


TAKE A DEEP

Lung function



THE MAIN FUNCTION of the lungs is to exchange oxygen for carbon dioxide. Lungs take oxygen from the surrounding air and transfer it to red blood cells that deliver it to all body tissues and organs. As tissues produce energy they create a waste product, carbon dioxide, which is delivered by the blood stream to the lungs and exhaled to the atmosphere. The lungs normally function automatically and self-regulate to allow us to accomplish everything we do in a day.

Two lungs are located in our chest cavity, which acts like a bellows. When the diaphragm pulls down and the chest wall extends outwards, the chest cavity expands, pulling air through the nose and mouth towards the trachea (windpipe). The trachea branches into two main divisions or bronchi on the left and right sides. Branching from the bronchi are smaller airways called bronchioles that have tiny air sacs called alveoli at their ends. This is where the actual exchange of carbon dioxide and oxygen takes place.

This exchange of gases is called ventilation. Blood is the transport vehicle that carries oxygen from the alveoli to all of our cells, and carts off the constant production of carbon dioxide. Exercise increases demand for oxygen delivery and carbon dioxide removal, causing more air to circulate into and out of

BREATH

explained

by **Dr. Abraham Born**

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the lungs. Our body depends on the lungs, the diaphragm, several muscle groups, and a sensitive chemical regulatory system to control how much ventilation the lungs require at any given time.

Breathing

Normally, we require about 12 breaths every minute while at rest, inhaling about 0.75 liters of air into the lungs each time. This provides a ventilatory volume of nine litres per minute. At maximum exertion, a healthy young man may have a ventilatory volume of 180 litres per minute. The body has two mechanisms to increase the ventilatory volume: breathing deeper, i.e. taking in more air with each breath, or breathing faster. Exercise studies have indicated that the body spontaneously balances the volume of ventilation and the frequency of breathing so that lung function is efficient.

Normal breathing at rest involves primarily the diaphragms. These large muscles below the lungs smoothly contract and expand causing slight upper abdominal movements. However, when we need to move a lot of air in and out of the lungs, we contract muscles between the ribs and attached to the rib cage, expanding the thorax

and allowing more air to enter and leave the lungs. Breathing out is basically a relaxation of the respiratory muscles while we are at rest and this diminishes the size of the lungs. Expiration is more demanding during exercise when we need to ensure more rapid and complete exhalation of the carbon dioxide loaded air.

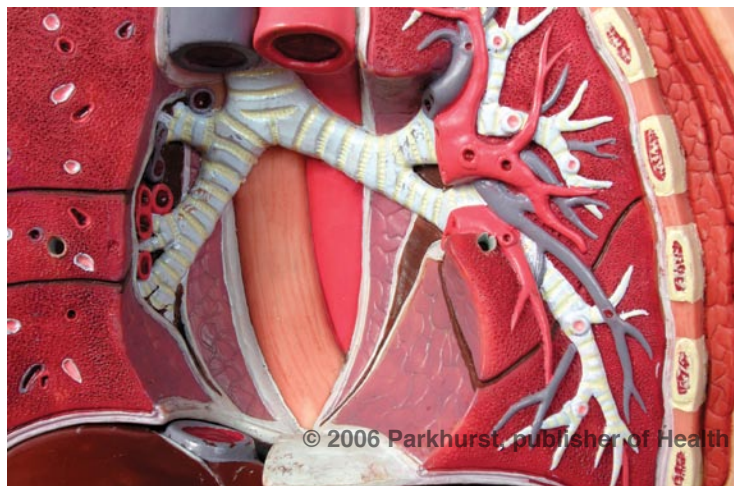
Out of breath

Alternating between normal activity, work, exercise, and extreme exertion requires the synchronized interaction of three systems — the lungs, heart and circulation — to make sure muscles are receiving enough oxygen to do what we expect of them.

Sometimes when we exercise, the sensation of breathlessness or chest tightness makes us want to stop so that we can “catch our breath.” The difference between the casual exerciser and the highly trained athlete, however, isn’t in

the maximum amount of air they can breathe in and out, but the efficiency in extracting oxygen to deliver to tissues. An untrained exerciser may use between 60 and 80% of their maximum ventilation volume, while an athlete may function above the 90% level. In general, healthy lungs have the ability to meet most exercise demands.

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Cross-section illustration of the lung, with the two bronchi coming down and branching out into the bronchioles and alveoli.

Making the most of your lungs

The lungs develop steadily throughout childhood, with peak function being reached between 20 and 25 years of age. Lung function then remains stable for about 10 years before starting to decline very slowly with age at a rate of about 1% a year. There's enough lung function reserve so that normal function isn't impaired for many years.

However, all people are exposed to acute viral or bacterial lung infections periodically and the baseline (your normal) lung function affects the severity of symptoms. Smokers or people with medical conditions such as asthma or emphysema may have worse symptoms that last longer than for other people. Most lung infections heal on their own and lung function is completely restored. However, patients who smoke or have chronic obstructive pulmonary disease (COPD) may have further deterioration after they recover from the acute infection.

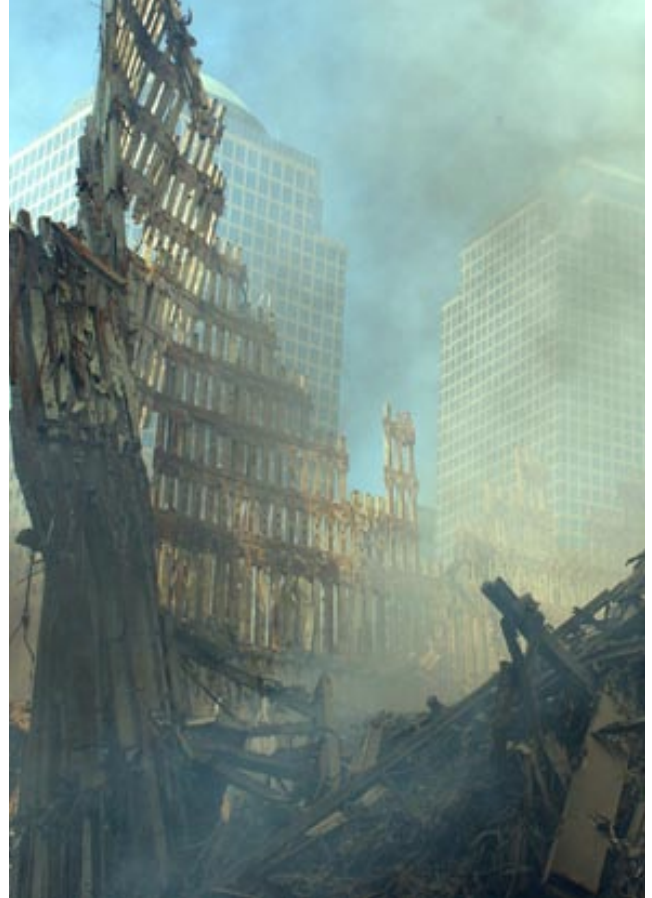
How we breathe and how we feel

There are intimate connections between our psychological state and breathing. A recent study of older American men with COPD found that hostility and depression were associated with poorer lung function and more rapid decline in lung function.

Many people who suffer anxiety notice a change in breathing patterns during anxiety episodes. Shallow rapid breathing disrupts the balance of oxygen and carbon dioxide necessary for a relaxed state. This type of breathing worsens anxiety symptoms. Diaphragmatic breathing (stomach breathing) can help to improve anxiety and, when practiced regularly through the day, can help to modify the anxiety state in a beneficial manner.

Our environment

While it's a complex area to study conclusively, research does show that environmental pollution,



especially carbon rich air from heavy automobile traffic, coal-burning home heating, and open cooking fires used in many parts of the developing world impairs lung function. One recent study of English schoolchildren found a strong association between inhaled carbon particles (measured from the child's neighbourhood) and impairment of laboratory measured lung function.

Single massive exposure to smoke, ash, fine sand particles and toxic dust can cause significant damage to the airways and lung tissue. Epidemiologic follow-up studies of firefighters and rescue workers sent to the 9-11 World Trade Center disaster in New York City have demonstrated significant reduction in forced expiratory volume compared to firefighters and rescue workers not directly involved with that tragedy.

Those with more severe and frequent respiratory symptoms (such as chest pain, cough, wheezing and dizziness on exertion) exhibited greater declines in lung function over time. Some of these heroes have unfortunately developed pulmonary fibrosis, emphysema, and bronchiectasis.

Smoking

Smoking brings irritants and carbon particles directly into the airways and lungs. The lungs are a very effective way to distribute nicotine through the bloodstream. Lung function decreases somewhat with age, but does so much faster among smokers than non-

BE NICE TO YOUR LUNGS

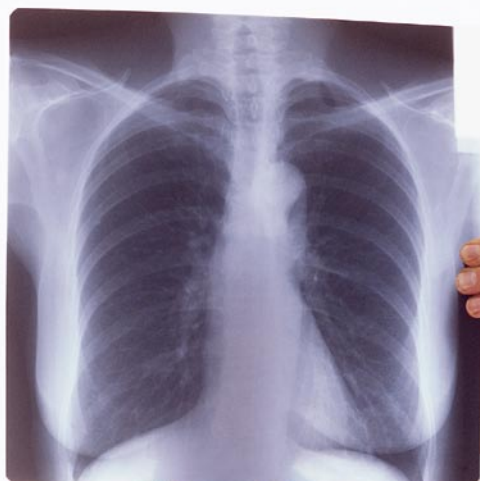
- don't smoke
- avoid air pollution and exposure to toxins at work
- exercise regularly to prevent lung function decline
- treat asthma or COPD optimally so you can function at your best
- get an influenza vaccine each autumn if you have lung disease
- avoid exposure to germs
- wash hands meticulously when appropriate



smokers. Some smokers develop chronic bronchitis when their airways are inflamed, narrowed, and loaded with mucous that causes them to cough. Emphysema develops in other smokers and is characterized by loss of lung tissue and destruction of structures supporting the alveoli. COPD occurs when the smaller airways collapse during expiration so that airflow is limited and air is generally trapped in the lungs. The most prominent symptom of COPD is shortness of breath with exertion such as climbing stairs.

Because some damage may be partially reversible, studies have shown that quitting smoking benefits lung function. Asthmatic patients can improve their performance on lung function tests and see symptoms improve rapidly after smoking cessation because of the decreased airway inflammation. The Lung Health Study demonstrated that people with mild to moderate COPD who stop smoking have initial improvement in lung function in the first year after quitting and thereafter experience a level of lung function decline due to aging comparable to non-smokers.

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Breathe easy

Our lungs perform vital and life-sustaining work 24 hours per day. Avoidance of smoking, air pollution and occupational lung toxins prolongs normal lung health and allows this complex mechanism to stay in the background, except that is, when we want to fill up our lungs to belt out a song. 🎵

TESTING LUNG FUNCTION

Spirometer

The spirometer measures lung function. You breathe with maximum effort or quietly through a tube attached to a machine that calculates the volume of air and the rates at which the air can be inhaled and exhaled. This machine produces many readings of which the most reliable is the FEV1 (forced expiratory volume in 1 second) that's expressed as a percent of "predicted normal" based upon body weight and height, age, and gender. Test variations include performing exercise before and after the spirometry, or inhaling a bronchodilator medication to establish the diagnosis of asthma.



Gas diffusion

This test determines how well oxygen and other gases pass from the lung's air sacs and become absorbed by blood.

Arterial blood gases

Oximetry is used to measure the exact amount of oxygen and carbon dioxide in the blood at a given time and also measure the pH or acidity of arterial blood. Oximetry can measure the instant arterial oxygen saturations while at rest or during activity such as walking. A standard "6 minute walking oximetry test" can measure the oxygen saturation response for normal people and for people with lung disease, as well as the distance walked during the standard 6 minute time period.