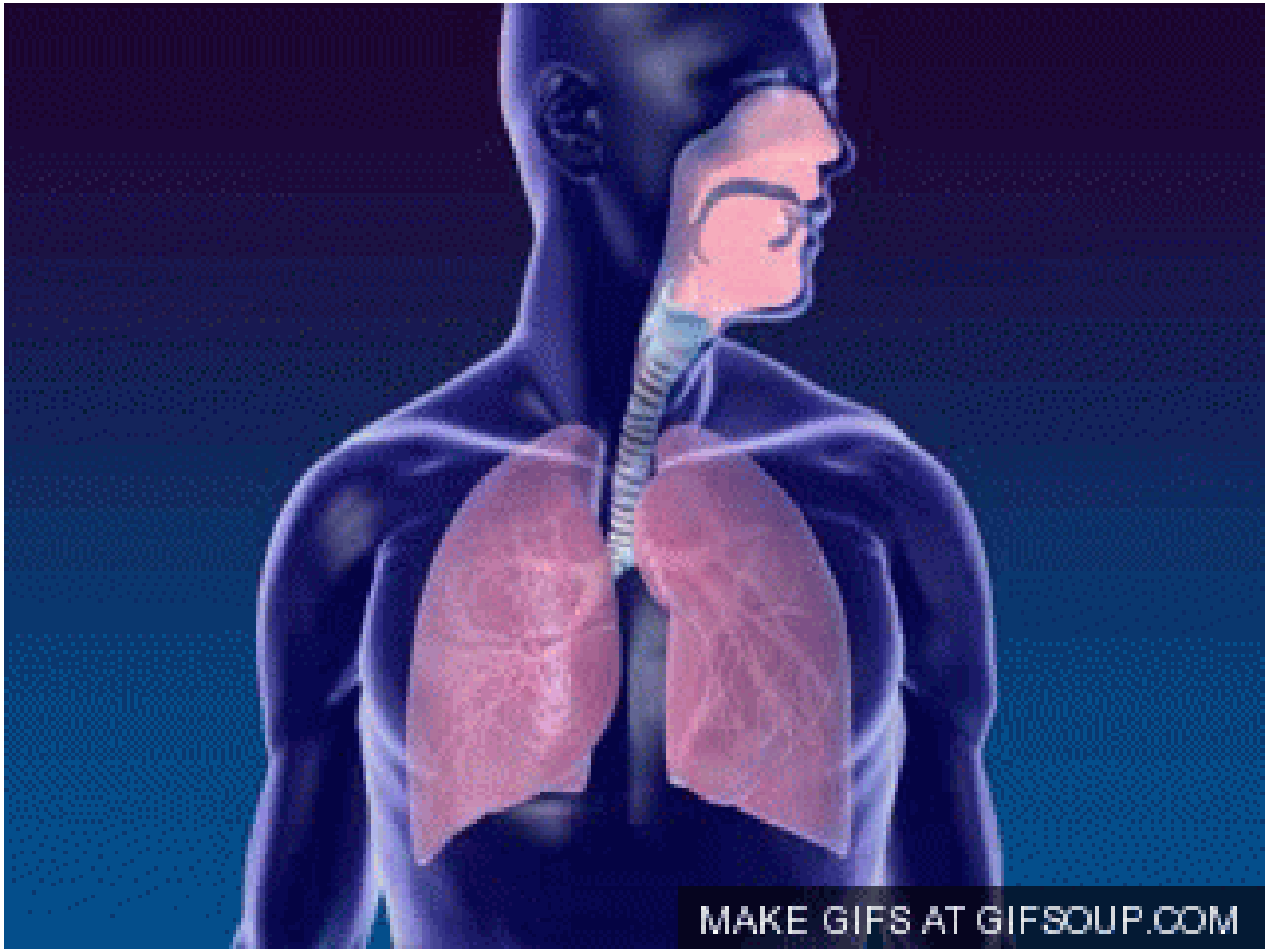
THE RESPIRATORY SYSTEM

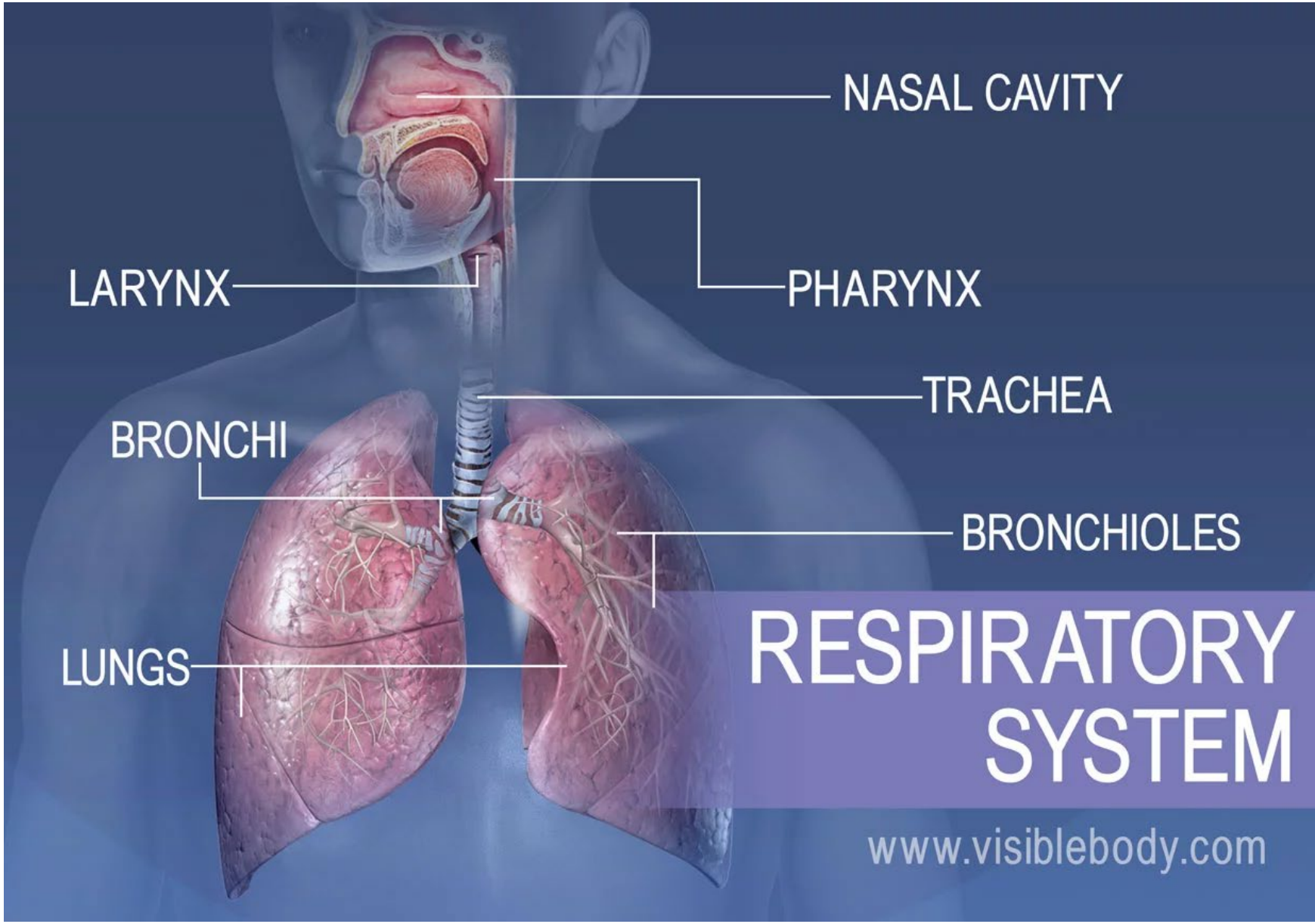


COMPILED BY HOWIE BAUM

Through breathing, inhalation and exhalation, the respiratory system facilitates the exchange of gases between the air and the blood and between the blood and the body's cells.

The respiratory system also helps us to smell things and create sound.

The following are the five key functions of the respiratory system.



The respiratory system aids in breathing, also called pulmonary ventilation.

In pulmonary ventilation, air is inhaled through the nasal and oral cavities (the nose and mouth).

It moves through the pharynx, larynx, and trachea into the lungs. Then air is exhaled, flowing back through the same pathway.

Changes to the volume and air pressure in the lungs trigger pulmonary ventilation.

During normal inhalation, the diaphragm and external intercostal muscles contract and the ribcage elevates.

As the volume of the lungs increases, air pressure drops and air rushes in.

During normal exhalation, the muscles relax. The lungs become smaller, the air pressure rises, and air is expelled.

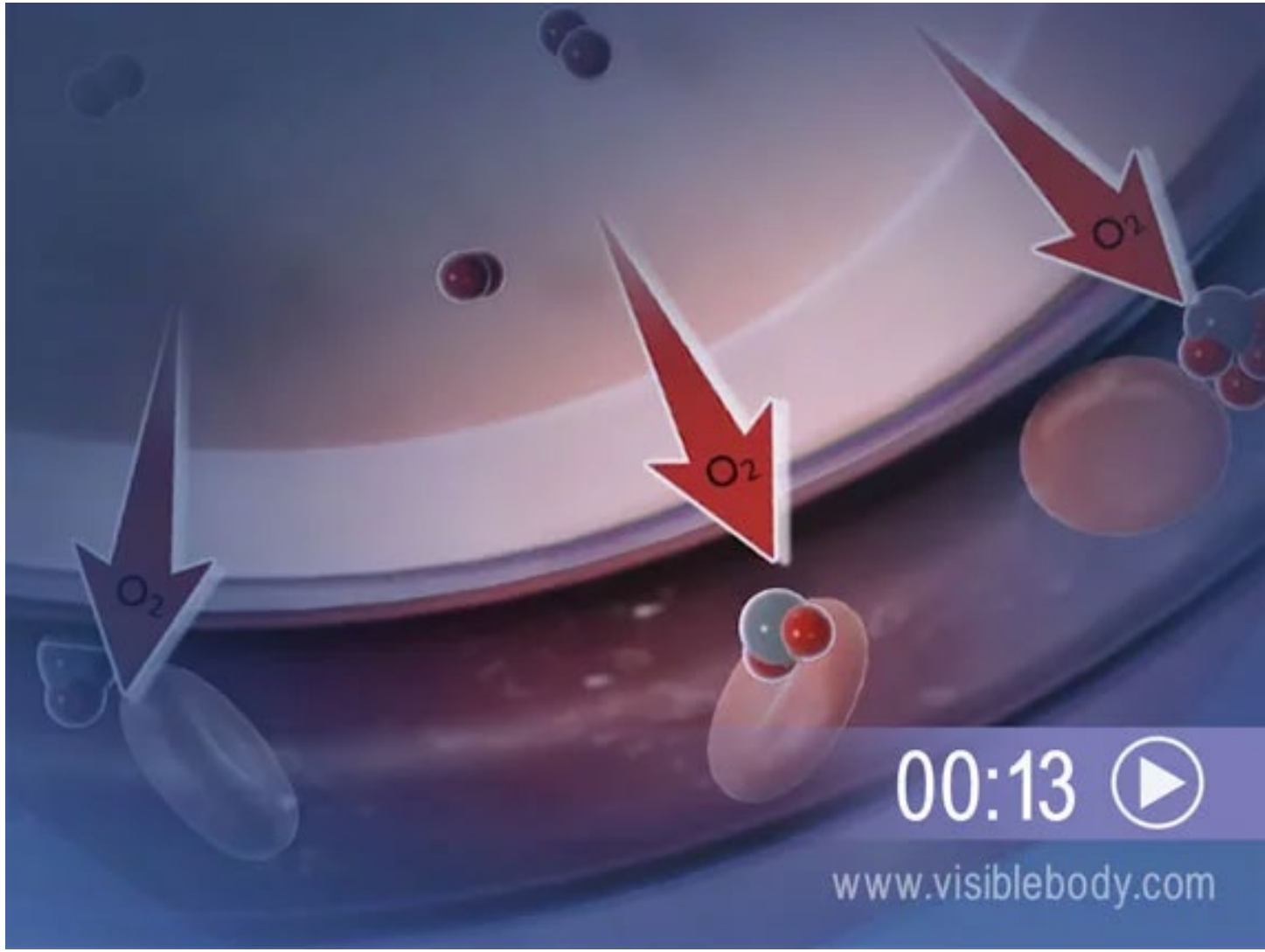
Inside the lungs, oxygen is exchanged for carbon dioxide waste through the process called external respiration.

This respiratory process takes place through hundreds of millions of microscopic sacs called alveoli.

Oxygen from inhaled air diffuses from the alveoli into pulmonary capillaries surrounding them.

It binds to hemoglobin molecules in red blood cells and is pumped through the bloodstream.

Meanwhile, carbon dioxide from deoxygenated blood diffuses from the capillaries into the alveoli and is expelled through exhalation.



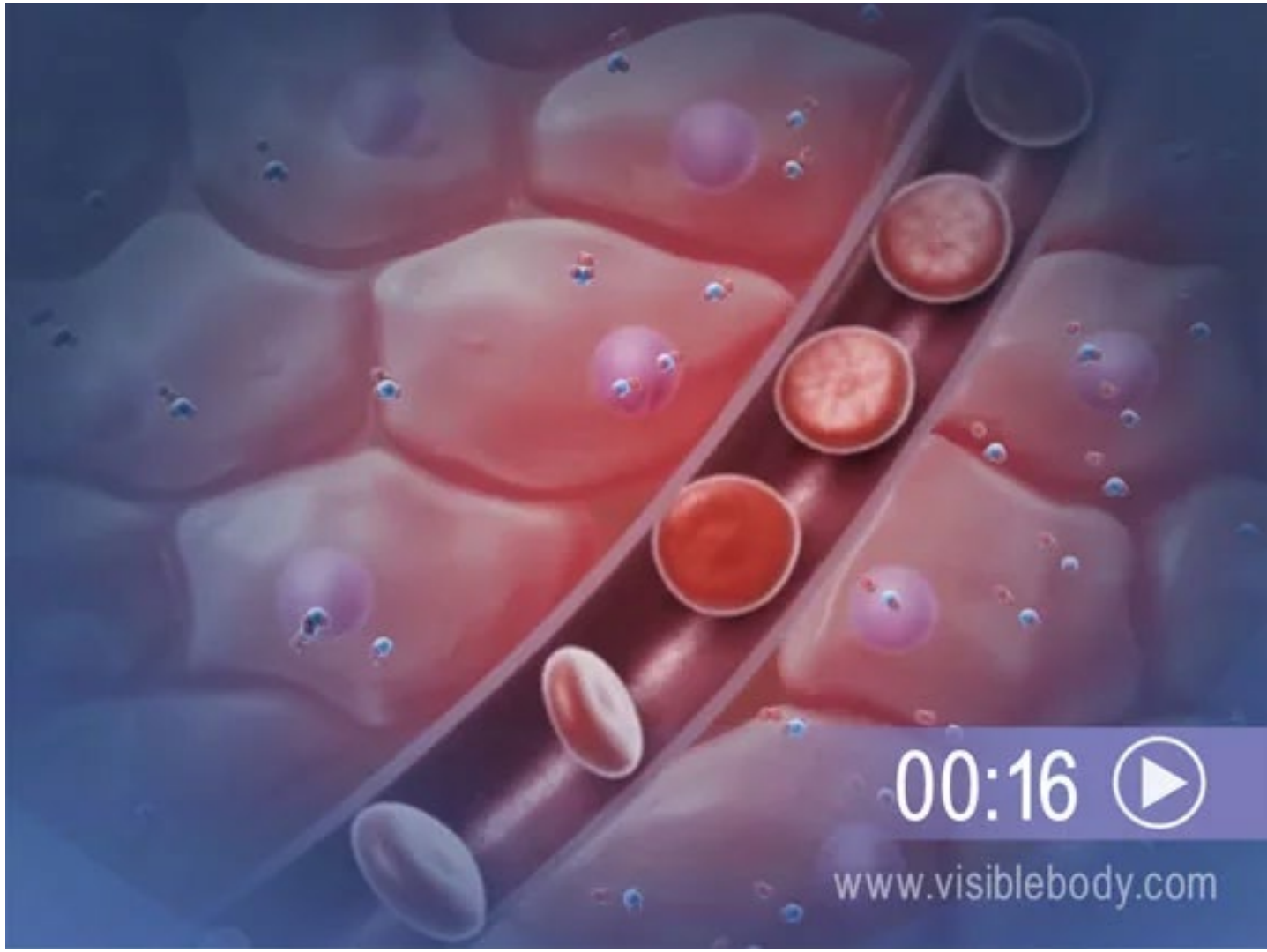
The bloodstream delivers oxygen to cells and removes waste carbon dioxide through internal respiration, another key function of the respiratory system.

In this respiratory process, red blood cells carry oxygen absorbed from the lungs around the body, through the vasculature.

When oxygenated blood reaches the narrow capillaries, the red blood cells release the oxygen.

It diffuses through the capillary walls into body tissues. Meanwhile, carbon dioxide diffuses from the tissues into red blood cells and plasma.

The deoxygenated blood carries the carbon dioxide back to the lungs for release.

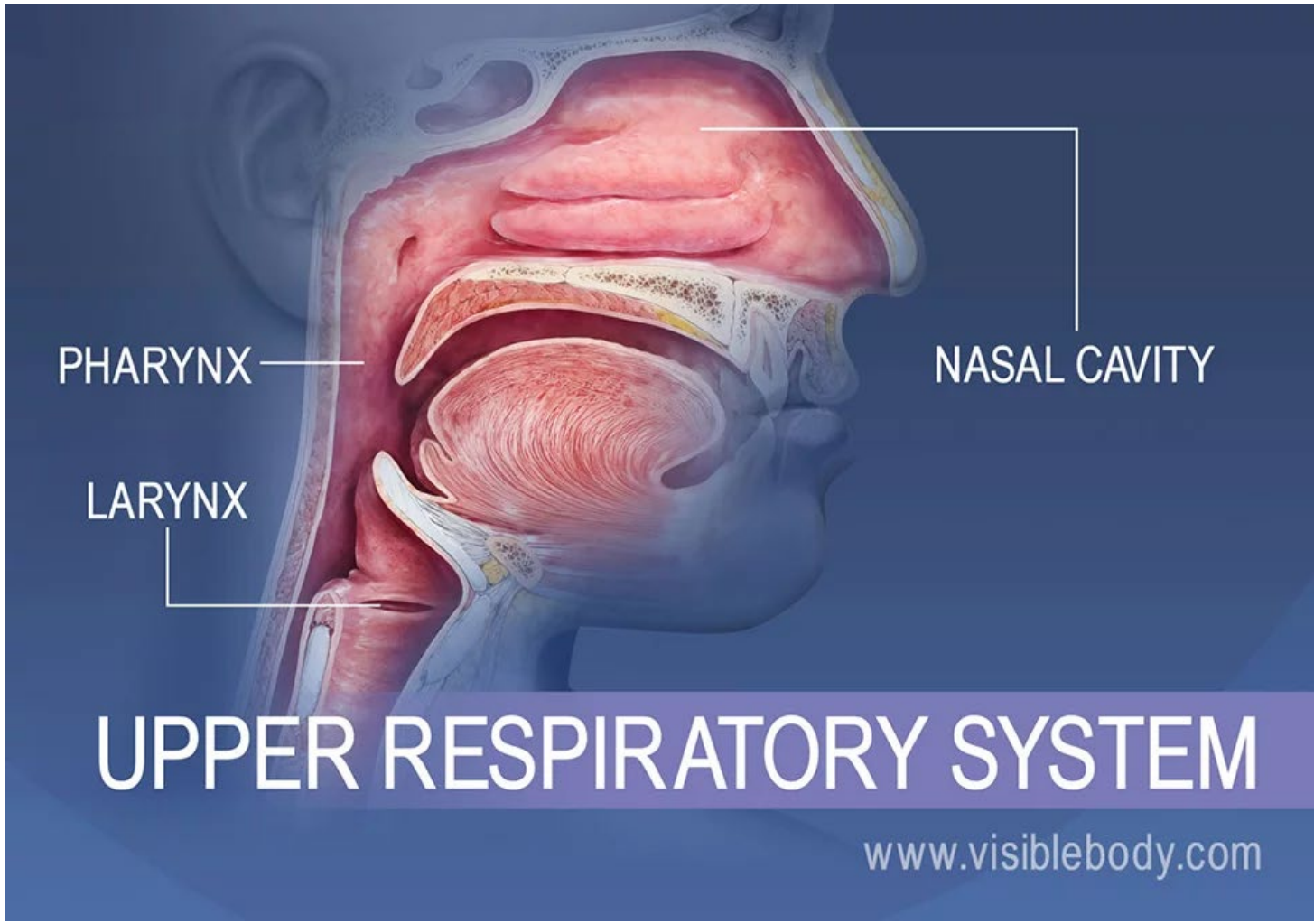


The upper respiratory system, or upper respiratory tract, consists of the nose and nasal cavity, the pharynx, and the larynx.

These structures allow us to breathe and speak.

They warm and clean the air we inhale.

mucous membranes lining upper respiratory structures trap some foreign particles, including smoke and other pollutants, before the air travels down to the lungs.



OLFACTION (SMELLING)

The nasal cavities are chambers of the internal nose.

In front, the nostrils, or nares, create openings to the outside world.

Air is inhaled through the nostrils and warmed as it moves further into the nasal cavities. Scroll-shaped bones, the nasal conchae, protrude and form spaces through which the air passes.

The conchae swirl the air around to allow the air time to humidify, warm, and be cleaned before it enters the lungs.

Epithelial cilia (commonly called “nose hair”) and a mucous membrane line the inside of the cavities.

The cilia, along with mucus produced by seromucous and other glands in the membrane, trap unwanted particles.

Finally the filtered, warmed air passes out of the back of the nasal cavities into the nasopharynx, the uppermost part of the pharynx.

The paranasal sinuses are four paired, air-filled cavities found inside bones of the skull.

These sinuses are named for the skull bones that contain them:

Frontal

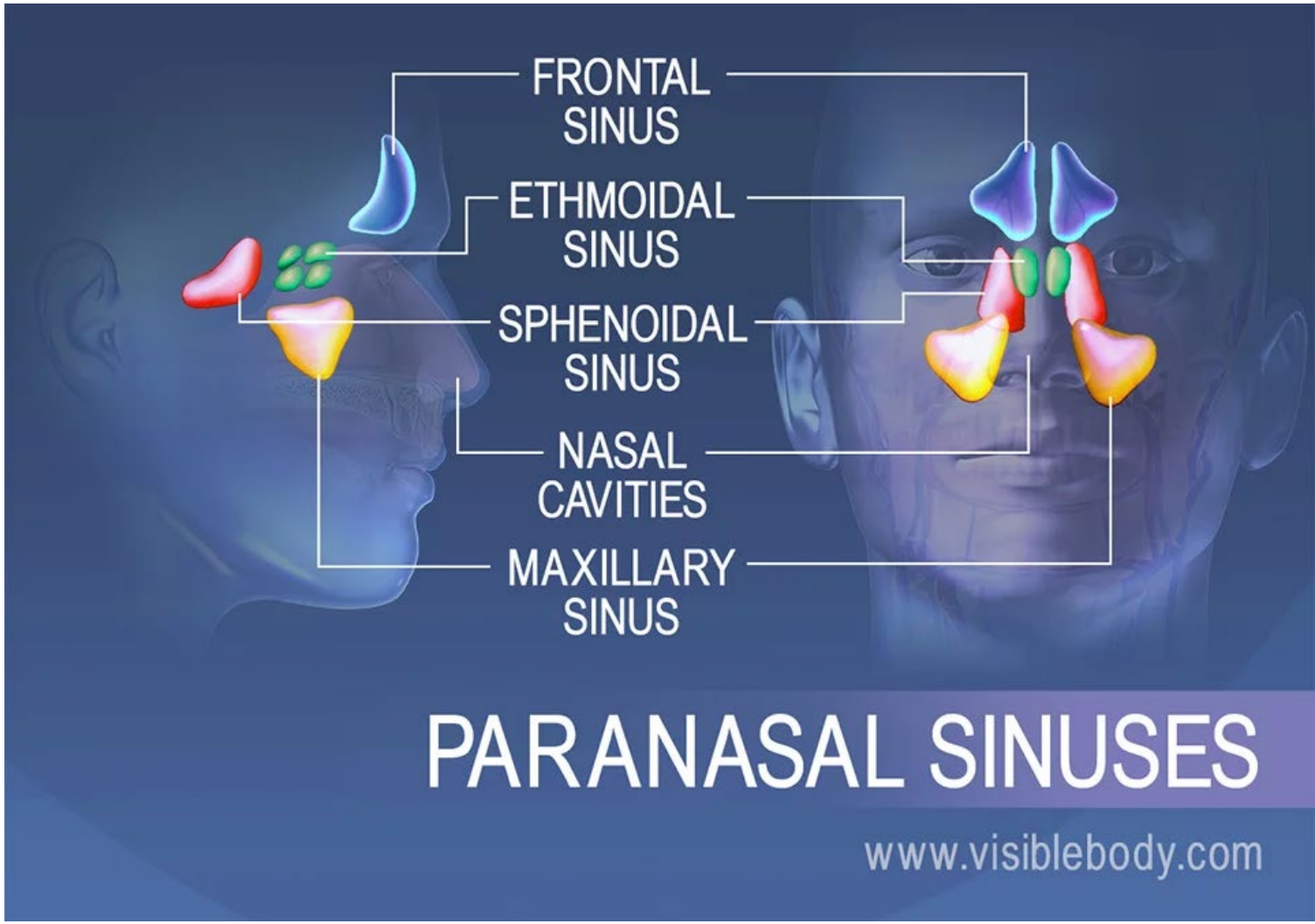
Ethmoidal

Sphenoidal

Maxillary

Mucosae line the paranasal sinuses and help to warm and humidify the air we inhale.

When air enters the sinuses from the nasal cavities, mucus formed by the muscosae drains into the nasal cavities.



The pharynx, or throat, is shaped like a funnel.

During respiration, it conducts air between the larynx and trachea (or “windpipe”) and the nasal and the oral cavities.

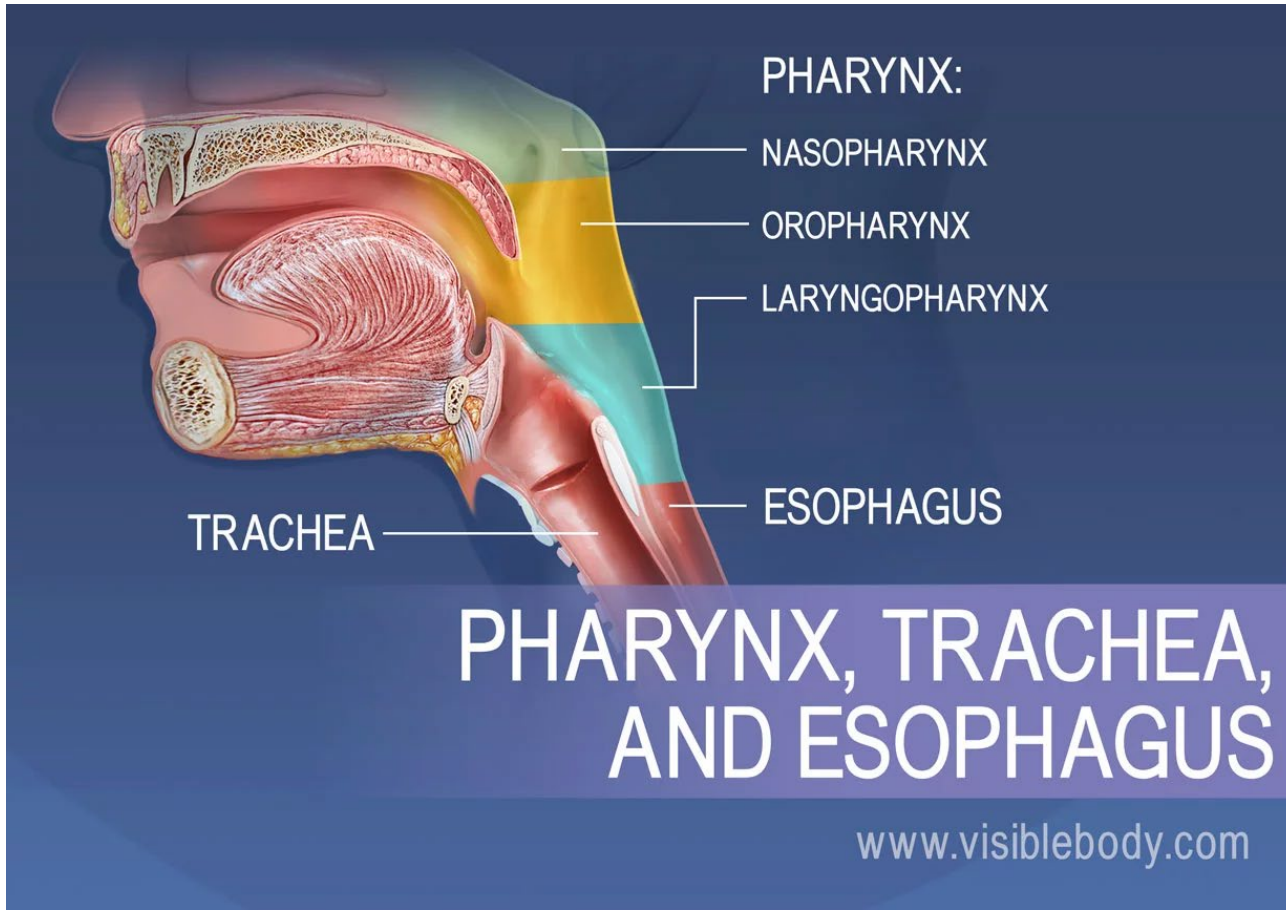
The pharynx includes three regions: The nasopharynx is posterior to the nasal cavity and serves only as a passageway for air.

The oropharynx lies posterior to the oral cavity and contains the palatine tonsils.

Both air and ingested food pass through the oropharynx and through the laryngopharynx below.

The laryngopharynx lies posterior to the epiglottis and connects to the larynx and the esophagus.

As we breathe, the epiglottis stays up and air passes freely between the laryngopharynx and the larynx.



The larynx connects the lower part of the pharynx, the laryngopharynx, to the trachea.

It keeps the air passages open during breathing and digestion and is the key organ for producing sound.

This larynx is comprised of nine cartilages.

One, the epiglottis, is a lifesaver: Located on the posterior side of the larynx, the epiglottis closes like a trap door as we swallow.

This action steers food down the esophagus and away from the windpipe.

Inside the larynx are the vocal folds (or true vocal cords), which have elastic ligaments at their core.

When we speak, yell, or sing, air coming up from the lungs and trachea vibrates the folds, producing the sound.

Phonation is the creation of sound by structures in the upper respiratory tract of the respiratory system.

During exhalation, air passes from the lungs through the larynx, or “voice box.”

When we speak, muscles in the larynx move the arytenoid cartilages.

The arytenoid cartilages push the vocal cords, or vocal folds, together.

When the cords are pushed together, air passing between them makes them vibrate, creating sound.

Greater tension in the vocal cords creates more rapid vibrations and higher-pitched sounds.

Lesser tension causes slower vibration and a lower pitch.

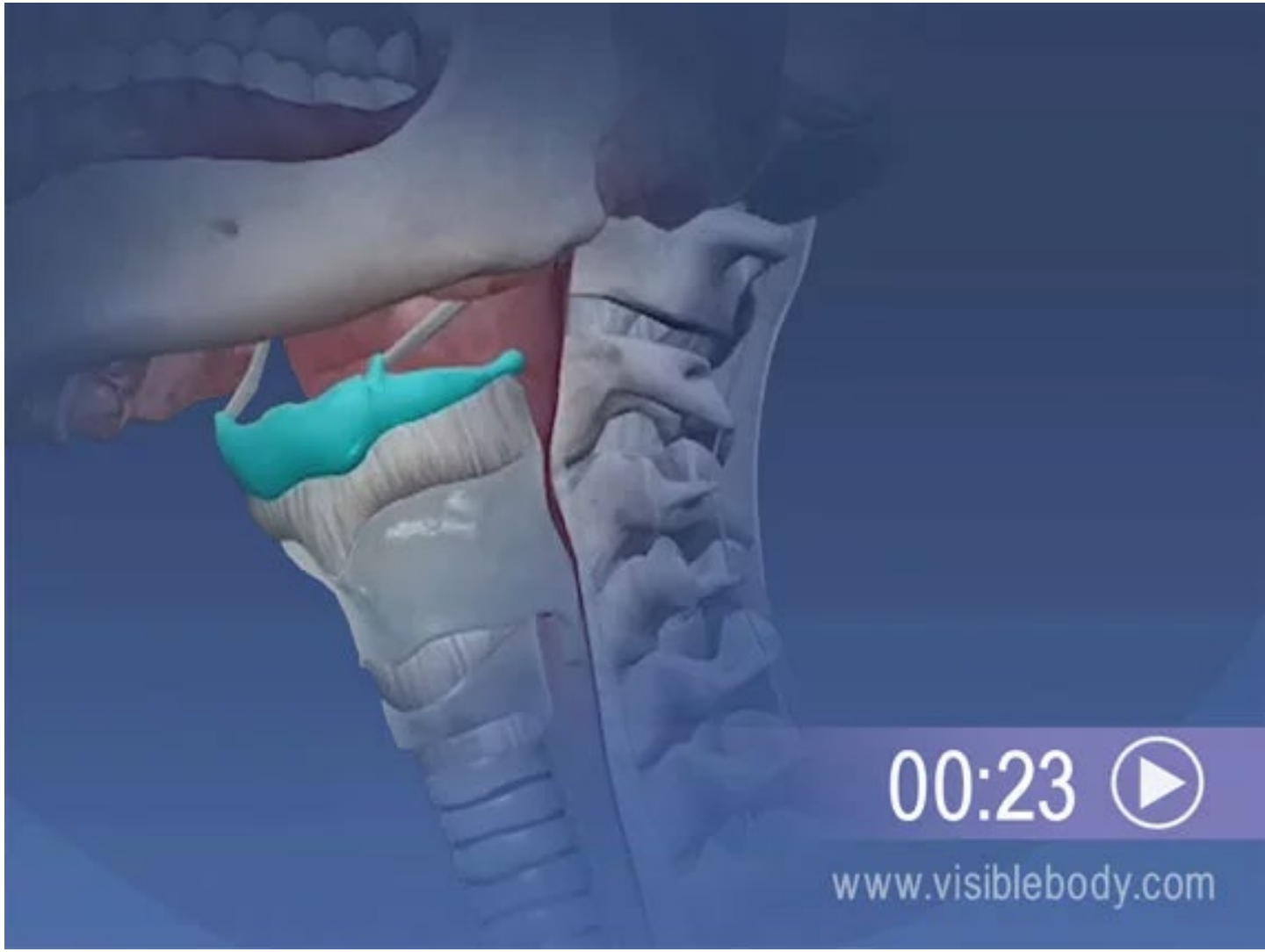
The **U-shaped hyoid bone**, located just under the chin, is an important contributor to both respiratory and digestive processes.

Is the Only Bone in the Body That Doesn’t Touch Another Bone !!

The hyoid is attached to the tongue, and helps you to swallow at the start of digestion.

In the respiratory system, structures that produce sound depend on the hyoid.

The body and the greater horns of the bone serve as attachment points for neck muscles that raise and lower the larynx during speech (as well as during swallowing).



The process of olfaction begins with olfactory fibers that line the nasal cavities inside the nose.

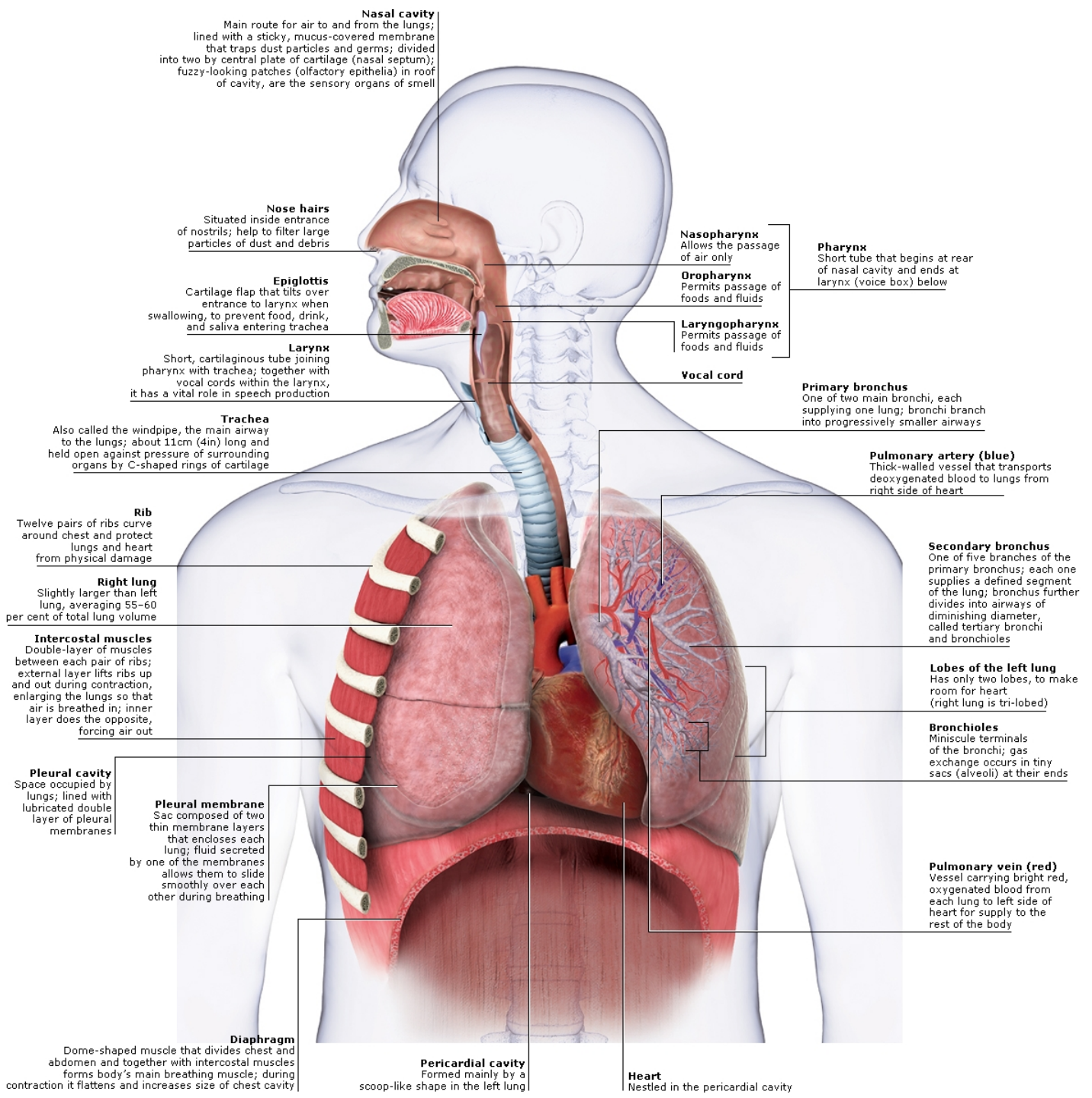
As air enters the cavities, some chemicals in the air bind to and activate nervous system receptors on the cilia.

This stimulus sends a signal to the brain: neurons take the signal from the nasal cavities through openings in the ethmoid bone, and then to the olfactory bulbs.

The signal then travels from the olfactory bulbs, along cranial nerve 1, to the olfactory area of the cerebral cortex

The respiratory system, in close conjunction with the circulatory system, is responsible for supplying all body cells with essential oxygen and removing potentially harmful carbon dioxide from the body.

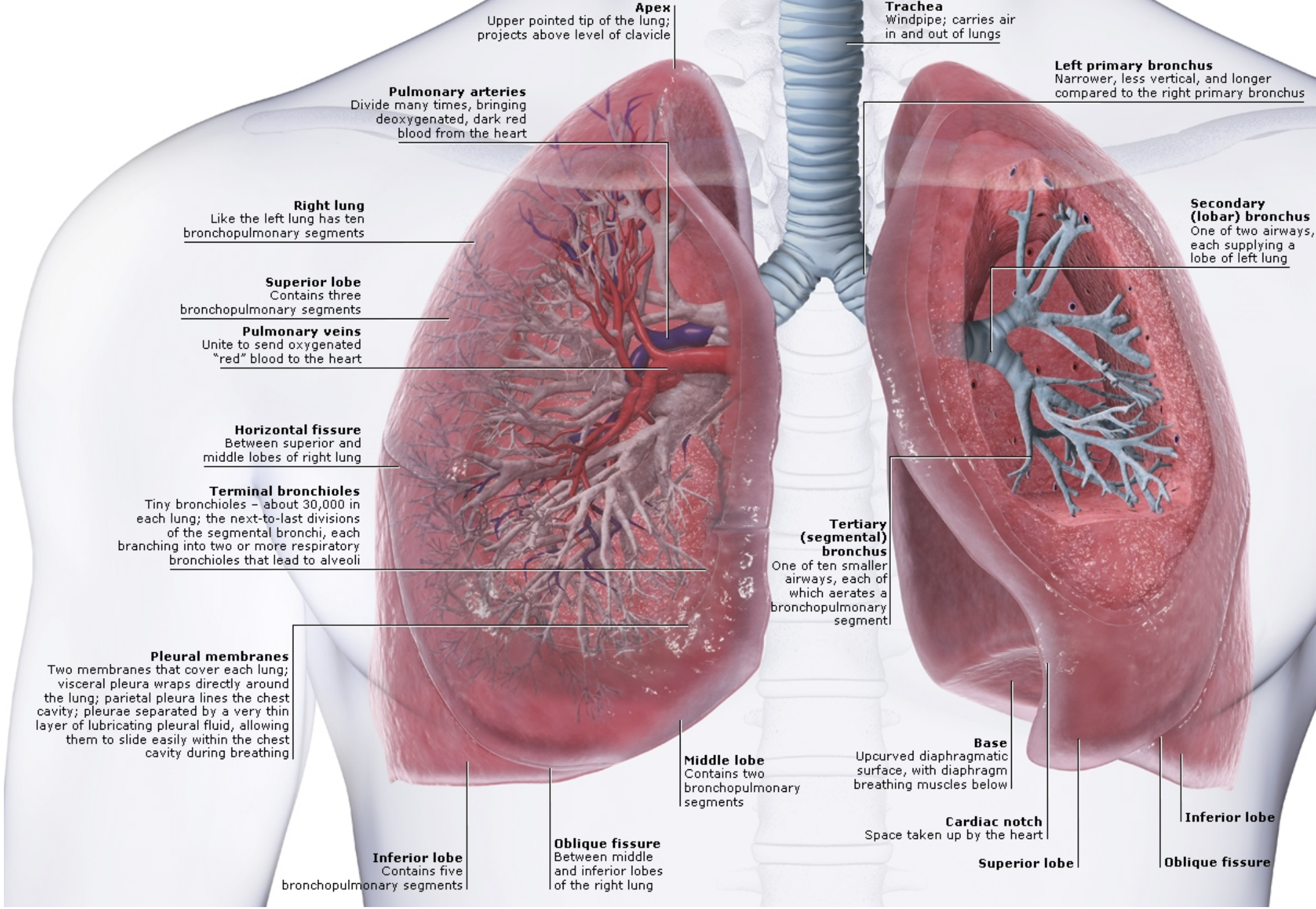
The mouth and nose channel air from outside the body through a system of tubes of diminishing size that eventually reach the two lungs situated on either side of the heart within the chest cavity.



Healthy lungs are approximately cone-shaped, pinkish in color, and occupy most of the chest cavity.

Joining them is the muscular trachea that is reinforced by roughly 20 rings of cartilage and lined with a mucous membrane.

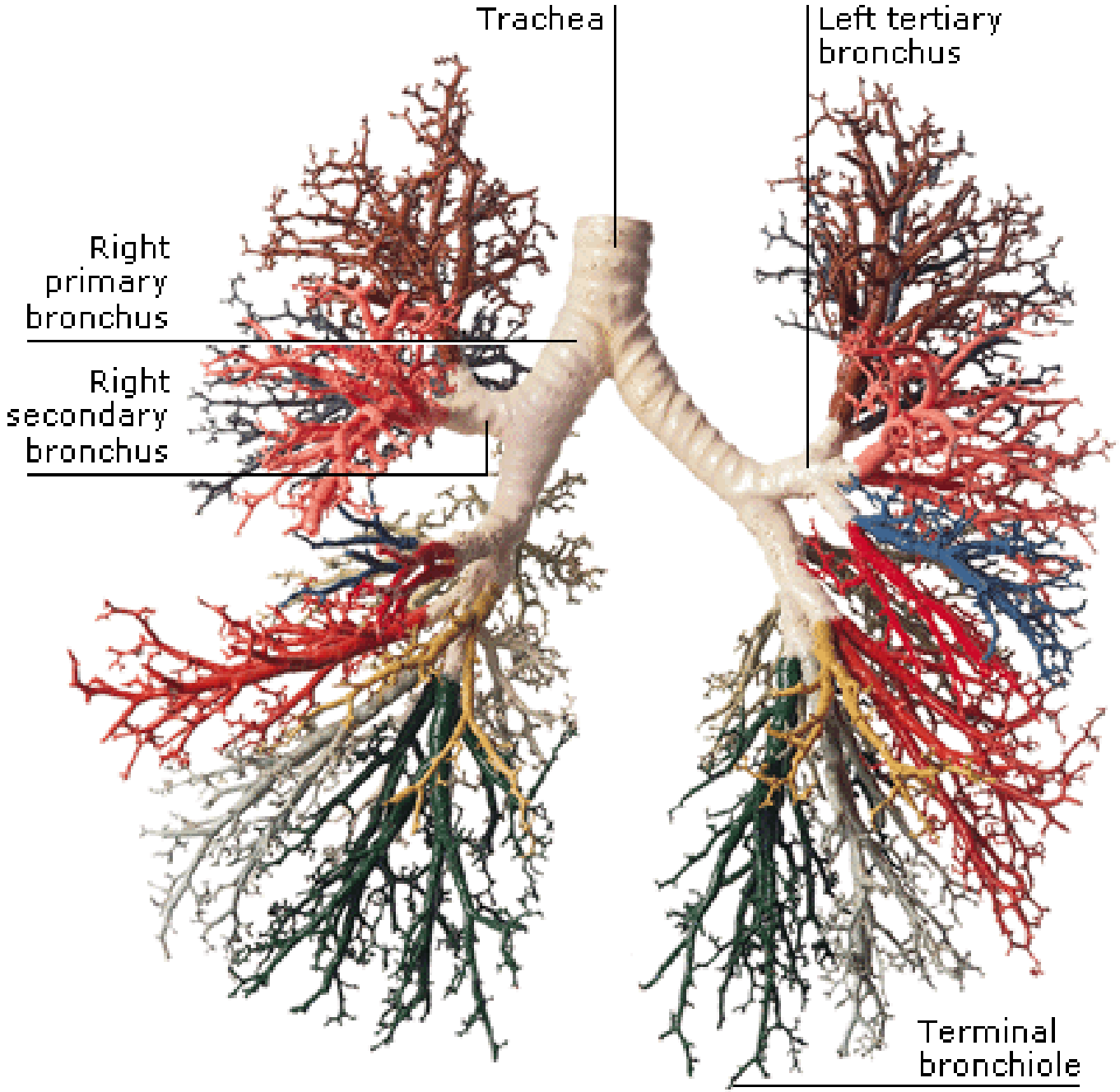
https://www.visiblebody.com/learn/respiratory/lower-respiratory-system#lungs



Bronchial cast

By filling a lung's airways with a resin that hardens, a cast such as this can be made of the bronchial tree.

Each color indicates an individual bronchopulmonary segment aerated by a tertiary, or segmental, bronchus.



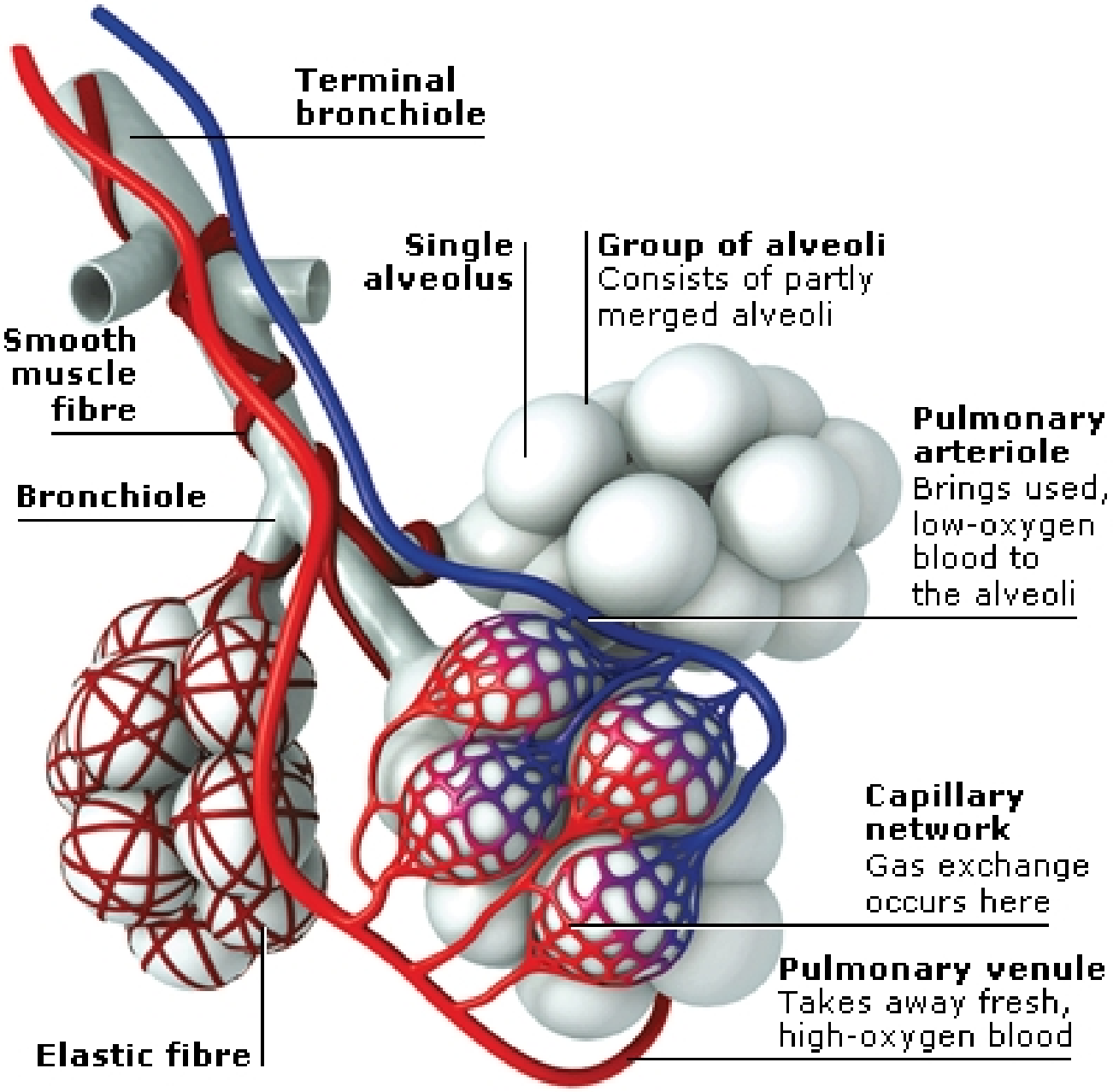
ALVEOLI - The lungs' microscopic air sacs, alveoli, are elastic, thin-walled structures arranged in clumps at the ends of respiratory bronchioles.

They resemble bunches of grapes, although the alveoli are partly merged with each other.

White blood cells known as macrophages are always present on their inner surfaces, where they ingest and destroy airborne irritants such as bacteria, chemicals, and dust.

Around the alveoli are networks of capillaries. Oxygen passes from the air in the alveoli into the blood by diffusion through the alveolar and capillary walls

Carbon dioxide diffuses from blood into the alveoli. There are more than 300 million alveoli in both lungs, providing a huge surface area for gas exchange – about 40 times greater than the body's outer surface.



Supporting the alveoli

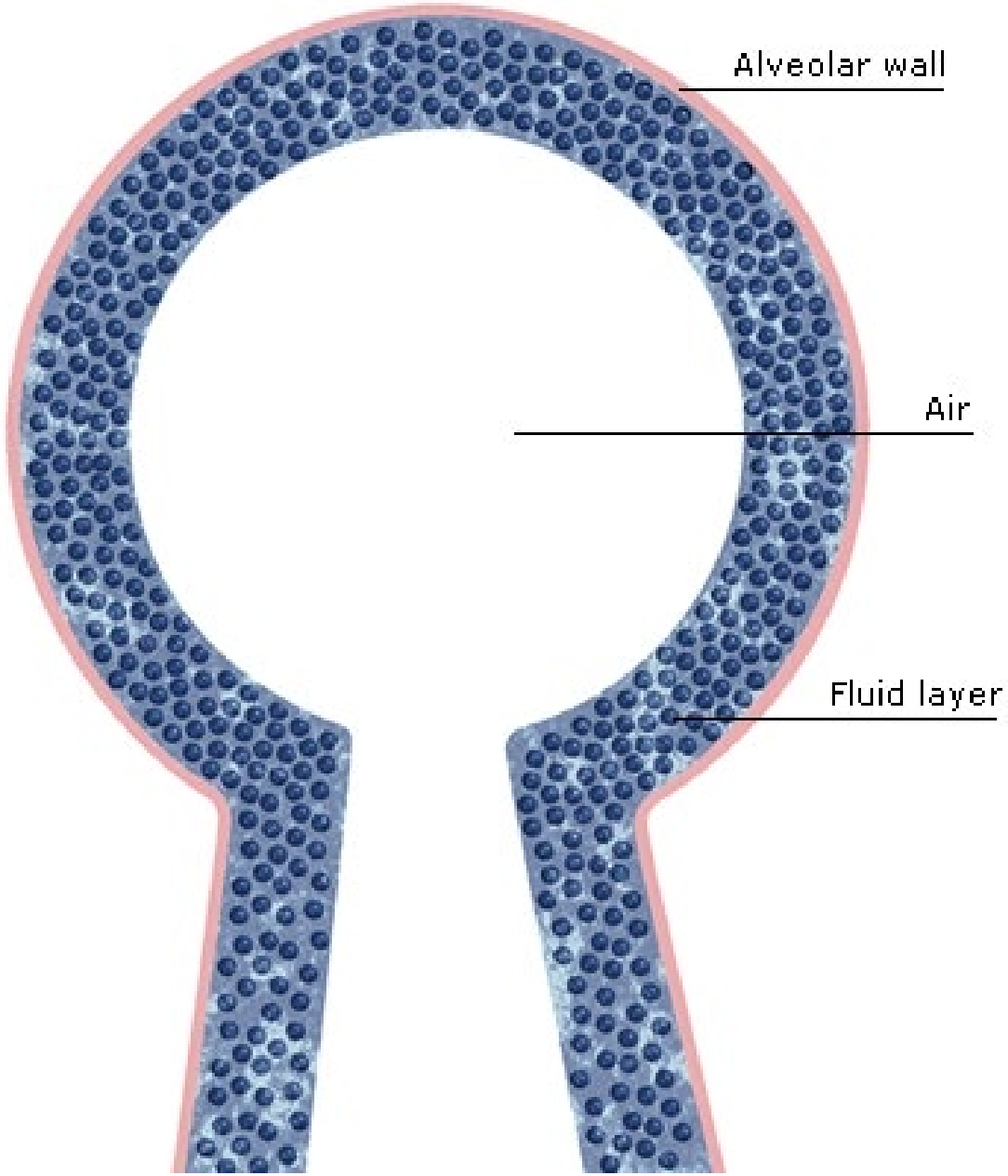
Alveoli are only 0.2mm (1/125 in) across when fully inflated.

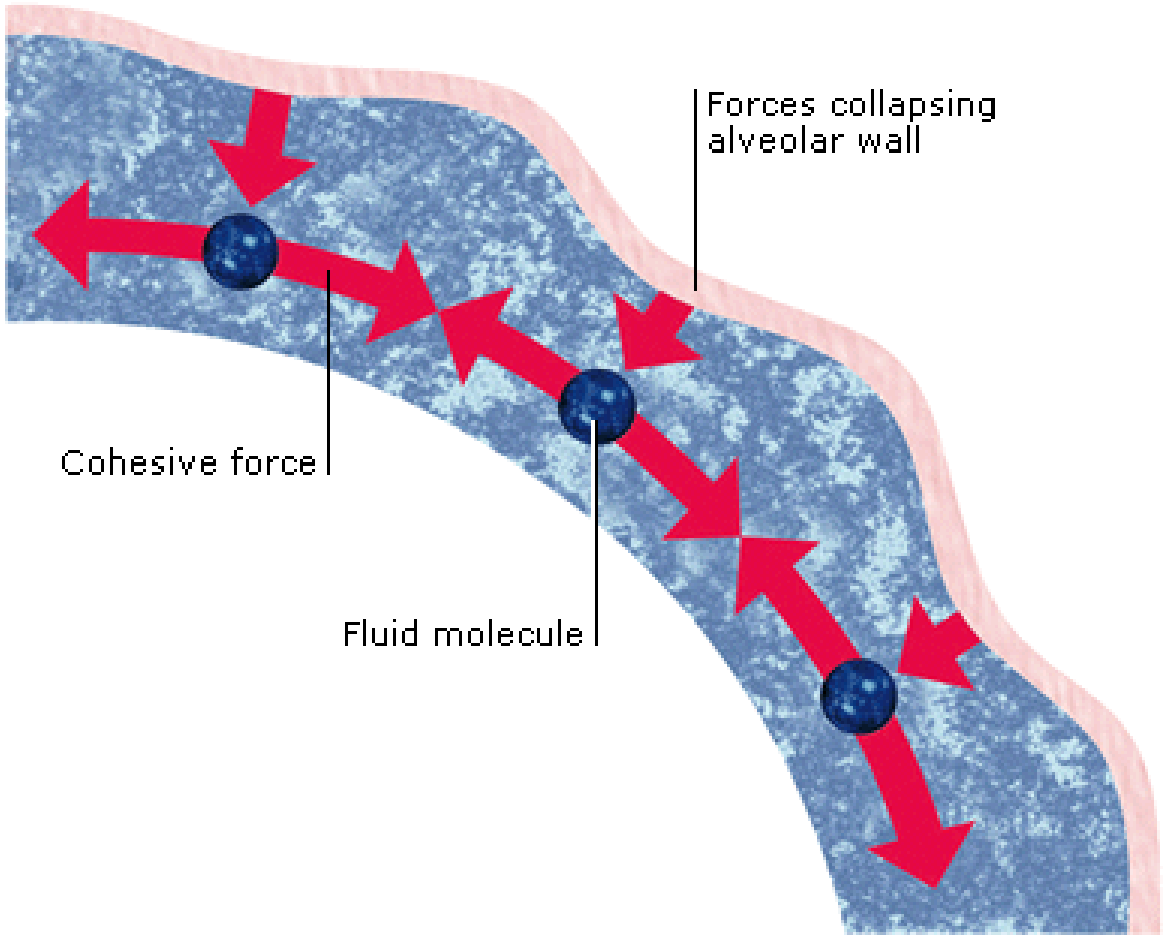
They should collapse inwards like deflated balloons due to powerful surface tension in their fluid lining.

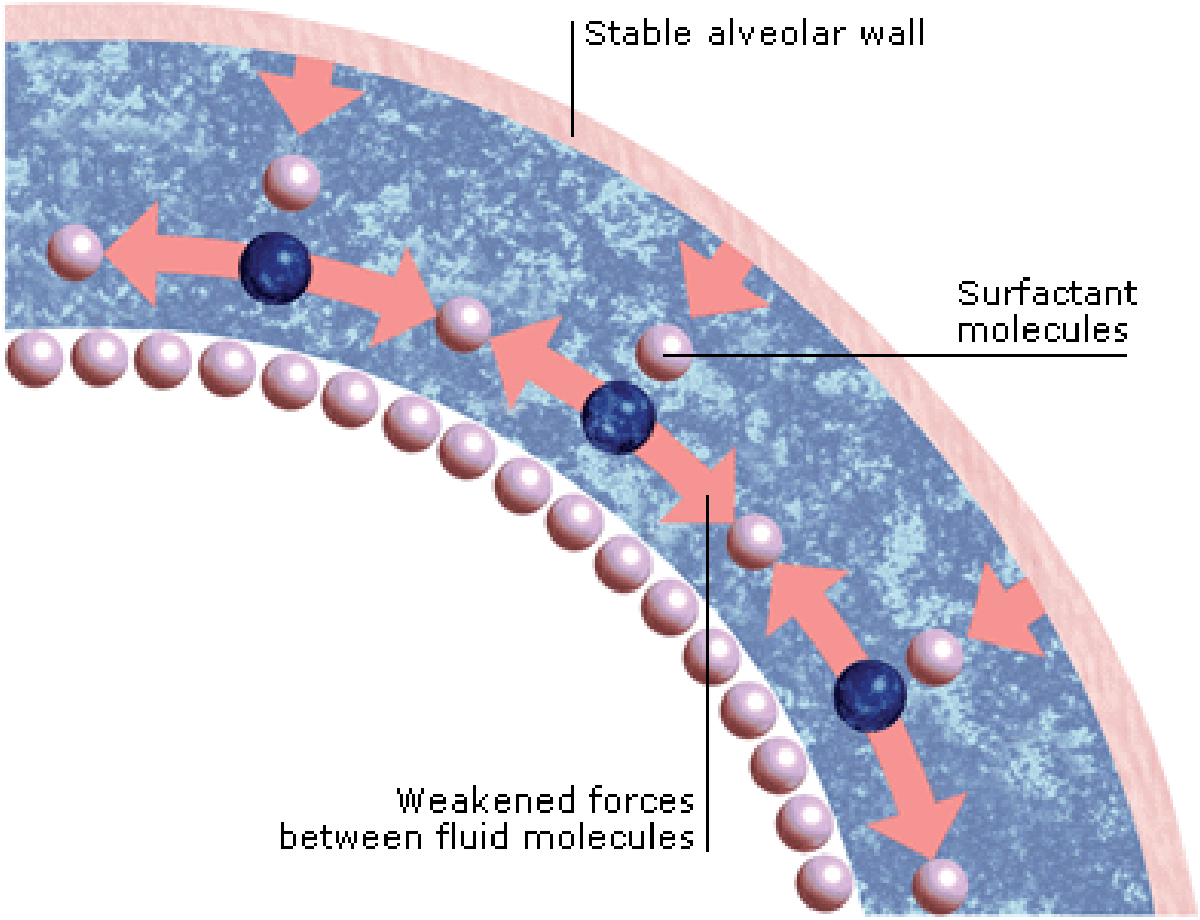
Their collapse is prevented by a natural substance with detergent-like properties called surfactant.

It is produced by alveolar cells and consists mainly of fatty substances, such as cholesterol and phospholipids, and proteins.

Besides keeping alveoli inflated, it plays a role in disabling bacteria which prevents certain lung infections.







Without surfactant

Molecules in the watery fluid lining attract and cohere to each other, making the alveolar wall pull inwards and collapse.

With surfactant

Molecules of surfactant flow between the fluid molecules and reduce their cohesive forces, allowing the alveoli to stay inflated.

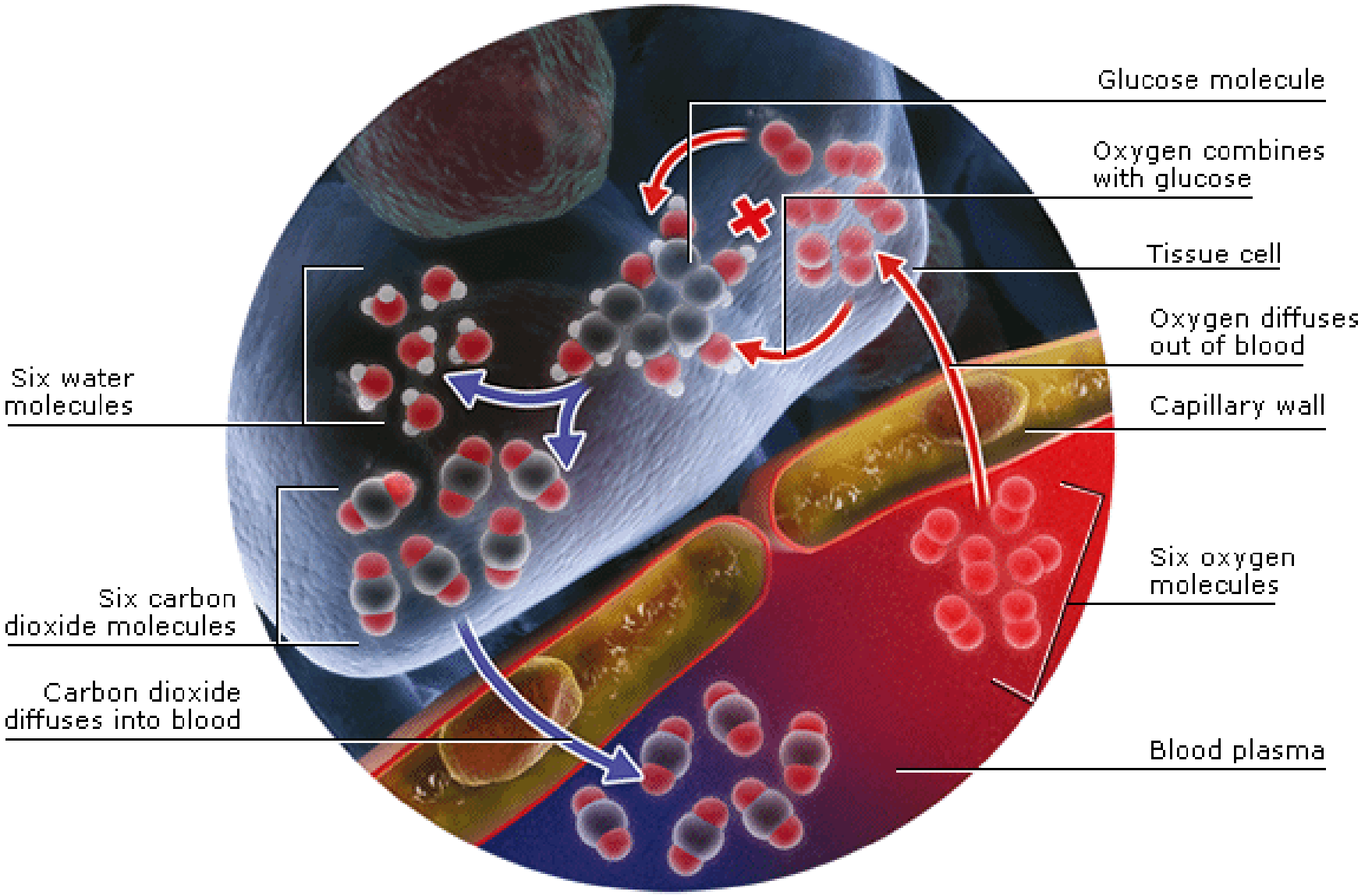
Cellular respiration

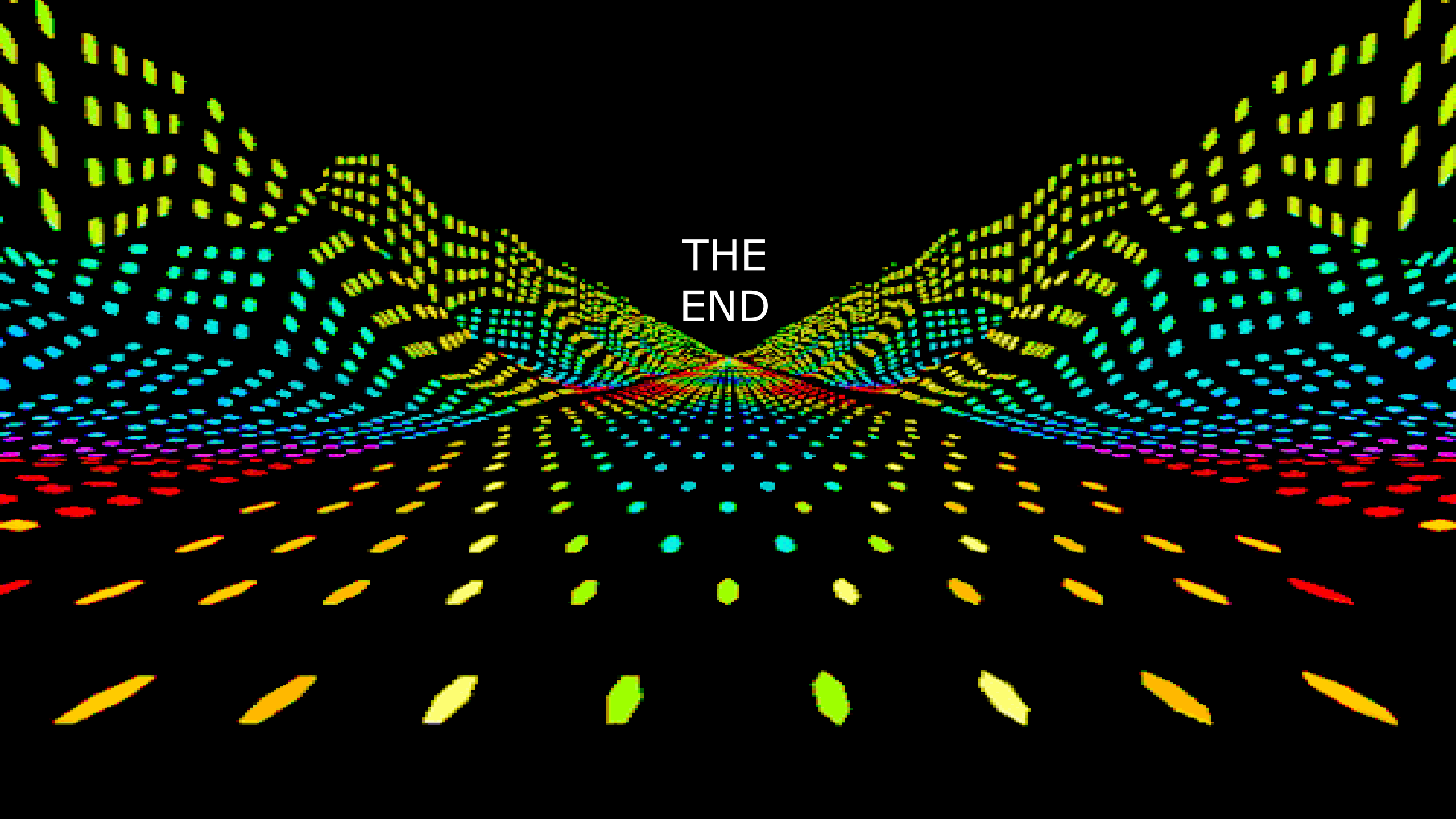
Glucose (blood sugar) is the body's main energy source.

Cellular respiration occurs in every body cell when oxygen reacts with glucose to free its energy in chemical form.

The end products are carbon dioxide and water, which is known as metabolic water and amounts to about 300ml (10fl oz) daily throughout the body.

The whole process is called aerobic (oxygen-requiring) cellular, or internal, respiration.

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