state. They wait it out until conditions improve. Historically, spore formation was a defense against drying out, high temperature, or some other change in their environment. As spores, microbes can drift about unharmed in 'antiseptic' solutions specifically designed to kill them.

By the early 1990s, a number of strains of E coli developed resistance to chlorine. Microbes can now survive in doses of chlorine that used to kill them. Chlorine has had a long use in treatment at municipal water treatment plants. There is catch-22 in using chlorine: if there are a lot of pollutants in the water, additional chlorine to counter this pollution makes the water carcinogenic. If you decrease the chlorination level, more resistant E. coli can survive.

Despite the frightening trend, most people aren't likely to encounter a "superbug" that can outsmart all antibiotics, says Mark Goldberger, M.D., director of the Food and Drug Administration's division of special pathogen and immunologic drug products. "For the average person walking around on the street, the risk at the moment remains low."

But many disagree with this FDA position even within the same agency. As one antibiotic's effectiveness wanes, doctors are forced in many cases to rely on more expensive and toxic drugs. Resistance is "a big problem and growing," says Linda Tollefson, director of surveillance and compliance in FDA's Center for Veterinary Medicine. "You're dealing with living microbes that have shown an incredible ability to accommodate antibiotics and come out winning. We have no idea what they are going to do next. Our fear is that we're seeing the tip of the iceberg."

Jeremy Laurance, Health Editor at The Independent, disagrees with Dr. Goldberg at the FDA. He writes: "Humans aren't the only ones getting antibiotics. Cows, chickens, pigs, cattle, sheep, ducks and other livestock get them also. This adds to the global selective pressure upon bacterial populations. Salmonella infections are becoming more deadly primarily due to the antibiotic treatment of animals. Unregulated livestock antibiotic usage is altering their bacterial flora."

## THE UNIVERSAL BIOCIDE: ASO® Activated Stabilized Oxygen

What all anaerobic pathogens have in common is the fact that they die in the presence of oxygen. Regardless of the mutation, regardless of the strain and regardless of the size of the organism, oxygen always kills these microorganisms when it comes into contact with them.

Unicellular organisms fall into four general categories that describe how these microbes react to the presence of oxygen:

AEROBES are microorganisms that require the presence of oxygen to live and reproduce themselves. Strict aerobes cannot survive in the absence of oxygen and produce energy only by oxidative phosphorylation. (Oxidative phosphorylation is a biochemical process in cells. It is the final metabolic pathway of cellular respiration in which energy, as ATP, is created in the cell's mitochondria.)

AEROTOLERANT ANAEROBES are microorganisms that do not require the presence or oxygen to live and reproduce, and are not destroyed if oxygen is present. They generate ATP only by fermentation and have mechanisms to protect themselves from oxygen.

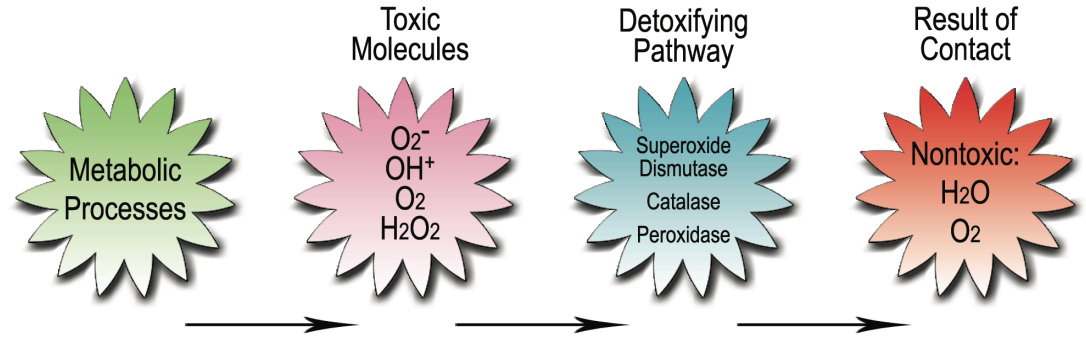
STRICT ANAEROBES, in most cases, generate their energy by fermentation or by anaerobic respiration and are always killed in the presence of oxygen. These organisms are also called "obligate anaerobes". Obligate anaerobes vary greatly in their sensitivity to oxygen. Extremely oxygen-sensitive anaerobes, such as spirochetes and some Clostridium species, cannot tolerate even 0.5% oxygen. Thus, oxygen is toxic for them.

FACULTATIVE ANAEROBES prefer to grow in the presence of oxygen, using oxidative phosphorylation, but can grow in an anaerobic environment using fermentation.

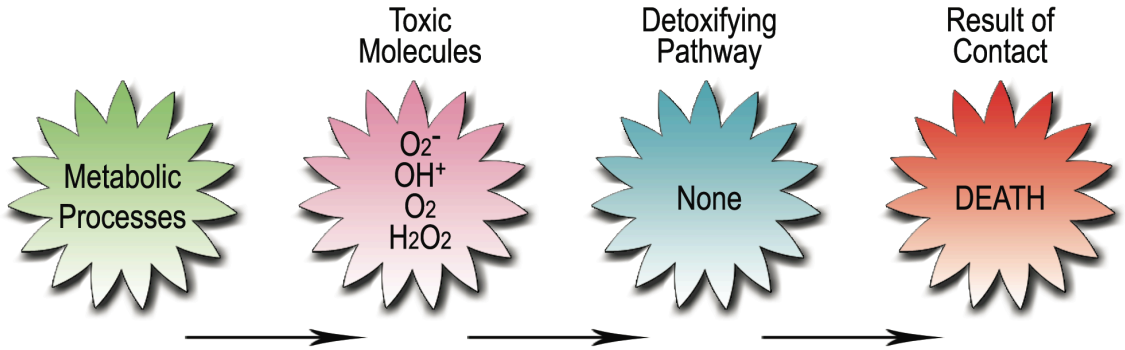
The most virulent and destructive pathogens that affect mankind generally fall into the "strict anaerobe" category. They include bacteria like Staphylococcus aureus, Streptococcus pneumonaiae, Clostridium botulinum and Escherichia coli. Viruses include Mycobacterium bovis, Herpesviridae and Influenza A virus/Orthomyxoviridae.

Oxygen has a tendency to form very reactive by-products, (including hydrogen peroxide [$H_2O_2$] and $O_2$-superoxide,) inside a cell. These by-products create havoc by reacting with protein and DNA, thus inactivating them. Cells that are able to live in the presence of oxygen have enzymes, (like Superoxide Dismutase, Catalase and Peroxidase,) that help them cope with $H_2O_2$ and $O_2$- and thus are not destroyed by the presence of oxygen.

Oxygen's anti-microbial mechanisms are not completely understood. It is known that the cell envelopes surrounding many pathogen's, like bacteria, are made up of polysaccharides, enzymes and proteins. In gram-negative pathogenic organisms, fatty acid alkyl chains and helical lipoproteins are present. In acid-fast bacteria, such as Mycobacterium tuberculosis, one third to one half of the capsule is composed of complex lipids, (esterified mycolic acid, in




*ABOVE: Aerobic organisms possess enzymes that deactivate oxygen so that reactive toxic molecules containing oxygen do not damage the cells.*




*Above: Unlike aerobic organisms, anaerobic organisms do not possess enzymes that are able to deactivate oxygen. Thus, reactive toxic molecules containing oxygen, damage the cells' structural integrity, stop the metabolic processes, and bring about cellular destruction and death.*

addition to normal fatty acids), and glycolipids (sulfolipids, lipopolysaccharides, mycosides, trehalose mycolates).

It is this high lipid content of the cell walls of these pathogenic organisms that may explain their sensitivity, and eventual destruction, when exposed to oxygen molecules. Oxygen breaks the chemical bonds in the molecules that make up the cell walls. Oxygen exchanges atoms and electrons with other compounds, such as the enzymes, lipids, etc. in these organisms. When enzymes come in contact with oxygen, one or more of the hydrogen atoms in the molecule are replaced by oxygen. This causes the entire molecule to change shape or fall apart. When enzymes do not function properly, a microorganism will die.

Oxygen molecules easily penetrate these cellular envelopes and affect the cytoplasmic integrity of pathogenic organisms. In addition, oxygen disrupts the metabolic activity of these disease-causing cells.

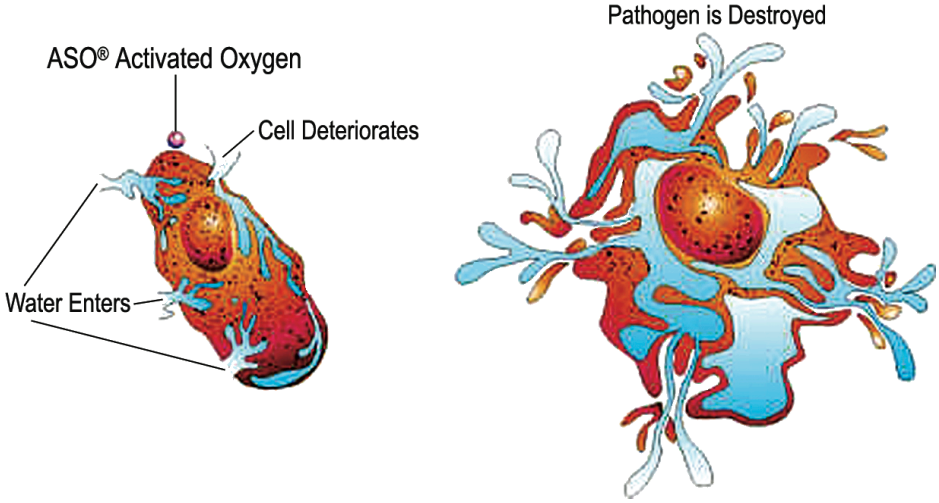
As mentioned previously, the outer cytoplasmic membranes of unicellular pathogens are composed of lipids, proteins, and lipoproteins. These membranes act as a diffusion barrier for water, ions and nutrients. Research indicates that the membranes are actually a lipid matrix containing randomly distributed globular proteins that penetrate through the lipid bilayer.

Oxygen reacts with the unsaturated fatty acids of the lipid layer in cellular membranes, forming hydro-peroxides. There is a synergistic effect with cellular-formed $H_2O_2$. Lipid peroxidation products include alkoxyl and peroxyl radicals, singlet oxygen, ozonides, carbonides, carbonyls, alkanes and alkenes.

Oxygen disrupts the integrity of the bacterial cell envelope through oxidation of the phospholipids and lipoproteins. In fungi, oxygen inhibits cell growth at certain stages. With viruses, the oxygen damages the viral capsid and disrupts the reproductive cycle by disrupting the virus-to-cell contact with peroxidation. The weak enzyme coatings on cells that make them vulnerable to invasion by viruses make them susceptible to oxidation and elimination from the body, which then replaces them with healthy cells.

Basically, oxygen disorganizes membrane permeability so that the organism's nucleic acids and cations leak out and the cell dies.

In addition, oxygen destroys pathogens in a number of different ways: oxygen short-circuits the processes by which pathogens create energy; oxygen disturbs the structure of the bacterial cell wall; oxygen also interferes with the production of essential proteins.




## Hypoxia and Disease

Red blood cells are rich in a substance called hemoglobin, a protein that carries oxygen molecules to all other cells. In adults, hemoglobin-rich red blood cells comprise 35%-52% of a person's blood; this percentage is known as the hematocrit level. Normal variations in the hematocrit level depend largely on factors such as gender and physical fitness. Anemia occurs when a person's hematocrit levels drop too low, indicating that the red blood cells are not properly transporting oxygen to other parts of the body.

It's estimated that three million Americans suffer from anemia. That number is expected to increase as the population continues to age—almost 10% of people over sixty-five have some form of the disease.

New research published in June of 2012, conducted at a host of universities, independent of each other, have together reestablished the critical role of oxygen in preventing disease. The combined data reconfirms the Nobel research of Dr. Otto Warburg dating as far back as the 1930s. In an article published in Science (February 1956), Dr. Warburg wrote:

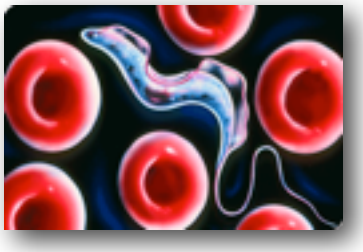
"Since the respiration of all cancer cells is damaged, the question is, 'How can the respiration of body cells be injured?' Of this damage to respiration, it can be said at the outset that it must be irreversible, since the respiration of cancer cells can never return to normal. Second, the injury to respiration must not be so great that the cells are killed, for then no cancer cells could result. One method for the destruction of the respiration of body cells is removal of oxygen...The other theories of cancer origin (mutation and carcinogen) are not viable alternatives, but empty words. Even more harmful in the struggle against cancer is the continual uncovering of miscellaneous cancer agents and cancer viruses, which, by

# COMMON HUMAN PATHOGENS

## Oxygen is the common controlling factor.

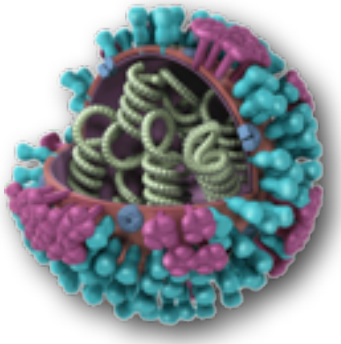
### BACTERIA

Bacteria found in effluent (sewage), especially coliforms and pathogens like Salmonella (right), show significant sensitivity to the presence of oxygen in concentrations higher than 4 p.p.m. Other bacteria that react to oxygen's disinfecting properties include Streptococci, Shigella, Legionella pneumophila, Pseudomonas aeruginosa, Yersinia enterocolitica, Campylobacter jejuni, Mycobacteria, Kiebsiella pneumonia, and Escherichia coli.



### PROTOZOAS

Protozoan organisms are also disrupted by the presence of high levels of oxygen. These include Giardia (left), Cryptosporidium (right), and the free-living amoebas including Acanthamoeba, Hartmonella, and Negleria. The exact anti-microbial mechanism of oxygen on these protozoans is yet unknown. Perhaps there exists a direct relationship between oxidative stress, oxygen perfusion into the cytoplasm and the inactivation of metabolic functions that result in organism death.

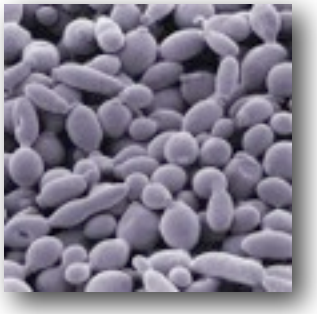


### VIRUS

Numerous families of viruses, including poliovirus I and 2, human rotaviruses, Norwalk virus, Parvoviruses, and Hepatitis A, B, and non-A non-B (C), among many others, are affected by the presence of oxygen molecules. Most research on oxygen's virucidal effects appear to indicate that oxygen breaks apart the lipid molecules at the sites of multiple bond configurations. Once the virus' lipid envelop is fragmented, the cell's DNA or RNA is then quickly destroyed.

Non-enveloped viruses (Adenoviridae, Picornaviridae, Coxsachie, Echovirus, Rhinovirus, Hepatitis A and E, and Reoviridae (Rotavirus), are viruses that do not have traditional cell envelopes and so are called "naked viruses." They have a nucleic acid core (made of DNA or RNA) and a nucleic acid coat, or "capsid", which is made of protein. Oxygen not only reacts with unsaturated lipids, it can also interact with proteins and protein constituents, especially amino acids. When oxygen contacts capsid proteins, protein hydroxides and protein hydroperoxides are formed.

Normal mammalian cells possess a complex system of enzymes (including superoxide dismutase, catalase, peroxidase) which tend to ward off the effects of free radical oxygen species. Virus pathogens have no protection against oxidative stress and are devoid of similar defensive mechanisms. Oxygen's effect upon cellular unsaturated lipids is only one of its documented biochemical actions. Oxygen is known to interact with the proteins, carbohydrates, and nucleic acids of pathogenic organisms causing disruption and eventually death.



### FUNGI, YEAST & MOULDS

Fungi families are also inhibited and destroyed by an exposure to oxygen. These include Candida (right), Aspergillus, Histoplasma, Actinomycoses, and Cryptococcus. The cell walls of fungi are multilayered and are composed of approximately 80% carbohydrates and 10% of proteins and glycoproteins. The cell walls of these organisms contain disulfide bonds. It is likely that these bonds mark the site for this oxidative inactivation. In all likelihood, however, oxygen does have the capacity to diffuse through the fungal walls into the organismic cytoplasm, thus disrupting cellular organelles and killing the organism.

### PARASITE

A parasite is an organism that lives off the host and lives a parallel life inside our bodies, feeding off our own cells or the food we eat. Pinworm eggs can be transferred to the mouth by fingers, clothing and bedding. Blood flukes and eggs enter the body through drinking water. Trichina worm larvae enter the body from undercooked meat. Hookworms (above) can lay up to 10,000 eggs every day in the digestive tract and can survive for up to 15 years. The tapeworm can grow to more than 33 feet in length, can lay as many as 1,000,000 eggs a day and can have as many as 4,000 segments. Recent medical studies estimate that 85% of the North American population has at least one form of parasite living in their bodies. Frequent symptoms of these intestinal parasite infections are irritable bowel syndrome, diarrhea, chronic fatigue syndrome.

obscuring the true cause, lack of oxygen, may hinder necessary preventive measures and thereby become responsible for cancer cases."

## Cellular hypoxia and cancer

Hypoxic red blood cells, like those pictured above, cannot supply the cells and organs with life-giving oxygen. As the body's oxygen levels decrease, cellular energy is reduced and disease organisms find the conditions more ideal for proliferation.

Low oxygen levels in cells may be a primary cause of uncontrollable tumor growth in some cancers, according to a new University of Georgia study. The authors' findings run counter to widely accepted beliefs that genetic mutations are responsible for cancer growth.

University of Georgia Professor Ying Xu and his colleagues have found that low oxygen levels in cells may be a primary cause of uncontrollable tumor growth in some cancers. Therefore, if hypoxia, or low oxygen levels in cells, is proven to be a key driver of certain types of cancer, treatment plans for curing the malignant growth could change in significant ways. New treatments could include a host of oxygen-based therapies that are successfully being used in other countries.

"Previous studies have linked low oxygen levels in cells as a contributing factor in cancer development, but not as the driving force for cancer growth. High incidence rates of cancer around the world cannot be explained by chance genetic mutations alone", Xu said.

In another dramatic explosion of knowledge, Dr. Stephen Lee, a professor in the Department of Cellular and Molecular Medicine at University of Ottawa, has made a breakthrough, unlocking the secret of how cancer cells function in low-oxygen environments.

Scientists have known for decades that in the presence of oxygen, cells make proteins — the building blocks of life — using a process called protein synthesis. But how they do so in conditions of limited oxygen had remained a mystery.

"There's a huge amount of research, hundreds of thousands of papers," Lee said in an interview. "But still nobody has discovered how we make the basic building blocks of life in these conditions. That's what we discovered." Lee's team found there's an oxygen-regulated switch in the protein synthesis machinery, a "very novel and unexpected way of synthesizing proteins," Lee said. "It's very different. Cancer cells utilize that way of producing proteins without oxygen, even if oxygen is present," Lee said. "They hijack that system and that drives their proliferation...If the cancer cells use the low-oxygen machinery to spread, we can develop an antibiotic against that protein synthesis machinery. It's as easy as that. And it's working very well."

Again, low cellular oxygen levels are responsible for the creation, growth and the spread of cancer tumors in the body. Dr. Warburg and now Dr. Lee have identified the cause. Now, using this knowledge, we have the opportunity to utilize the power of simple oxygen to turn the tide on this and other deadly diseases.

Researchers at Purdue University have created and tested a miniature device that can be implanted in tumors to generate oxygen, boosting the killing power of radiation and chemotherapy. The technology is designed to treat solid tumors that are hypoxic at the center, meaning the core contains low oxygen levels. The device fits inside a tube that can then be inserted into a tumor with a biopsy needle.

The new "implantable micro oxygen generator" is an electronic device, slightly less than one centimeter long, that receives ultrasound signals and uses the energy to generate a small voltage to separate oxygen and hydrogen from water, a chemical operation called water electrolysis. Researchers have tested the devices in pancreatic tumors implanted in mice, showing they generated oxygen and shrunk tumors faster than tumors without the devices.

## ASO® and the release of nitric oxide:

Studies of ASO® and its effect on $PaO_2$ (blood oxygen saturation) have demonstrated a positive effect, lasting up to four hours, on the amount of oxygen in the blood stream. (Suntory, Aker, et. al.) However, no explanation, until now, has offered a possible explanation as to just how ASO® may actually facilitate such a prolonged increase in the saturation.

Measurements of the bioavailable dissolved polyatomic oxygen in ASO® have been conducted by independent researchers using various test methods including mass spectrometry and dissolved oxygen test kits by LaMotte and Hach. In all instances, these dissolved levels have ranged from a low of 35,000 mg/L to a high of 350,000 mg.L, depending on the concentration of the test sample analyzed.

Nevertheless, even at the highest analysis (350,000 mg/L or p.p.m.), one mL only contains a maximum of 350 mg/L of oxygen.

The average adult at rest inhales and exhales approximately 7 or 8 liters (about one-fourth of a cubic foot) of air per minute. That represents about 11,000 liters of air (388 cubic feet) in a day.

The air that is inhaled is about 20-percent oxygen, and the air that is exhaled is about 15-percent oxygen, so about 5-percent of the volume of air is consumed in each breath and converted to carbon dioxide. Therefore, a human being uses about 550 liters of pure oxygen (19 cubic feet) per day or .38 liters every minute (380 mg). So, one serving of ASO® is equivalent to only one breath of oxygen. The logical question is then: how can only one serving of ASO® cause such a dramatic change in the $PaO_2$ level?

The answer may just be in how ASO®'s polyatomic oxygen interacts with the body's release of nitric oxide (NO) in arterial and capillary walls. The walls of arterioles are encased in smooth muscle. The constriction (narrowing) of arterial and capillary walls decreases blood flow while dilation (enlarging) has the opposite effect. In time of danger or stress, the arteries supplying the skeletal muscles will dilate while those supplying the digestive organs will decrease.

These actions are carried out by three very related actions in the body:

- the autonomic nervous system,
- local controls in the capillary beds,
- Nitric oxide (NO), which is a potent dilator of arteries is released.

When the endothelial cells that line the blood vessels are stimulated, they synthesize nitric oxide (NO). The

growing theory is that the unique oxygen molecules in ASO® trigger the immediate release of NO.

Upon release, NO quickly diffuses into the muscular walls of the vessels causing them to relax. In addition, as the hemoglobin in red blood cells releases its $O_2$ in actively-respiring tissues, the lowered pH causes additional NO to be released, which helps further dilate the vessels to meet the increased need of the tissue. The result is a significant increase in oxygen flowing to the brain, organ, tissues and flooding the blood stream to enhance the immune system.

NO diffuses freely across cell membranes. Mice whose genes for the NO synthase found in endothelial cells (eNOS) were "knocked out" suffer from hypertension.

By the way, nitroglycerine, which is often prescribed to reduce the pain of angina, does so by generating nitric oxide, which relaxes the walls of the coronary arteries and arterioles.

The importance of NO cannot be underestimated especially when evaluating its importance to human health. Here are just a few established by ongoing research:

• NO inhibits the aggregation of platelets and thus reduces the possibility of inappropriate clotting that can interfere with blood flow to the heart and brain.

• The release of NO around the glomeruli of the kidneys increases blood flow through the kidneys thus increasing the rate of filtration and urine formation.

• The erection of the penis during sexual excitation is mediated by NO released from nerve endings close to the blood vessels of the penis. Relaxation of these vessels causes blood to pool in the blood sinuses producing an erection. Most of the popular ED drugs focus on the release of NO.

• The wavelike motions of the gastrointestinal tract are aided by the relaxing effect of NO on the smooth muscle in its walls.

• NO inhibits inflammation in blood vessels. It does this by blocking the exocytosis of mediators of inflammation from the endothelial cells.

• NO stimulates the release of the Gonadotropin-releasing hormone (GnRH) from the hypothalamus. GnRH is a necessary hormone in reproduction and promotes estrogen and testosterone production

• NO stimulates the release of pancreatic amylase from the exocrine portion of the pancreas. Amylase is one of the primary starch-digesting enzymes secreted in the body.

• NO stimulates the release of adrenaline from the adrenal medulla. When released, adrenaline stimulates a wide array of bodily functions. From the heart rate to blood vessels, it effectively counters high-stress and physical situations. This enables us to process information, while utilizing actions at a rapid rate. These are referred to as adrenaline rushes, which increase physical performance in unexpected instances. The process also sends more oxygen to the lungs. This is essential when responding to emergencies and natural disasters. The body is then able to perform tasks in a timely manner. These tasks, however, might not be accomplished without implementing adrenaline.

• NO aids in the killing of engulfed pathogens within the lysosomes of macrophages (killer white blood cells). Th1 cells, the ones responsible for an inflammatory response against invaders, secrete NO.

• NO may promote longevity. Mice whose genes for NO have been knocked out, show signs of premature aging, have shortened life spans and fail to benefit from the life-extending effects of a calorie-restricted (CR) diets.

## ASO® increases blood oxygen levels

In two independent studies, one in vivo, confirm that when taken orally, ASO® raises blood oxygen saturation, called $PaO_2$. Suntory International performed an independent study on ASO® to determine whether the partial pressure of oxygen in arterial blood ($PaO_2$) in the forearm after rest would change following the oral consumption of ASO®. Three healthy males were tested before and after consuming the solution over a period of 240 minutes. The dosage was only 6 mL (.2 ounces) of ASO® per person. Suntory's conclusion (please see the graph on the nest page.):

"Each subject's partial pressure of oxygen was relatively stable prior to consumption, but then rose immediately after consumption. The partial pressure of oxygen peaked 90 to 120 minutes after consumption, after which it gradually dropped, eventually reaching its pre-consumption level. In a subject with a particularly low baseline, a significant increase was observed."

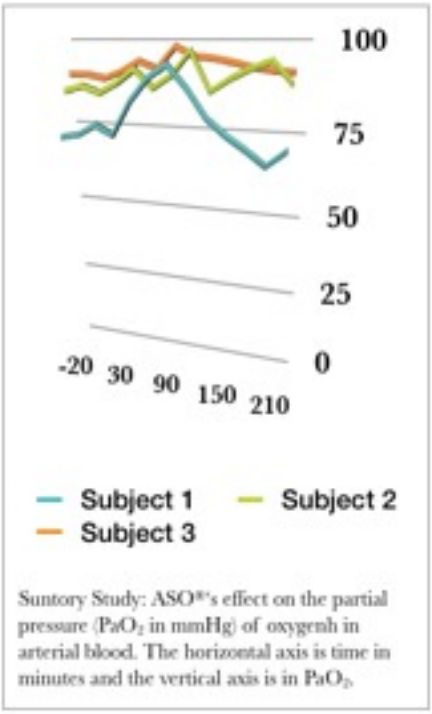
Another test on ASO® represented a variety of individuals with varying physiological differences including age, sex, weight, medical health conditions, physical conditioning, etc. The test was conclusive on three major points:

1. Free oxygen (160) is present in ASO® as it was absorbed into the blood stream both sublingually and/or internally after it was tagged with Protac C/Iodine26 in every administered case.
2. The combination of component ingredients in ASO® has a positive affect, in varying degrees, on capillary dilation.
3. The combination of component ingredients in ASO® has a significant affect on the reduction of systolic and diastolic blood pressure.

The researcher, Dr. James Aker, Ph.D., stated: "...ASO® results in greater metabolic efficiency which may correlate to significant energy reductions thus prolonging and enhancing the quality of an individual's life. Further, ASO®, used in conjunction with mineral supplements, may be an excellent therapeutic tool for treating physiological disorders including chronic fatigue syndrome, immune deficiency disorders and several chronic pain related disorders."

*James D. Aker, Ph.D., M.S., P.A., P.P.A.. Dr. Aker has a Ph.D. in Biochemistry, a Master's Degree in Biochemistry (concentration: Organic Chemistry) and a Master's Degree in Quantum Physics, Research. He is a Board Certified P.A. (Physician's Assistant) and P.P.A. (Psychiatric Physician's Assistant). For three years he served as a Nutritional Research Fellow with the World Health Organization (W.H.O.) in India (soil and nutritional analysis) and has spent the past 12 years as a biochemical, nutritional and medical research consultant specializing in nutritional product research, product development and product formulations.)*

In a third study, Dr. E. Wayne Askew, Ph.D. (University of Utah) wrote: "In short, in both measurable parameters




Suntory Study: ASO®'s effect on the partial pressure ($PaO_2$ in mmHg) of oxygenh in arterial blood. The horizontal axis is time in minutes and the vertical axis is in $PaO_2$.

and subjective observations, the test subjects in the group treated with the oxygen supplement (ASO®) experienced the following to a greater degree than the control group: Greater stamina and endurance, Reduced muscle fatigue, More energy, Less "out of breath", Greater feeling of strength, Felt that the product helped them perform better."

*"Effect of stabilized oxygen consumed with water on blood and urine markers of oxidative stress and blood oxygen saturation during extended military mountaineering training at moderate altitude." Eldon W. Askew, Ph.D. Department Chair, School of Nutrition, University of Utah, Donald E. Roberts, Ph.D., James E. Reading, M.A., Jeffrey M. Pfeiffer, M.S., Lt. Lance Orr, MC, USNR.*

## How does ASO® get into the body?

There appears to be ample supportive scientific evidence that dissolved oxygen in a liquid supplement form can be absorbed either sublingually into the blood stream or may pass directly through the stomach lining into the blood plasma. Research has clearly shown (Dr. Arthur Guyton, M.D.) that the blood plasma contains approximately 3% dissolved oxygen, the red blood cells (hemoglobin) hold the remaining 97% in a completely healthy and well-oxygenated individual.

Oxygen passes out of the red blood cells and into the plasma to be transferred to the cells that need oxygen for the metabolic process. These cells then pass $CO_2$ back into the plasma which is picked up by the red blood cells in the exchange. Oxygen is almost always present in the plasma as it travels though the body.

Research conducted on BIO2's ASO® Activated Oxygen by Suntory International of Japan indicates that there is a direct and long-lasting correlation between the consumption of BIO2's stabilized oxygen and an increased partial pressure of oxygen in arterial blood. The Duke University study, completed in March of 1996, indicates clearly, for the first time, the actual mechanisms by which oxygen is transported in the blood directly to the tissues and how oxygen is released and acquired by the blood through both the lungs and the plasma. The combination of these two studies implies that BIO2's Activated Oxygen, when taken orally, is absorbed into the blood stream where it is transported directly to the tissues.

## You Have To Be A Fish With Gills To Get Oxygen Out Of A Liquid!

A number of professional practitioners, medical doctors and scientists have inferred that only a fish with gills could benefit from stabilized oxygen, or any oxygen molecules, dissolved in a liquid. These individuals, trained in the ways of Western Medicine and science, should have a greater grasp of chemistry, digestion and metabolism before making such a claim. Let us then look at the possibility of absorbing oxygen through the lungs in a liquid medium -- something that many medical professionals and scientists believe is impossible, and have no problem staking their reputations on this assertion as if it were medical fact.

A number of years ago a movie was released (The Abyss) in which the lead actor puts on a special diving suit that uses a super-rich oxygenated liquid instead of a gaseous oxygen mixture used in traditional pressurized gaseous state for deep underwater diving. Many thought that this was Hollywood science fiction. However the concept of "liquid breathing" actually began in the mid 1960s when "...Dr. J. Kylstra, a physiologist at the State University of New York at Buffalo, realized that salt solutions could be saturated with oxygen at high pressures. Working in a US Navy decompression chamber, Kylstra performed an experiment to see if mice would be able to move the saline solution in and out of their lungs, while extracting enough oxygen from the fluid to be able to survive." The test animals survived for almost 18 hours. (10)

Several years later (1966), Dr. Leland Clark performed another "liquid breathing mouse" experiment. Instead of using a saline solution, he used a fluorocarbon (like freon) that had a higher capacity for the absorption of gasses like oxygen and carbon dioxide. His test animals survived breathing this fluid for up to 20 hours.

Why this interest in liquid rebreathing? Because liquid breathing solutions, like perfluorooctyl bromide (also called perflubron) may be useful as either a blood substitute or to put directly into the lungs of patients with acute respiratory failure. Infection, severe burns, and the inhalation of toxic substances and may cause such failure as well as complications due to premature birth. "Once inside the lungs, perflubron enables collapsed alveoli to open and permits a more efficient transport of oxygen and carbon dioxide."

Have there been any successful documented reports of such usage? Dr. Corrine Leach, M.D. of State University (Children's Hospital) of New York at Buffalo gave 13 premature infants partial liquid ventilation therapy from 24 to 76 hours without difficulties or adverse side effects. Six of the infants died of complications unrelated to the liquid ventilation. The other seven survived. This study was published in the New England Journal of Medicine (September 1996). The article in the Journal concluded: "Partial liquid ventilation leads to clinical improvement and survival in some infants with severe respiratory distress syndrome who are not predicted to survive" (11)

Of course, we are not fish and our bodies were not designed with gills that can pull oxygen out of water. However, our bodies are remarkably resilient enough that oxygen, present in high

enough concentrations in a liquid medium, can indeed be directly absorbed by the lungs into the blood stream. The medical community has already established this unique oxygen transport medium. (12) Given established physiological research, this same dissolved oxygen, in a liquid medium, may also be absorbed through the digestive tract. This diffusion action is no more of a surprise than the absorption of oxygen through the lungs.

## Can oxygen really be digested?

Can, from a biological perspective, dissolved gasses, like oxygen, can be absorbed into the body at any point in and at any time during the digestive process? The digestive process begins in the mouth (oral cavity) and ends at the colon. In one of the most widely used and highly acclaimed medical textbooks on physiology, Dr. Arthur Guyton, M.D. and John E. Hall, Ph.D., agree that such gas absorption is possible through the digestive tract and does occur. (1) All molecules and ions in the body's fluids, including water and dissolved gasses in water, are in constant motion, which is called "diffusion". It is through simple diffusion that these molecules move through the intermolecular spaces and through the lipid layers of the cells' membrane openings.

Drs. Guyton and Hall write: "One of the most important factors that determines how rapidly a substance will move through the lipid bilayer is the lipid solubility of the substance. For instance, the lipid solubilities of oxygen, nitrogen, carbon dioxide, and alcohols are high, so that all these can dissolve directly in the lipid bilayer and diffuse through the cell membrane in the same manner that diffusion occurs in a watery solution...Especially large amounts of oxygen can be transported in this way: therefore oxygen is delivered to the interior of the cell almost as though the cell membrane did not exist." The author's go on: "The rapidity with which water molecules can penetrate most cell membranes is astounding." (1)

Since water can easily pass in and out of the cells, does this water also contain oxygen? In addition, does water passing through the gastrointestinal tract also penetrate the tract's wall barriers so that the body absorbs it? The author's confirm that this is exactly the case. In Chapter 65 of their book, the authors describe the digestive process of carbohydrates, fats and proteins, but also water, electrolytes and other substances, including gasses like oxygen. (1)

When taken undiluted, or diluted in water, stabilized oxygen solutions like ASO® enter the digestive system. Mineral assays on ASO® indicate that a number of trace and essential minerals are present and thus also become available for absorption into the body. Oxygen is also present and it too is absorbed along with these other ions, electrolytes, etc. as they are carried into the body along with the water.

Drs. Guyton and Hall make the important point that a great deal of water is absorbed into the body during the digestive process each day. In fact, this quantity can be as large as 8 to 9 liters. The stomach is a poor absorptive area and the authors' point out "only a few highly lipid-soluble substances, such as alcohol and some drugs like aspirin, can be absorbed in small quantities." (1) Oxygen is also lipid soluble and therefore is definitely absorbed into the body through the stomach lining by any one of three processes: active transport, diffusion or solvent drag.

What oxygen is not absorbed through the stomach passes with the water that is present in the digestive tract to the small intestine. Each day, the small intestine absorbs approximately 7 - 8 liters of water. However, the small intestine's absorption capacity is greater than this: up to as much as 20 liters of water.

As the water passes into the large intestines, additional water and ions are absorbed, as much as an additional 5 - 7 liters. Therefore, the potential for absorption of water throughout the digestive system is extremely high, up to a maximum potential of nearly 27 liters of water. Thus, it is an obvious conclusion, that the oxygen in stabilized oxygen solutions may be easily absorbed, along with all the other components found in water, into the body.

It should be no surprise that some of these molecules will find their way into the blood stream. This is the process by which the Protac C tagged oxygen in research conducted by Oxigenesis, LLC, Inc. entered the blood stream.

There appears to be ample supportive scientific evidence that dissolved oxygen in a liquid supplement form can indeed be absorbed either sublingually into the blood stream or may pass directly through the stomach lining into the blood plasma. Biologists agree that human blood plasma contains approximately 3% dissolved oxygen.

The red blood cells (hemoglobin) hold the remaining 97% in a completely healthy and well-oxygenated individual. Oxygen passes out of the red blood cells and into the plasma to be transferred to the cells that need oxygen for the metabolic process. These cells then pass $CO_2$ back into the plasma, which is picked up by the red blood cells in the exchange. Oxygen is almost always present in the plasma as it travels though the body.

Author Nathaniel Altman, in his book "Oxygen Healing Therapies", quotes Dr. Christiaan Barnard, M.D., one of the world's most respected and the leading heart surgeons, who in 1986 stated that the oral ingestion of an oxygen-rich solution -- in this case hydrogen peroxide -- has physiological benefits. Dr. Barnard states: " It is true that I have found relief from the arthritis and I attribute it to taking hydrogen peroxide orally several times a day." (7)

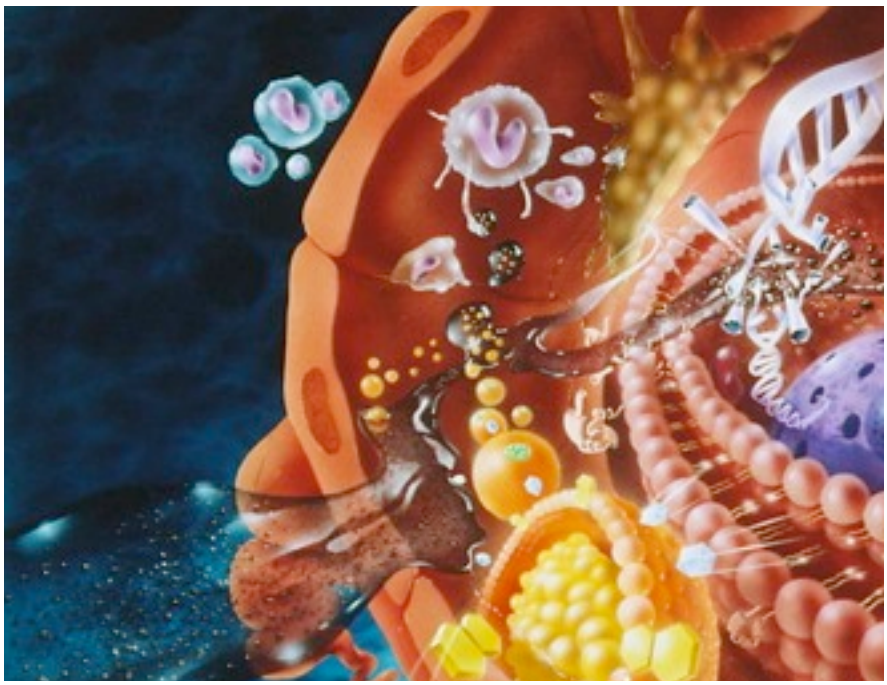
## Oxygen free radicals are the major cause of disease and aging. Or are they?

The conventional wisdom has held for decades that free radicals cause aging, and that antioxidants, which squelch the reactivity of these highly reactive molecules, are a way to slow the process. But brand new research adds to a growing body of prior research that suggests the story is not so simple.

In a new study, published in PLoS Biology, worms that made more free radicals, or that were treated with a free-radical-producing herbicide, actually lived longer than normal worms. What's more, when the longer-lived mutant worms were given antioxidants, the effects were reversed, and the worms had

a conventional worm lifespan. The finding flies in the face of the idea that antioxidants battle the effects of aging.

According to the study's author Siegfried Hekimi (McGill University in Montreal, Canada) and others, what is



*Oxygen free radicals (black stream, bottom left to centre right) damaging cellular DNA (deoxyribonucleic acid, white, centre right). The DNA has originated from the cell nucleus (purple, lower right) and a sectioned cell membrane surrounds it. Vitamin C (blue particles) reduces this damage. A sectioned blood vessel wall runs vertically through centre. Particles of low-density lipoprotein cholesterol (LDL, orange) are oxidized by free radicals, and protected by vitamin E (yellow hexagons). Oxidized LDL is removed by white blood cells (leucocytes, pink/grey, upper centre). These LDL-filled cells form atherosclerotic plaque (brown, upper right) JIM DOWDALLS/SCIENCE PHOTO LIBRARY*

emerging from this and other experiments is a view of free radicals -- or, more precisely, reactive oxygen species -- as a normal part of the body's stress response, with beneficial effects at certain levels.

"Maybe the reason why free radicals and aging are correlated is because free radical production in the mitochondria (part of the cell) is a stress reaction to the damage of aging," Hekimi said. "The organism tries to counter with free radical production." Hekimi and others point out that part of exercise's benefit may be because exercise causes mild increases in the levels of reactive oxygen species that are actually good for us.

The emerging view casts a pall on the idea of popping antioxidant pills in hopes of slowing the aging process or protecting against disease!

"When clinical trials have been done with antioxidants, they have not shown benefits," Hekimi said.

"If we're right that reactive oxygen species are fundamental to maintain normal fitness and also adaptation to stress, then you don't want to take too many antioxidants," said Navdeep Chandel of Northwestern Medical School in Chicago.

Free radicals do cause damage, Hekimi said, but at normal levels their beneficial effects are perhaps more important. If the stress of aging or disease increases sufficiently, he said, the damage caused by the free radicals might overwhelm their positive effects.

"You cannot live without them, nor should you wish to, but they will probably help to kill you in the end," agreed Barry Halliwell of the National University of Singapore, of reactive oxygen species. "Learning how to stop the latter whilst preserving the useful functions of reactive oxygen species should be a major research priority in the next few years."

Halliwell said that evidence supports that reactive oxygen species probably contribute to the progression of cancer and neurodegenerative diseases, despite having beneficial effects at lower levels. They also probably cause skin wrinkling, he added.

In results that counter the idea that oxygen free radicals cause aging, an MIT researcher reports in the July 18 issue of Nature that calorie restriction prolongs life because it increases respiration, not because it decreases oxygen free radicals.

MIT biologist Leonard Guarente believes "the conventional wisdom on oxygen radicals is dead wrong. Our results (in yeast) are contrary to the frequent suggestion that calorie restriction functions by slowing metabolism and thereby slowing the generation of free radicals."

Guarente, who is working on a book on aging to be published in the fall of 2012, discovered in 2000 that calorie restriction activates the silenced information regulator ($SIR_2$) gene, which has the apparent ability to slow aging. This gene makes a protein called $SIR_2$, which Guarente has shown is integrally tied to extending life span in yeast and in the roundworm. Humans carry a similar gene.

Rather than a slower metabolism leading to a slower rate of respiration, it turns out that respiration in yeast cells under calorie restriction goes up, not down. "The increase in anti-oxidant enzymes that is reported to occur during calorie restriction in animals may be a result of an increase in respiration rather than a cause of the observed longevity," Guarente said.

"A high respiration rate is intimately connected with calorie restriction in yeast," he said. "A high respiration rate activates $SIR_2$. When respiration goes up, NAD (nicotinamide adenine dinucleotide, a co-enzyme that activates $SIR_2$) goes up and $SIR_2$ goes up. When $SIR_2$ goes up, longevity happens."

## The culprit behind aging.

Studies have suggested that calorie restriction slows aging primarily because it decreases oxygen free radicals. Oxygen free radicals are byproducts of oxidation,

the body's process of turning oxygen into energy. Free radicals are thought to be toxic, causing damage to DNA and cells. Although antioxidants "clean up" free radicals, this process becomes more inefficient as we age. Many scientists speculate that free radical damage is the primary culprit behind age-related diseases and the symptoms of aging.

Contrary to these previous findings, Guarente says in the current paper that oxygen free radicals do not limit the reproductive life span of yeast and are not central to the extension of life span by calorie restriction.

The bottom line: Free radicals are an important part of our body's normal functioning and may even be good for us in certain doses. Worms that made extra free radicals lived longer than typical worms, but the effect was reversed when they were treated with antioxidants. Research does not support taking more antioxidants than we consume via diet. Nor, on the other hand, is increasing oxygen consumption going to cause a rise in free radicals that can do harm to the body.

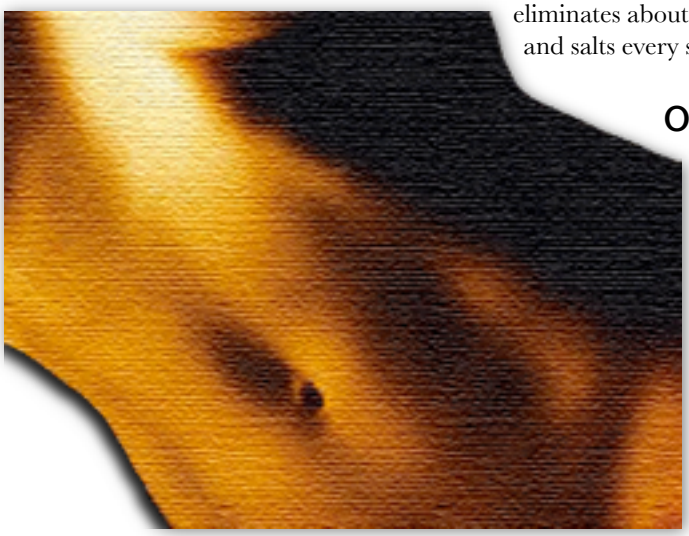
*Co-authors for the paper are Su-Ju Lin, Matt Kaeberlein, Pierre-Antoine Defossez of the MIT Department of Biology; biology graduate student Alex A. Andalis and MIT Professor of Biology Gerald Fink of the Whitehead Institute for Biomedical Research and Lori A. Sturtz and Valerie C. Culotta of the Johns Hopkins School of Public Health. This work is supported by the National Institutes of Health, the Ellison Medical Foundation, the Seaver Institute and the Howard and Linda Stern Fund. For more information: MIT News Office, (617) 258-9276.*

## The skin is our largest organ.

The skin is a wonder whose complexity is partially indicated by the facts that our skin covers an average of nineteen square feet and weighs about seven pounds. A cross section reveals three defined layers. The epidermis is the outermost layer known as the cuticle or protective layer and is made of tightly packed, scale-like cells that are continually being shed.

An entirely new cuticle layer of skin forms every twenty-eight days. (Though this is believed to slow down with age.) The next layer is the dermis. It is also called the 'true skin' because most of the vital functions of the skin are performed there. It contains the glands that secrete perspiration and sebum (oil), the papilla (hair manufacturing plant), nerve fibers, blood vessels, lymph glands and sense receptors.

The dermis has an elastic quality that is due to the protein connective tissues called elastin and collagen. These proteins give skin its strength as well as its flexibility. Below the dermis is the third layer called the subcutaneous layer. It is made of a fatter tissue that gives the skin its smoothness and contour and serves as a shock absorber for the vital organs. In addition, this layer stores energy and is an effective insulator.



Together, these three layers form the miraculous 'living fabric' known as skin. The skin serves to maintain our health and well being in an amazing variety of ways. In one square inch of skin there are about 65 hairs, 100 sebaceous (oil) glands, 78 yards of nerves, 20 yards of blood vessels, 650 sweat glands, twelve feet of nerves, 1,300 nerve endings, twenty sebaceous glands, six feet of blood vessels, 19,500 sensory cells at the ends of nerve fibers, 80 cold detection nerve endings and 165 pressure sensors.

Unbroken, the skin is our first line of defense against disease and bacterial invasion. It regulates body temperatures, sends neurological messages to the brain, detoxifies by excreting wastes from the body, respires (absorbs oxygen and releases carbon dioxide), absorbs nutrients, manufactures vitamin D and protects the body from ultra violet damage from the sun. Fundamental skin care recognizes that the skin is our largest vital organ and it requires care and attention to look its best and to maintain peak performance.

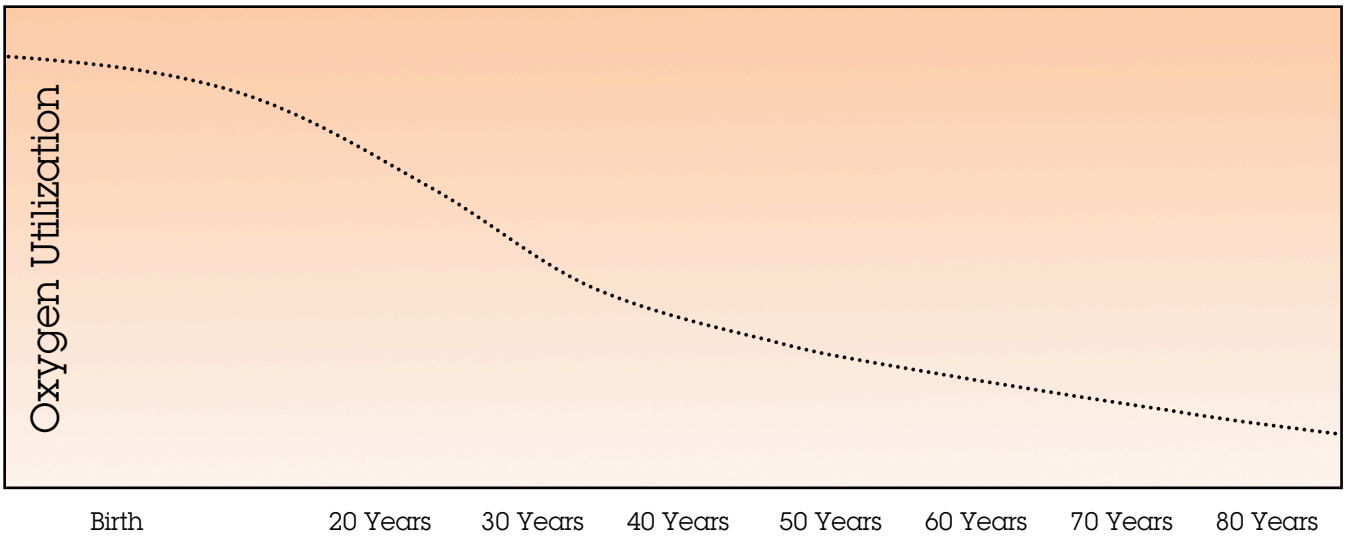
The skin takes in oxygen and expels carbon dioxide. In fact, the skin does up to 5 percent or more of all the "breathing" done by the body. The skin, as an important organ, also functions just like the kidney because the skin eliminates about two pints of water and salts every single day.

## Our skin needs an extra supply of oxygen to stay young and healthy.

The skin renews itself every four weeks and it is very responsive to what goes on the inside the body. Makeup can cover some signs of an unhealthy life-style, but ultimately the ravages of a poor diet and free radical damage will become apparent no matter how good the makeup job is. The truth is that the quality and health of our skin reflects the quality of the raw materials used to make up its cells.

Most skin-care products on the market today are "cosmetic cover-ups," which means they cover-up skin problems. Natural products that use essential healing extracts and vitamins can dramatically change the skin without covering-up anything. BIO2‘s natural oxygen-infused products work with the body to heal and protect the skin naturally.

In the cosmetics industry, many companies use harmful ingredients that can suffocate the skin by keeping oxygen out and trapping toxins in. The skin needs oxygen to breathe, and oxygen keeps our skin strong, healthy, and looking young. BIO2‘s natural skin care formulations use enzymes from fruits and plants along with essential skin nutrients and vitamins that work synergistically to promote dramatic results in the skin's




*The age at which wrinkles start to appear is largely determined by genetics, but has been proven that aging can be accelerated by overexposure to sunlight, pollutants, poor diet and low oxygen levels in the skin. Our skin tissue loses about 30% of its oxygen "capacity" by the age of 30 and close to 60% by age 40. As oxygen metabolism decreases, the cells cannot dispose of wastes, cannot fully utilize key molecules in the blood stream and free-radical damage increases dramatically. Skin needs oxygen to stay healthy. Oxygen assists in the production of collagen, elastin and other products necessary for healthy skin condition.*

appearance and health. Our natural products, infused with oxygen, can work to get to the root of the problem rather than covering up the problems.

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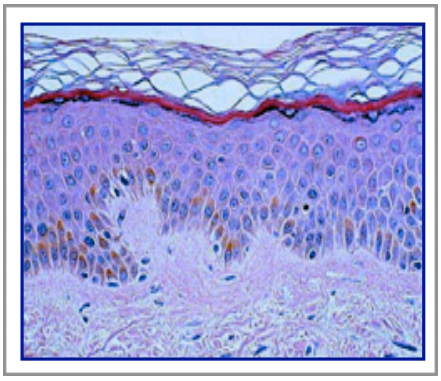
Skin normally renews itself every 28 days. However, if oxygen and nutrients are not available, the cell reproduction process is slowed down and the new skin cells are not as healthy. This results in premature aging, an increase in fine lines, wrinkles and a lack of healthy skin tone and texture. As we age, the circulation in our capillaries deteriorates and results in a lack of oxygen and other nutrients reaching our skin cells. This leads to dehydration of the skin. ASO® plays a significant role in replenishing vital oxygen to the skin cells, as well as playing a significant role in helping to heal burns and wounds

## What is "mature skin"?

Throughout the course of our lives, our skin will change. It will change from the soft and delicate characteristics of baby skin to childhood's smooth, velvety texture and resilience. During the



teenage years, the skin reacts to changes in our diets and hormones and continues to change through the twenties when our skin begins to finally mature. By our thirties, the skin begins drying and we notice signs of the first wrinkles. By forty, our skin is aging. As the skin ages, it characteristically becomes drier and loses its elasticity.

The skin's rejuvenating capacity (cell renewal) slows down as we get older and the oxygen and nutrient supply decreases because of a decrease in blood circulation. Protective oil (sebum) production decreases. These changes take place in the dermal layer of the skin. Just how fast and to what extent this dermal layer changes depends on three things: our age, our heredity (genetics) and lifestyle.

On the surface of the skin, as the cells work their way from the dermal layer outward, the cells become thicker and more dense and lose their ability to retain moisture. Lubrication (oil) decreases, which give mature, skin its dry appearance.

## Why the skin needs to be moisturized:

Moisturizing starts from within. Increasing the intake of pure and fresh water during the winter months helps replenish the skin's lost moisture. Eight to ten glasses of water daily give the skin an edge in its fight against dehydration.

Remember that the body consists of about 70 percent water with some skin cells containing over 90 percent water. When cells lose water, they diminish in size and flatten out. Chronic cell dehydration appears as lines, wrinkles and lackluster skin.

Good circulation and sufficient water lay the foundation for good-looking and youthful skin. Proper circulation permits a normal cellular exchange of nutrients

and wastes, so that the cells receive adequate nourishment and wastes are routinely eliminated. Without proper circulation, cell renewal and repair slow and toxins accumulate. BIO2's ASO® activated oxygen helps improve both oxygenation and the circulation of essential skin nutrients.

Dry skin has a low level of sebum and can be prone to sensitivity. Parched and dehydrated skin is unable to retain moisture. It usually feels "tight" and uncomfortable after washing unless some type of moisturizer or skin cream is applied. Chapping and cracking are signs of extremely dry, dehydrated skin.

Our skin is in constant need for oxygen, just like every other cell in our bodies. The skin needs oxygen to survive, reproduce, and regenerate healthy tissue.

## The cause of aging is oxygen deficiency.

When our skin does not get a sufficient amount of oxygen, it prematurely ages, loses firmness and elasticity and becomes pale in color.

Oxygen is also critical to healthy looking skin. Oxygen assists in the construction and manufacture of collagen and elastin, components that give the skin its supple and youthful appearance. In addition, recent research confirms that more than 60% of the oxygen the skin needs to cleanse and grow comes from the oxygen around us. And if the environmental air around is polluted or re-circulated, our skin will reflect this deficiency by losing its color, elasticity and smooth texture.

Dryness is exacerbated by wind, temperature and air-conditioning, all of which cause the skin to flake, chap and feel tight. Skin will look dull, especially on the cheeks and around the eyes. There may be tiny expression lines around the eyes and at the comers of the mouth. Again, topical applications of ASO® may help dramatically improve skin health by promoting blood flow and enhancing moisture retention.

## Why exfoliate?

Exfoliating, or sloughing off dead cells, also boosts circulation to the surface of the skin, imparting a rosy glow. A mild scrub is even more important in the winter, because dry and flaky skin cells tend to accumulate on the surface.

Removing dead cells improves the skin's ability to absorb moisturizing creams. Daily facial scrubs and the application of ASO® solution help unclog pores, combat bacteria and eliminate deeply embedded dirt and oil.

Ideal skin is skin is visibly clear of blemishes, has a smooth, soft texture, has: a firm yet resilient muscle tone; a moist surface that is neither too oily nor too dry: pores that are only slightly visible.

## How wounds heal:

Wound healing is a four step process that requires a consistent supply of oxygen. It has been shown in numerous clinical studies that typical wound partial pressures of oxygen are markedly reduced and may be the primary limiting factor in wound repair.

In order for a wound to heal properly, the affected area has to develop new tissue as quickly as possible. Progenitor cells from our bone marrow migrate into the wound and lay down collagen to being the process of forming new tissue. Oxygen is the key ingredient in promoting new capillary growth in the fibrous collagen matrix of new tissue. Wound healing is a dynamic process, and an adequate oxygen tension is mandatory for this first step in healing to proceed successfully.

Oxygen is also important to the healing process because oxygen destroys (kills) bacteria. Oxygen is lethal to strict anaerobic bacteria because these organisms are unable to detoxify oxygen radicals. Oxygen enhanced environments, including hyperbaric oxygen therapy or HBOT, have been clinically proven to be bactericidal for most pathogenic organisms.

In normal skin, the epidermis (outermost layer) and dermis (inner or deeper layer) exists in a steady-state equilibrium, forming a protective barrier against our external environment. However, once the protective barrier is broken, the physiological process of wound healing is immediately set in motion.

When the skin is wounded by a tear, cut or burn, complex biochemical events take place in a very specific sequence to repair the damage. Within minutes of an injury, blood platelets (thrombocytes) gather at the injury site to form a clot to control and hopefully stop the loss of blood and plasma. This is the hemostasis phase.

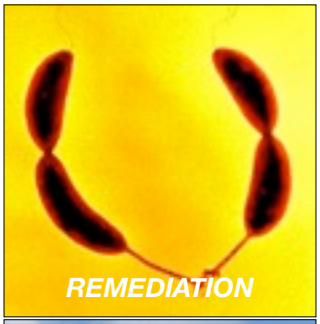
In the inflammatory phase, bacteria and debris are "phagocytosed", (killed by our warrior white blood cells, called "phagocytes", using "oxygen" as a weapon,) Bacteria and debris are then removed. The body then releases factors that influence the migration and division of cells involved in the third proliferative phase.

The proliferative phase is characterized by angiogenesis, the depositing of collagen, granulation tissue formation, epithelialization, and wound contraction. In angiogenesis, new blood vessels are formed by vascular endothelial cells. Fibroblasts begin to migrate, divide, and produce collagen which is an essential matrix for wound healing.

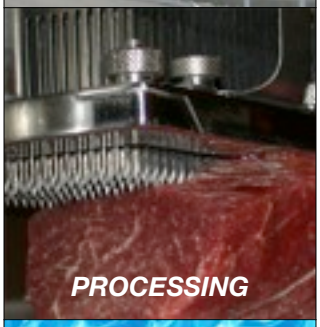
In order to promote fibroblast proliferation and the production of collagen, oxygen must be present in sufficient quantities. The wound is made smaller as myofibroblast cells grip on the wound edges and contract themselves using a mechanism similar to that in smooth muscle cells.

In the maturation and remodeling phase, collagen is remodeled and realigned along tension lines and cells that are no longer needed are removed. Oxygen is required in increased amounts during the repair process to provide all the energy for protein synthesis.

This entire process is not only complex but very fragile. Factors that contribute to the failure of a wound to heal are influenced by diseases like diabetes, cardiovascular issues, old age, and infection. But without a consistent supply of oxygen, wounds cannot heal properly.











# Industrial & Commercial Uses

## ASO® is versatile in its applications.

ASO® is a natural, oxygen-rich, biocidal and purification agent for the water, industrial, food processing,and agricultural-related Industries.

Broad-Spectrum and Biocidal Antimicrobial Disinfectant Dip, Spray & Wash

Anti-fungal • Anti-viral • Anti-bacterial • Completely Natural & Non-Toxic • Bio/Eco-Friendly

## Introduction

As simple as it may seem, the treatment of contamination is diverse and complicated. In today's environment, where merely transferring contaminants from one medium to another, is no longer acceptable, it is no surprise that a powerful oxidizer that looks like water -- in its appearance, chemical formula and reaction products -- should be so widely used. This is ASO® Activated Oxygen: a powerful yet versatile oxidant that is both safe and effective.

"Oxidation" literally, means "converting to an oxide". This process applies to metals (iron converts to iron oxide), nonmetals (sulfur converts to sulfur oxide), and organic matter (mainly carbon and hydrogen converts to carbon oxide and hydrogen oxide). The most powerful of all oxidizing agents is the element "oxygen".

Substances that have the ability to oxidize other substances are said to be oxidative and are known as oxidizing agents, oxidants, or oxidizers. Put another way, the oxidant removes electrons from another substance, and is thus itself reduced. And, because it "accepts" electrons, it is also called an electron acceptor.

## ASO® Advantages

Powerful: ASO® is one of the most powerful, natural and safe oxidizers known. It is stronger in its oxidizing power than chlorine, chlorine dioxide, and potassium permanganate.

| Oxidant | Oxidation Potential, V |
|---|---|
| Fluorine | 3.0 |
| Hydroxyl radical | 2.8 |
| Ozone | 2.1 |
| Hydrogen Peroxide | 1.8 |
| ASO® | 1.8 |
| Potassium Permanganate | 1.7 |
| Chlorine Dioxide | 1.5 |
| Chlorine | 1.4 |

## Safe

Despite its oxidizing power, ASO® is completely non-toxic to animals and humans. Consequently, ASO® has none of the problems associated with the gaseous releases or chemical residues that are associated with other volatile and carcinogenic chemical oxidants. And since ASO® is totally miscible with water, the issue of safety is totally non-existent. Industrial strength ASO® is a strong oxidizer yet requires no special handling precautions and no specialized storage or handling equipment. ASO® has undergone extensive toxicity testing and has been found to be completely non-toxic. Complete toxicity studies are available upon written request.

## Versatile

The fact that ASO® is used for diverse applications proves its versatility. For example, it can inhibit microbial growth (as in the biofouling of water circuits) and encourage microbial growth (as in the bioremediation of contaminated ground waters and soils). Similarly, it can treat both easy-to-oxidize pollutants (iron and sulfides) and difficult to oxidize pollutants (solvents, gasolines and pesticides).

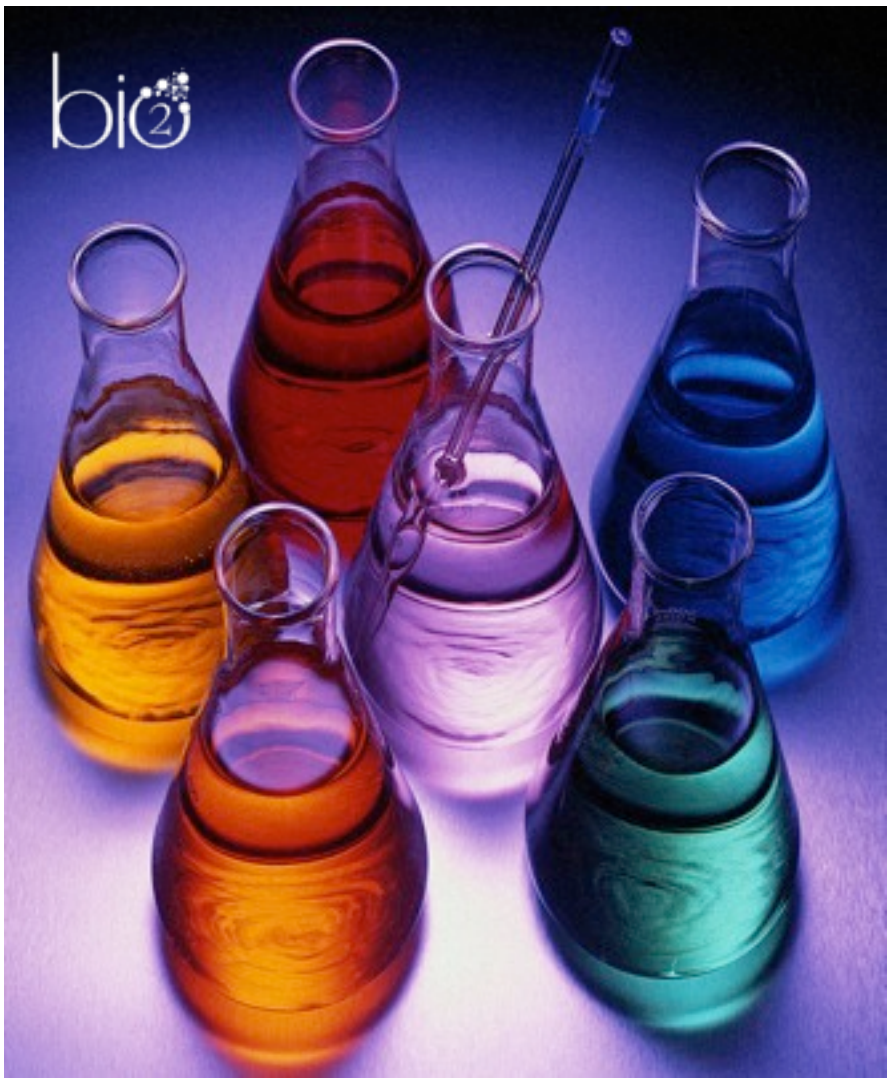
## Selective

The reason why ASO® can be used for such diverse applications is the different ways in which its oxidizing potential may be directed. This is described as "termed selectivity". By simply adjusting the conditions of the reaction (e.g., pH, temperature, dose, reaction time, and/or catalyst addition), ASO® can often be made to oxidize one pollutant over another, or even to favor different oxidation products from the same pollutant.

## Diverse Uses

Since it was first commercially used in 1991, ASO® 's has now been utilized in dozens of different consumer, industrial and agricultural industries. In addition to pollution control, ASO® may be used to bleach textiles and paper products, and to assist in the manufacturing or processing of foods, petrochemicals, minerals and consumer products (detergents). Its use for waste water or water contamination and purification pollution

control may someday rival the use of chlorine dioxide or even hydrogen peroxide without any of their respective detrimental or instability side-effects. Today, ASO® is readily available




throughout the world in drum concentrations of up to 35% free oxygen by volume.

## End Use Industries

- Landfills
- Food processing
- Oil refining
- Electronics
- Mining / metallurgy
- Pulp and paper
- Machining
- Timber products
- Textiles
- Hazardous wastes
- Power production
- Site remediation
- Animal health enhancement
- Composting
- Municipal or agricultural wastewater
- Potable water

## Environmental Applications of ASO®

ASO® applications span the range of possible media: air, water, wastewater, soils and sludges. Depending on the objective, ASO® may be used either alone or in combination with other processes to enhance their performance.

## Stand-Alone Applications

**Odor control:** ASO® oxidizes hydrogen sulfide, mercaptans, amines and aldehydes. ASO® may be applied directly to aqueous wastes containing these odorants, or may be applied directly to wet scrubbers used to remove contaminants from the air. If the odors are the result of biological activity, ASO® may be used as a preventative to eliminate the anoxic conditions which favor the generation of odors.

## PRODUCT DESCRIPTION

Activated Oxygen (ASO®) is a broad spectrum antimicrobial solution created from water and sodium chloride in a proprietary manufacturing process.

## Applications

Activated Oxygen is an extremely potent and effective broad spectrum bactericide, fungicide, anti-viral, anti-yeast and anti-parasitic solution. Activated Oxygen has been shown to increase the blood oxygen saturation levels in human subjects when taken sublingually or consumed orally. Initial studies also indicate that when taken, Activated Oxygen may also lower blood pressure. Activated Oxygen is environmentally safe with no known toxicity to man or animals.

## Mode of Activity

Studies indicate that the antimicrobial activity of ASO® Activated Oxygen is in the cytoplasmic membrane. The oxidizing potential ($O_2$ and $O_4$ oxygen molecules) of Activated Oxygen appears to prevent the uptake of amino acids while disorganizing the cytoplasmic membranes causing a leakage of low molecular weight cellular contents and rendering the microbes harmless.

## Biodegradable

Activated Oxygen is considered biodegradable according to the "Standard Test Methods for Determining the Anaerobic Biodegradation Potential of Organic Chemicals". ASTM Standards, Section 11, Water and Environmental Technology, Procedure E 1196-2, pp. 879-901, 1993.

## Corrosion Control

ASO® destroys residual chlorine and reduced sulfur compounds thiosulfates, sulfites, and sulfides) which form corrosive acids when condensed onto

processing equipment and oxidized by air.

## BOD/COD Removal

ASO® oxidizes both organic and inorganic pollutants which contribute to BOD and COD.ASO™ may also affect BOD/COD removal by enhancing the performance of other processes (see below).

## Inorganic Oxidation

ASO® oxidizes cyanides, $NO_2/SO_2$, nitrites, hydrazine, carbonyl sulfide, and other reduced sulfur compounds mentioned above (odor/corrosion control).

## Organic Oxidation

ASO® hydrolyzes formaldehyde, carbon disulfide, carbohydrates, organophosphorus and nitrogen compounds, and various water-soluble polymers; and (with catalysis) destroys phenols, BTEX pesticides, solvents, plasticizers, chelants, and virtually any other organic requiring treatment.

## Metals Oxidation

ASO® oxidizes ferrous iron, manganese, arsenic, and selenium to improve their adsorption, filtration, or precipitation from process waters and waste waters.

## Toxicity Reduction/ Biodegradability improvement

ASO® may also help chemically digest complex organics into smaller, less toxic and more biodegradable fragments.

## Disinfection/Bio-Control

ASO® may help check excess biogrowth in water supplies and cooling circuits, and (with catalysis) disinfect process waters and biological effluents.

## Flocculation Precipitation

ASO® may help oxidize metal complexes and improve the performance of inorganic flocculants.

## Air Flotation

ASO® may help release evenly dispersed micro-bubbles which entrain emulsified fats, oils and greases to enhance their removal in air flotation units and grease traps.

## Bio-Treatnent (as a pre-treatment)

ASO® degrades toxic, refractory or bio-inhibitory organic materials, rendering them more amenable to biodegradation. In con junction with - provides a supplemental source of dissolved oxygen in-situ (penetrating both soil columns and bioflocs, eliminating the sludge bulking phenomenon). As a polishing step - ASO® destroys trace levels of organics that pass through biotreatment, providing the ancillary benefit of disinfection.

## Filtration

ASO® may help control biofouling of UF and RO membranes while eliminating foul odors from media filters.

## Carbon Adsorption

ASO® may enhance the adsorption of many pollutants while providing dissolved oxygen to support biologically-active carbon beds (improving removal efficiencies still further).

## Air Scrubbers

ASO® may replace chlorine for deodorizing off-gases and controlling VOC's. Depending on the target pollutant(s), catalytic or Advanced Oxidation Processes may be required.

## Wells and Water Supplies

Most ASO® applications involve its simple injection into the water stream with no requirement for additional chemicals or equipment. These include the control of biogrowth (slime), the supply of supplemental oxygen, the removal of FOG and chlorine residuals, and the oxidation of sulfides/sulfites, metals, and other easy-to-oxidize components of BOD/COD.

## Catalytic ASO®

The more difficult-to-oxidize pollutants may require ASO® to be super-activated with catalysts such as iron, copper, manganese, or other transition metal compounds. These catalysts may also be used to speed up ASO® reactions that may otherwise take hours or days to complete. ASO® catalysis may occur either in solution (using soluble catalysts) or in packed columns (using solid catalysts).

## Solution Catalysis

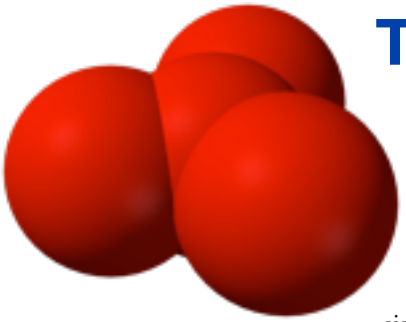
The most commonly used solution catalyst is iron. The reaction requires a slightly acidic pH and results in the formation of highly reactive hydroxyl radicals (OH) which are capable of degrading most organic pollutants. Another solution catalyst is copper, which is often used to destroy cyanides. Other metals also show catalytic activity with, ASO® and may be used to selectively destroy specific pollutants.

## Packed Column Catalysis

Solid catalysts eliminate the need to add soluble metals to the waste stream, and may offer greater flexibility in terms of reaction rates, selectivity, and the need for pH adjustment.

## Advanced Oxidation Processes (AOP's)

AOP's represent the newest development in ASO® technology applications, and are loosely defined as processes that generate highly reactive oxygen radicals without the addition of metal catalysts. Typically, this means combining ASO® with additional ozone and/or ultraviolet light. The result is the on-site total destruction of refractory organics without the generation of sludges or residues. This technology could be applied to treat contaminated ground waters, to purify and disinfect drinking waters and process waters, and to destroy trace organics in industrial effluents.



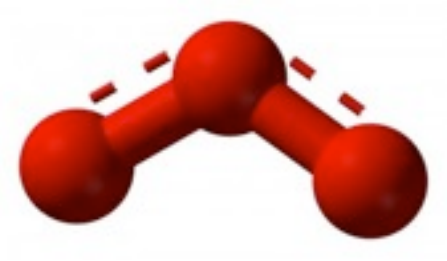
# The ASO® Oxygen molecule

## Polyatomic Tetraoxygen ($O_4$)

We know that water is made of hydrogen and oxygen atoms arranged in molecules of $H_2O$. But many may not be aware that there are different types of oxygen atoms. Different atoms of the same element are called isotopes. All oxygen atoms have 16 protons and 16 electrons, but some oxygen isotope atoms have 16, 17, or 18 neutrons in the nucleus.

The most abundant isotopes of oxygen in water are oxygen sixteen ($^{16}O$) and oxygen eighteen ($^{18}O$). Water molecules with $^{16}O$ atoms evaporate more easily than water molecules with $^{18}O$ atoms, so the relative numbers of $^{16}O$ and $^{18}O$ atoms that remain in the water change as evaporation occurs.

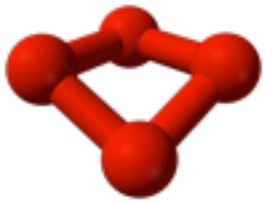
The oxygen atom exists in nature in four basic forms: (1) free atomic particle ($O_1$), also called "singlet oxygen", is highly reactive and unstable; (2) diatomic oxygen ($O_2$), is the most common and stable form, is colorless as a gas and pale blue as a liquid; (3) ozone ($O_3$) *(see molecule at right)*, contains a large excess of energy in its molecular form, is distinctly blue as a gas and dark blue as a solid; (4) $O_4$, *(pictured above and below,)* is typically an unstable, rare, nonmagnetic pale blue gas, that readily breaks down into two molecules ($O_2$) of oxygen. This is the molecule believed to be the active component in ASO®.



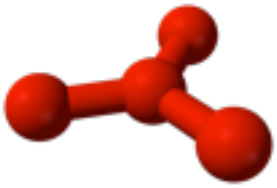
The polyatomic tetraoxygen molecule ($O_4$), also called oxozone, was first predicted in 1924 by Dr. Gilbert N. Lewis, Ph.D. who proposed $O_4$ to explain the failure of liquid oxygen to obey Curie's Law. Research conducted during the last 10 years reveals that Lewis was off, but not by much. Computer simulations indicate that $O_2$ molecules may actually occur in pairs, with antiparallel spins, forming $O_4$ units.

In 1999, researchers thought that solid oxygen existed in its ε-phase (at pressures above 10 GPa) as $O_4$. However, in 2006, it was shown by X-ray crystallography that this stable phase known as ε oxygen or red oxygen is in fact $O_8$. Nevertheless, polyatomic tetraoxygen has been detected as a chemical species in mass spectrometry experiments, including two independent studies conducted for BIO2 in 1999 and 2000. In 2008, further experimentation resulted in a fourth theoretical model of $O_4$ (above left).

Mass spectrometry analysis conducted by Dr. James D. Aker, using specialized quantitative software analyzed by Dr. Cioslowski at Florida State University, indicates the presence of what is believed to be $O_4$ in sufficient quantities to indicate stable levels of more than 240,000 ppm of this unique molecule. The existence of $O_4$ was further confirmed in research by Bevsek, Ahmed, Peterka, Sailes and Suits in their study published in Faraday Discuss. 1997 (108, 131-138). Further research, conducted by various scientists and reported by the NIST, have also concluded its existence. Dr. Contenetti et. al have also investigated the $O_4$ molecule and reported its properties and existence. Thus, the premise that one of the active species in ASO® could be $O_4$, is not implausible and explains part of the electrochemical makeup of ASO®. The size (mass) of the $O_4$ molecule is twice that of $O_2$ and it is believed that this increase in mass, as well as the electron spins, and electron sharing, that help explain the stability of $O_4$ in ASO®.



Structural data from Hernández-Lamoneda, R.; A. Ramírez-Solís (September 2000). "Reactivity and electronic states of $O_4$ along minimum energy paths". Journal of Chemical Physics 113 (10): 4139–4145. DOI:10.1063/1.1288370.



A second theoretical ball-and-stick model of a proposed D2d structure for the tetraoxygen molecule, $O_4$.

In 2001, a team at the University of Rome La Sapienza conducted a neutralization-reionization mass spectrometry experiment to investigate the structure of free $O_4$ molecules. Their results did not agree with either of the two earlier proposed molecular structures, but they did agree with a complex between two $O_2$ molecules, one in the ground state and the other in a specific excited state.

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12. Note: in the mid 1990s, Alliance Pharmaceutical Corporation applied to the FDA for official approval to use its patented gas ventilation system (LiquiVent®) employing perflurochemical liquids which it calls "partial liquid ventilation". The approval is still pending.


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## ASO® TECHNICAL SPECIFICATIONS

**Since 1990, ASO® has been independently tested at universities and at highly regarded laboratories throughout the world.**

**No other activated oxygen supplement has undergone as much scrutiny and validation. This research has established that ASO® is completely non-toxic and safe to use as a dietary supplement*.**

***This statement has not been evaluated by the F.D.A.**

| DESCRIPTION | DETAILS |
|---|---|
| CAS Number | 7732-18-5 |
| Specific Gravity | 1.016 23° C |
| Density | 1.016 g/cm$^3$ |
| pH | 7.1 |
| Boiling Point | 100° C |
| Vapor Density (Air = 1) | 17.5 |
| Solubility in Water | Complete |
| Color | Clear |
| Odor | Slightly Saline |
| Chlorine/Chlorate/Peroxide | NONE |
| Recommended Serving Size | 1 mL |
| Main Ingredients Per Serving (mg/L): | |
| Distilled Water | 1 mL |
| Dissolved Polyatomic Tetraoxygen ($O_4$) | 140 mg |
| Sodium Chloride & Trace Minerals | 29.6 mg |
| | |
| Calories | 0 |
| Protein | 0 |
| Fat | 0 |
| Carbohydrates | 0 |
| Schedule B | 2106906573 |
| MSDS Number | ASO®35 |
| ITC (HS) Classification | 220110 |
| Commodity | 42000 |
| Commodity Item Number | 196500 |
| Rating | Sub 4 Class 60 |
| Storage (Recommended) | 5° C to 130° C |
| Country of Origin | U.S.A. |
| Toxicity (Carcinogicity, Hazard, Respiratory, Internal) | NONE |
| Drum Dimensions (55 U.S. Gallons) | 24" D x 35" H |
| Drum Type | HDPE |
| Weight Full | 550 lbs (249 kg) |
| Cube | 33 cm/11.667 cf |
| Density | 755 kg/cm |
| Drums per 20/Container | 27 |
| Weight of Drums per 20' Container | 14,850 lbs/6,736 kg |
| Shelf Life | 3 years |

What is a dietary supplement?
Congress defined the term "dietary supplement" in the Dietary Supplement Health and Education Act (DSHEA) of 1994. A dietary supplement is a product taken by mouth that contains a "dietary ingredient" intended to supplement the diet. The "dietary ingredients" in these products may include: vitamins, minerals, herbs or other botanicals, amino acids, and substances such as enzymes, organ tissues, glandulars, and metabolites. Dietary supplements can also be extracts or concentrates, and may be found in many forms such as tablets, capsules, softgels, gel caps, liquids, or powders. They can also be in other forms, such as a bar, but if they are, information on their label must not represent the product as a conventional food or a sole item of a meal or diet. Whatever their form may be, DSHEA places dietary supplements in a special category under the general umbrella of "foods," not drugs, and requires that every supplement be labeled a dietary supplement.

What is a "new dietary ingredient" in a dietary supplement?
The Dietary Supplement Health and Education Act (DSHEA) of 1994 defined both of the terms "dietary ingredient" and "new dietary ingredient" as components of dietary supplements. In order for an ingredient of a dietary supplement to be a "dietary ingredient," it must be one or any combination of the following substances: a vitamin, a mineral, an herb or other botanical, an amino acid, a dietary substance for use by man to supplement the diet by increasing the total dietary intake (e.g., enzymes or tissues from organs or glands), or a concentrate, metabolite, constituent or extract.

A "new dietary ingredient" is one that meets the above definition for a "dietary ingredient" and was not sold in the U.S. in a dietary supplement before October 15, 1994.

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