

a passive role in breathing. There is a slight vacuum in my compartment—so when Joe's chest expands, I expand. When Joe exhales, I collapse. It is simply a recoil mechanism. Let Joe puncture his chest wall in an accident and my vacuum is broken. I'll hang loosely, doing no work, until healing takes place and the vacuum is re-established.

Take a closer look at my architecture. Joe's four-inch-long windpipe divides at its lower end into two main bronchial tubes—one for me, one for my partner. Then branching begins in me—like an upside-down tree. First the larger bronchi, then the bronchioles. At 100 of an inch in diameter. These are simply air passages. My real work is done in my alveoli—grape-like bunches of minute air sacs. I have some 250 million of these sacs. Flattened out, their tissue would probably cover half a tennis court.

Each alveolus is covered with a cobweb of capillaries. Blood is pumped by the heart into one end of a capillary. Red cells pass through single-file—passage taking about a second—and a remarkable thing takes place. Through the gossamer membrane of the capillary wall, the cells diffuse their cargo of carbon dioxide into my alveoli. At the same time, the cells pick up oxygen going the other way. It's a kind of gaseous swap shop—blue blood flowing in

THIS ARTICLE is based largely on interviews with Drs. Alton Ochsner and Hurst B. Hatch, of the world-famed Ochsner Clinic in New Orleans, La.

one end of the capillary, emerging refreshed and cherry-red at the other.

Joe's more important body organs—notably the heart—are under automatic control. Most of the time this is true of me, too, though I am under voluntary control as well. As a child, Joe had temper tantrums and would sometimes hold his breath until he turned a faint blue. His mother worried—unnecessarily. Long before he got into any real trouble, automatic respiration would take over. He would start breathing whether he wanted to or not.

My automatic breathing control is in the medulla oblongata—the bulge where the spinal cord tapers into the brain. It's an amazingly sensitive chemical detector. Laboring muscles burn oxygen rapidly and pour out waste carbon dioxide. As it accumulates, the blood becomes slightly acid. The respiratory control center detects this instantly—and orders me to work faster. Let the levels rise high enough—as when Joe does heavy exercise—and it orders *deeper* breathing as well—one's "second wind."

Lying quietly in bed, Joe needs about eight quarts of air a minute. Sitting up requires 16; walking, 24; running, 50. Since Joe is a desk worker, he has no large oxygen demands. Normally, he breathes about 16 times a minute—a pint of air each time. (This only partially inflates me. I can hold eight times as much.) Even so, not all of that one-pint breath reaches me; one third of it shuffles aimlessly in and out of the

windpipe and other air passages.

I like my air just about as moist and warm as that in a tropical swamp. Producing this very special air in the space of a few inches is quite a trick. The same tear glands that bathe Joe's eyes, plus other moisture-secreting glands in his nose and throat, produce as much as a pint of fluid a day to humidify my air. Surface blood vessels along the same route—wide open on cold days, closed on warm days—take care of the heating job.

There is an almost endless list of things that can cause me trouble. Each day, Joe breathes in a variety of bacteria and viruses. Lysozyme in the nose and throat, a powerful microbe slayer, destroys most of these. And those that slip into my dark, warm, moist passages—a microbial happy hunting ground—I can usually handle. Phagocytes patrol my passages and simply wrap themselves around invaders and eat them.

Dirty air, of course, is my biggest challenge. Other organs lead sheltered, protected lives, but for all practical purposes I am *outside* Joe's body—exposed to environmental hazards and contaminants. I am really quite delicate, and it's a wonder I am able to survive at all, having to deal with such things as sulfur dioxide, benzopyrene, lead, nitrogen dioxide. Since some of them actually melt nylon stockings, you can guess what they do to me.

My air-cleaning process—such as it is—begins with hairs in the nose, which trap large dust particles.

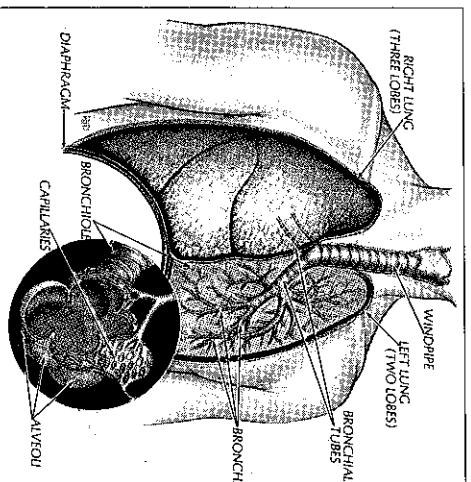
Sticky mucus in nose, throat and bronchial passages acts as flypaper to trap finer particles. But the real cleaning job falls to the cilia. These are microscopic hairs—tens of millions of them—along my air passages. They wave back and forth, like wheat in the wind, about 12 times a second. Their upward thrust sweeps mucus from lower passages to the throat, where it can be swallowed.

If Joe could watch my cilia under a microscope, he'd see that if cigarette smoke or badly contaminated air is blown on them, the wind-in-the-wheatfield action stops. A temporary paralysis sets in. Let this irritation continue long enough, and the cilia wither and die, never to be replaced.

After 30 years of smoking, Joe has lost most of his cilia, and mucus-secreting membranes in his air passages have thickened to three times normal size. Joe doesn't know it, but he is in actual danger of drowning. If enough mucus drops down into my air sacs, it halts breathing just as effectively as a lungful of water. One thing saves Joe from this: his noisy, inefficient smoker's cough, which has replaced the quiet efficiency of the cilia. Joe might remember that it's the only cleaning method left to me—and be cautious about taking cough-suppressing drugs.

A large part of the time, Joe is asking me to breathe real garbage. Some of the particles clog my smaller passages, and some actually scar my tissues. The fragile walls of my

An inside glimpse of a vital and delicate organ—which deserves a lot better care than it generally gets



## I Am Joe's Lung

By J. D. RARCULFF

Any general body exercise—climbing stairs, walking, jogging, sports—forces me to breathe more deeply, which is all to the good. And there are exercises for me alone. Ordinarily, the best breathing is deep breathing—more air at a slower pace. Joe could practice abdominal breathing, the way babies and opera singers do it: not by inflating the manly chest, but by dropping the diaphragm down. Then air is sucked into even my deepest alveoli.

Joe could also give me a house-cleaning a few times each day. He thinks that with a normal exhalation I'm empty. By no means. Let him blow out all the air he can via his mouth. Then if he will purse his lips, he can do quite a lot more blowing. If he does this while smoking, he will see something that should give him pause: smoke trailing out through his pursed lips that would normally be left in me to stagnate.

It all adds up to this: Most of my neighbor organs can absorb an enormous amount of abuse without complaint. I can't. Nature hasn't equipped me with all the defenses I really need in today's world. That's why a variety of lung diseases have reached epidemic proportions.

Boss Joe, take heed!

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alveoli lose elasticity. They don't collapse the way they should when I exhale. (Thus it is possible to breathe *in* but not *out*.) Carbon dioxide is trapped in them, and they can no longer contribute oxygen to the blood or extract waste carbon dioxide. The result is emphysema—a fearsome trial in which each breath represents a fight for survival.

Although Joe doesn't know it, this has already happened to a few million of my alveoli. Since Joe has about eight times the lung capacity he needs for desk work, he still has plenty of reserve. But lately he has noticed that even a small amount of exertion brings on breathlessness. I'm warning him.

Joe should heed the old medical saying, "If you are aware that you have lungs, you are already in trouble," and take a little better care of me. In the main, this means giving me better air to breathe. The big thing, of course, would be to give up smoking. Short of this, there are other things he can do. There is a small, reasonably priced machine which circulates room air through a thin bed of activated carbon—the stuff used in gas masks—and cleanses this air of chemicals deadly to my tissues. One in Joe's bedroom would give me some eight hours of protection, and another in his office would provide eight more.

A little more exercise and more sensible eating would be in order.

**Y**OU KNOW dozens of people like Joe. He is 47, successful, happily married. Joe's heart and stomach have already told their stories in this magazine.\* Now it's my turn.

I am Joe's right lung, and I claim the privilege of speaking since I am slightly larger than my partner in the left side of his chest. I have three lobes—sections—while the left has only two. Joe would be surprised if he could see me. He thinks of me as a kind of hollow, pink football bladder

hanging in his chest. I'm not much like that at all. I am not hollow—if you cut through me, I would look something like a rubber bath sponge. And I am not pink. I was when Joe was a baby. Now, a quarter of a million cigarettes plus half a billion breaths of dirty city air later, I am an unattractive slate-gray with a mottling of black.

There are three separate, sealed compartments in Joe's chest: one for me, one for the left lung, one for his heart. I hang loosely in my compartment, filling it completely, and weigh a little over a pound. I have no muscles and hence play

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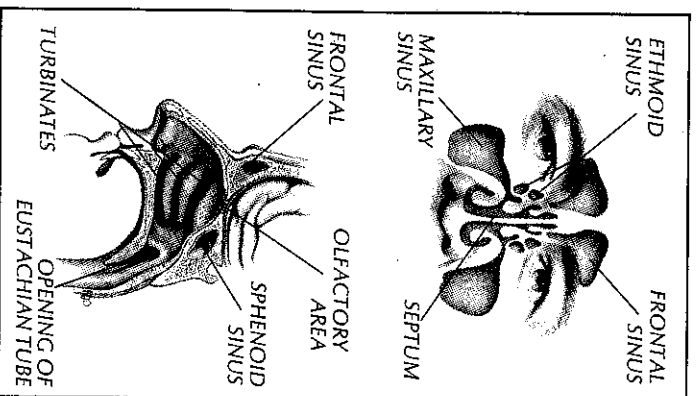
\*See "I Am Joe's Heart," The Reader's Digest, April '67; "I Am Joe's Stomach," May '68.

weight. Without my stimulus Joe becomes a picky eater.

Another thing Joe has a pleasing, deep voice. In part he has me to thank. I contribute some resonance. Let him pinch his nostrils when he speaks and he'll possibly hear the difference I make.

Architecturally, I am nothing to boast about. I am sandwiched in between the roof of Joe's mouth and his brain. In reality, I am *two* noses, since a septum, or partition, divides me in two. Above Joe's mouth I have a rather cavernous interior, my workroom. I also have small hollows in the bones on each side—in the cheeks, in the frontal bone over the eyes, in the wall between me and the eyes, and at the back of my main cavity. These hollow spaces make up my eight sinuses. They contribute some of the moisture I need to humidify air, make a slight contribution to voice quality and lighten Joe's skull, but mostly they cause trouble. Bacteria slip in to cause infection and blockage of the narrow channels that empty into my main passages. Then Joe is in for painful, headachy misery.

One of my major tasks is cleaning and conditioning the air for Joe's lungs. Each day I must process about 500 cubic feet of air—a small roomful. Joe may be skiving on a frigid, dry day, but his lungs aren't inter-



ested in dry, zero air. They want about what one would find on a humid summer day—75 to 80 percent saturated, temperature in the 60s. They demand air almost totally free of bacteria, and cleansed of grit, smoke and other irritants. The air conditioner for a medium-sized room is as large as a small trunk. My air-conditioning system is compressed into a tiny area only a few inches long.

For the humidifying job I secrete about a quart of moisture a day. Mostly this is sticky mucus, produced by the spongy, red membrane

that lines my passages. While the rough cleaning job is done by hairs in Joe's nostrils, it's the mucus that does the major work, acting as a kind of flypaper to trap bacteria and particles that get past the hairs. Naturally, I can't permit this film of mucus to stagnate. In a few hours there would be total pollution. So every 20 minutes I produce a clean new mucous blanket.

To remove the old mucus, I have an army of microscopic brooms—cilia. These minute hairs rapidly whip the film back to the throat for swallowing and then slowly settle back to their original positions. Strong stomach acid destroys most swallowed bacteria. My tireless little cilia make about ten sweeping strokes a second. Joe, of course, is unaware of this activity, which goes on day and night. But on a cold day he becomes aware of it, since cold partially paralyzes my cilia and causes an overproduction of mucus. Then, instead of being swept back to the throat, the moisture dribbles out the front. Joe gets a runny nose.

Besides mechanical trapping I have another protection against bacteria—a microbe slayer called lysozyme, the same stuff that protects Joe's eyes from infection. It makes one of the cleanest of all organs—so clean, in fact, that much nose surgery can be performed without elaborate efforts at antiseptics.

Warning the air that Joe breathes is also quite a task. I accomplish most of this with my turbinates.

Three of these little potato chips of bone, the biggest about an inch long, protrude from the side walls of each of my nostrils. In reality, they are small radiators. They are covered with erectile tissue with a relatively enormous blood supply—the steam for my radiators. Blood usually flows from tiny arteries, through a capillary bed, and into veins. In my turbinates the capillaries are associated with the tiny cisterns of my erectile tissue. As more blood is forced in, the tiny caverns swell. This happens when Joe breathes in cold air—I swell and provide greater warming surface.

My other big job, of course, is detection of odors. Joe, like most people, can recognize 4000 different scents. The really sensitive nose can go up to about 10,000. Since life rarely depends on me my great skills are subdued, unused. Had Joe been born deaf and blind he would have appreciated my enormous potential. As a key tool of identification I would have been able to recognize people, houses and rooms by scent alone.

How do I detect odors? On the roof of each of my nasal cavities I have a patch of yellow-brown tissue smaller than a postage stamp. In each patch I have roughly ten million receptor cells, and six to eight tiny sensory hairs that project from each cell. All this apparatus is connected to Joe's brain, an inch away.

That, then, is the setup. But it doesn't tell *how* Joe identifies the smell of a broiling steak. We have

This article is largely based on interviews with Dr. Harold G. Taub, chairman of the department of otolaryngology, Tulane University School of Medicine, New Orleans.

# I AM JOE'S NOSE

By J. D. RAYLUFF

Architecturally I may not be much, but in fact I'm one of Joe's most complex organs—and I do jobs for him that he doesn't even suspect

only theories. It's known that anything smellable throws off molecules. Hot onion soup throws them off in plenty, cold steel hardly any at all. One theory holds that my receptor sites can distinguish the sizes and shapes of different molecules. The difference is somehow registered, and a wisp of electricity is generated and dispatched to the brain. The electrical signal is familiar to Joe's brain. The brain arrives at a verdict: vinegar, it says, or marigold or burning rubber.

Actually, it isn't all that simple. It is possible that there are primary odors, just as there are three primary colors. With the brain as a palette, odors are blended into a familiar scent.

If I am overwhelmed by a particular odor, after a short time I can no longer detect it. After the first few whiffs, Joe's wife hardly notices the perfume she is wearing. If Joe gets a job in a tannery, glue works or stockyard, he is oppressed by the odors at first. Soon, however, he is so worn out with those particular harsh smells that he hardly notices them. Yet his sensitivity to other odors remains. Even in the stench of a tannery a rose smells as sweet as ever.

Being one of the body's most exposed organs, it's little wonder that I am the target for a wide spectrum of ailments. Certain microbes—notably those of syphilis and tuberculosis—can attack my cartilage and destroy my shape. Polyps sprout on my mucous membrane—little

"mushrooms" that vary from pea to grape size. They can block air passages or sinus channels to cause a variety of grief.

Allergens, tobacco smoke and dust irritate my mucous membranes, causing them to swell and to produce excess fluid which drips into the throat. This is postnasal drip. Or air passages may be inflamed and shut by a cold. Joe often tries to blast them open with a mighty blow. This is dangerous business. It can force infection into my sinuses, or into the middle ear via eustachian tubes. Or he may resort to nose drops—tissue shrinkers of various kinds. He'd best be cautious here, too. Drops cause the "rebound" phenomenon—temporary shrinkage is followed by greater swelling than originally present. Experts warn against nose drops because they end by complicating rather than solving the problem.

Joe is 47 now and my acuity is declining. Coffee doesn't smell quite as good as it once did, and other odors aren't quite as noxious. All this is perfectly normal. It might have been a handicap at one point in man's development, but no longer. Until I warm and cleanse Joe's last breath I will continue to do my jobs for him. And in defense of my lowly status I might add that in Joe's old age I will do my jobs far better than his eyes and ears will do theirs.

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I am that little hill that rises from the center of Joe's face—the nose.\* He worries about his eyes, ears and digestive tract but tends to think of me as a nuisance. I water on winter days, sneeze at the wrong time, clog with a cold, tend to get smashed in accidents. There are colorful and poetic allusions to other facial features—eyes, ears, lips. But not to me. I am kept to the grindstone, one pays through me, and nothing is plainer than the nose on a face.

As an important organ in Joe's body, I think I deserve better. I do numerous jobs that he is unaware of. Let him go to sleep on his left side,

for example, and my left nostril will gradually become engorged. In about two hours I send out a silent signal—I don't want to awaken him—which causes him to turn over. This is one of several trigger mechanisms that lead to movement, preventing his muscles from being cramped in the morning.

Automatically, I sniff Joe's victuals before he eats, to protect him from spoiled food that might poison him. Much of Joe's pleasure in eating comes through me. Let me smell a broiling steak and I crank up salivary glands that set his mouth to watering and start his digestive juices flowing. As Joe has noticed, when my capabilities are blunted by sickness, as by a cold, his food is tasteless, and he loses appetite and

\*Joe, 47, is a typical American man. A number of his organs have told their story in previous articles in The Reader's Digest.