This series looks at the structure and function of the respiratory system and describes the mechanics of breathing. Each of the cells in the body needs a supply of oxygen in order to function as well as a means to expel the carbon dioxide produced. The respiratory system (along with the cardiovascular system) is largely dedicated to supplying these needs. This article, the first in this four-part series, looks at the nose, pharynx and larynx (Fig 1).

The respiratory system is a tube with many branches that end in millions of tiny air-filled sacs called alveoli. The airways have three main functions:

- To act as channels for gases moving to and from the lungs;
- To protect the lungs from the entry of any foreign matter;
- To control the heat and humidity of the gases.

**The nose**

The nose is the only part of the respiratory system that is visible externally and is the route for air entry into the respiratory system. Air is drawn in via the nostrils or external nares and enters the large nasal cavity, which is divided into two by the nasal septum. The nasal cavity is partitioned from the oral cavity directly below it by the palate.

Like the rest of the respiratory tract, the nose is lined with mucosal epithelium containing glands that secrete a thick, sticky mucus that helps to moisten the tract. Just below the surface of the epithelium is a rich network of blood vessels that warm the nasal cavities. Nosebleeds are fairly common because the blood vessels are so superficial.

The nerve endings responsible for smell (olfaction) are found in the nasal mucosa at the back of the nasal cavities. Any obstruction of the nasal passages and surrounding sinuses, for example caused by oedema of the tissues produced by the common cold, will affect these nerve endings. Typically the symptoms of an upper respiratory tract infection, or ‘head cold’ involve the airways above the trachea.

Four further cavities – the paranasal sinuses – surround and drain into the nasal cavity (Fig 2). Their mucosal lining is continuous with that of the nose and this means that sinus infections (sinusitis) are common during a cold when the nasal mucosa is inflamed. The hollow sinuses help lighten the skull and act as a resonating chamber for sounds, as well as helping to produce mucus for the respiratory tract.

Lacrimal ducts open into the nose and drain tears from the corner of each eye. This also helps to moisten the surface of the nasal cavity.

Three shell-like structures, the conchae or turbinates, protrude into each side of the nasal cavity and increase the surface area over which air flows on its way to the lungs (Fig 2). As air is drawn in, the...
turbinates cause it to swirl around within the nasal cavity and this is useful in a number of ways:

- It allows extra time for the incoming air to be warmed and humidified, and for outgoing air to be cooled and dehumidified. Breathing though the nose is much more effective at these functions than breathing through the mouth;
- The swirling action forces the air into frequent contact with the nasal mucosa and large foreign particles become trapped;
- The eddy currents that are created then carry olfactory stimuli to the olfactory receptors in the nose, allowing us to smell.

Warmed, humidified air passes from the nasal cavities through the internal nares into the pharynx, a structure shared by the respiratory and digestive systems.

The pharynx

This funnel-shaped tube is about 12.5cm long and has three sections – the nasopharynx, just behind the nasal cavities, the oropharynx behind the mouth and the lowest section, the laryngopharynx (Fig 1).

The pharynx acts as a passageway for food on its way to the stomach and for air en route to the lungs. The mucosal epithelium in the pharynx is thicker than elsewhere in the respiratory tract as it has to protect the tissues from any abrasive and chemical trauma caused by food.

Two eustachian or auditory tubes connect the middle ears with the nasopharynx and allow pressure in the middle and outer ear to equalise. The mucosal lining of the nasopharynx, eustachian tubes and middle ear is continuous and middle ear infections can occur when the nasopharynx is inflamed.

The oropharynx can be entered from the mouth as well as from the nasopharynx, while the lower portion, the laryngopharynx, divides into the oesophagus which carries food to the stomach and the larynx through which air passes to the lungs.

Tonsils are mounds of lymphatic tissue embedded in the pharynx – the adenoids or pharyngeal tonsils are found in the nasopharynx and the palatine tonsils in the oropharynx.

When the adenoids are swollen, it is difficult for air to pass from the nose to the throat and sufferers often breathe through their mouths. Although lymphatic tissue plays an important role in the body’s defence mechanisms, both sets of tonsils can be removed (tonsillectomy) if they become infected repeatedly. However, the operation has potentially serious complications.

Air is drawn through the pharynx into the larynx.

The larynx or voice box

The larynx is located immediately below the pharynx and is formed of pieces of cartilage bound together by ligaments. The largest of these, the thyroid cartilage, is often visible in the neck of adult males and is known as the Adam’s apple.

Another leaf-shaped piece of cartilage, the epiglottis, partly covers the opening of the larynx and acts like a trapdoor, closing off the glottis during swallowing so that food and fluids cannot enter the trachea. If anything other than air enters the larynx, the cough reflex is triggered to try to expel the foreign matter (Marieb, 2006).

As well as being part of the airway, the larynx contains the highly elastic vocal cords or folds. These two short, fibrous bands are stretched across the inside of the larynx. The space between the two cords is known as the glottis.

Exhaled air passing through the glottis makes the vocal cords vibrate, producing sound waves. Muscles attach the vocal cords to the larynx and can stretch the vocal cords so that they become taut or allow them to relax. When the vocal cords are taut, the voice is high-pitched; when relaxed, it is low-pitched. The resultant sound is amplified and resonates in the pharynx, the oral and nasal cavities, and the paranasal sinuses.

At its lower end, the larynx joins the trachea.

**FIG 2. THE SINUSES AND TURBINATES**

![Diagram of the sinuses and turbinates](image)

**REFERENCES**