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RESPIRATORY SYSTEM

The primary function of the respiratory system is to supply oxygen to the blood and to remove carbon dioxide that the blood accumulates as a result of cellular respiration (Plate 54) in the tissues through which it passes. It also functions, along with the urinary system, in maintaining acid-base balance. The respiratory system consists of a series of tubes, the conduction part, and numerous tiny chambers, the gas exchange part.

Color the heading Conduction Part, titles A through F, and the related structures in the upper part of the plate. A light color for F is recommended.

The primary entrance to the respiratory tract is through the nose, which is guarded by large hairs. Alternatively, the tract may be entered by way of the mouth and oral pharynx. The lining tissue of the nose and *nasal cavities (respiratory mucosa)* is ciliated pseudostratified columnar epithelium. Numerous mucus-secreting goblet-shaped cells are interspersed throughout it, and a layer of connective tissue lies beneath it. The nasal cavities are narrow, twisting passageways created by curled bony projections (conchae), enabling particles suspended in the inspired air to be trapped in the mucus. The power strokes of the cilia carry the particles to the *pharynx,* where they can be swallowed. The single-cell thickness of the epithelial tissue allows heat from the adjacent rich blood supply to permeate the nasal cavity, warming the inhaled air, while evaporation from the constant flow of mucus humidifies it. This cleansing, warming, and humidifying function is essential to prepare air for contact with the delicate tissue of the lung capillaries. The nasal cavities connect with several cavities in the head that are lined with typical respiratory mucosa. These are called paranasal air sinuses (two are shown). They add resonance to the voice and probably increase the overall humidity of the air.

Below the pharynx is the *larynx,* a sound producing and manipulating organ, consisting of a cartilaginous framework, a membranous attachment to a small bone (the hyoid) at the base of the tongue, several groups of muscles, a covering of mixed respiratory and oral-like mucosa, and two taut ligaments (vocal cords) stretched in parallel across the laryngeal orifice from front to back. By opening and closing and by varying the tension of the two vocal cords and the flow of air across them, sounds of various pitches and volumes can be produced. The larynx also serves to guard the lower respiratory tract by functioning in the cough reflex.

The *trachea* is a tube lined with respiratory mucosa and stiffened by a series of incomplete cartilaginous rings secured by fibrous membranes. It conducts incoming air into the right and left *bronchi* (singular, bronchus). The *primary bronchi,* supported by cartilaginous plates enmeshed in fibrous tissue, disappear into the lungs, where they divide into *secondary,* or lobar, *bronchi.* Three secondary bronchi in the right lung and two in the left supply air to the lobes. Each secondary bronchus divides into *tertiary,* or segmental, *bronchi.* These are progressively smaller than the bronchi above and contain less cartilage and more elastic tissue and smooth muscle. Each tertiary bronchus serves a bronchopulmonary segment; there are generally ten segments in the right lung and eight in the left.

Within each segment, the bronchus narrows to a tube about 0.5 millimeter in diameter and loses all of its cartilage. Such a tube is called a *bronchiole,* and its epithelial surface is more cuboidal but still ciliated and glandular. It retains smooth muscle and elastic tissue in its wall. This bronchiole terminates by dividing into respiratory bronchioles.

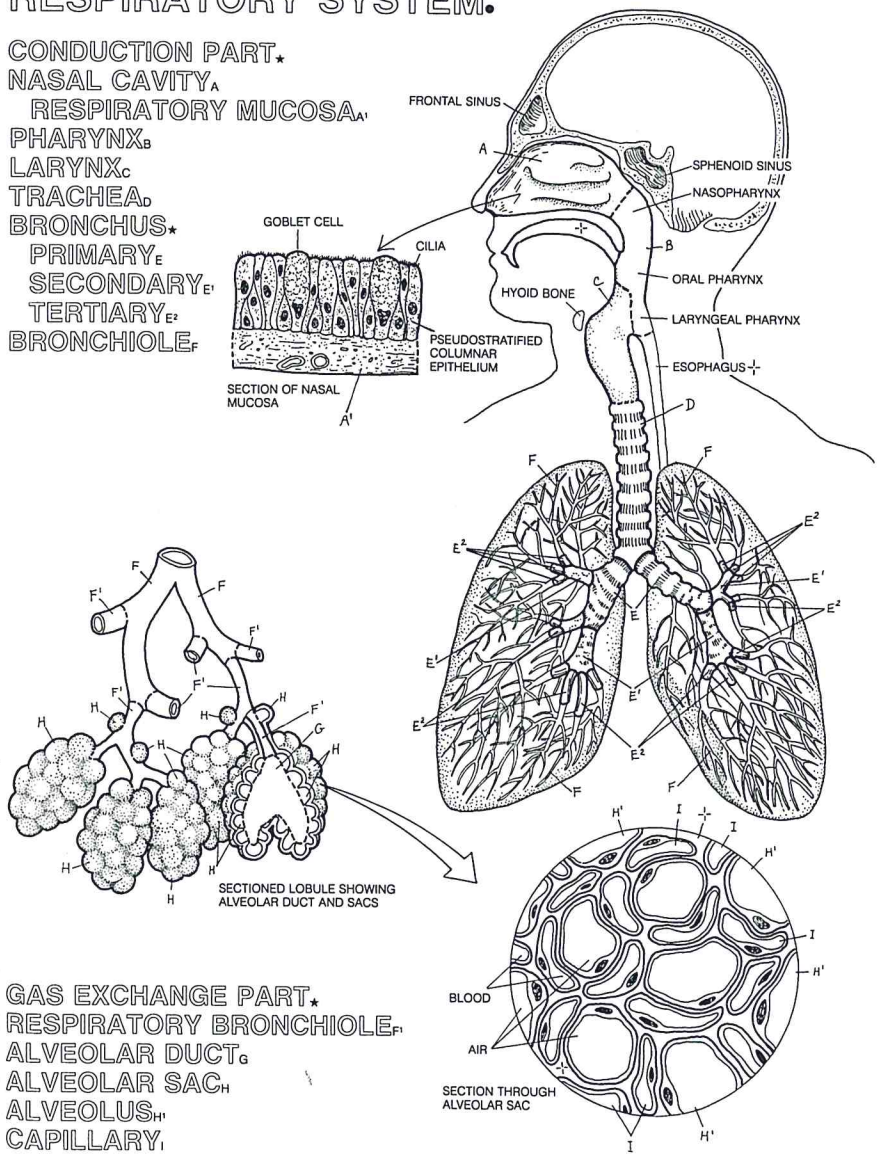
Color the heading Gas Exchange Part, titles F¹ through I, and the remainder of the plate.

As each *respiratory bronchiole* dives deeper into the lung, it loses its muscle investments and its epithelia become squamous, losing their cilia and mucus-secreting cells. The respiratory bronchiole divides into *alveolar ducts,* which open into *alveolar sacs,* each sac consisting of several *alveoli* (air sacs; singular, alveolus) where the actual exchange with the blood takes place. The part of the tract from respiratory bronchiole to alveolus constitutes the air exchange unit.

Each alveolus is adjacent to very thin-walled *capillaries,* and it is by way of this interface that gas exchange is accomplished. Oxygen diffuses rapidly from the alveolus into the blood, and carbon dioxide diffuses rapidly from the blood into the alveolus, since there is a marked difference in the concentrations of these two gases between the capillary and the alveolar spaces. If alcohol, acetone, or other volatile substances are present in the blood, they, too, can be excreted to some extent in this way. In a similar manner, volatile toxins in the inspired air can enter the alveoli and diffuse into the blood.

RESPIRATORY SYSTEM.

CONDUCTION PART★
NASAL CAVITY$_A$
RESPIRATORY MUCOSA$_{A'}$
PHARYNX$_B$
LARYNX$_C$
TRACHEA$_D$
BRONCHUS★
PRIMARY$_E$
SECONDARY$_{E'}$
TERTIARY$_{E^2}$
BRONCHIOLE$_F$



GAS EXCHANGE PART★
RESPIRATORY BRONCHIOLE$_{F'}$
ALVEOLAR DUCT$_G$
ALVEOLAR SAC$_H$
ALVEOLUS$_{H'}$
CAPILLARY$_I$

The Respiratory System

Word Bank:

- Alveoli of lung
- Bronchi
- Bronchioles
- Carbonic Acid
- CO_2 Diffuses into blood
- Diaphragm and intercostal muscles
- Due to high CO_2
- Epiglottis
- Nose
- O_2 diffuses in
- Pharynx then larynx
- Trachea

Are controlled by the

in humans

can be

Lungs
(cavities within animals)

in humans,
starts with the

(air is filtered)

goes to the

(voice box)

then
enters

is protected from
food/liquid by

then

(2 tubes)

then

(smaller tubes)

then

(Capillary rich elastic sacs)

where

where it

binds to
hemoglobin

when pH decreases

(or lactic acid)

hemoglobin releases O2

to tissues

then

where

carbonic anhydrase
(found in erythrocytes)

converts it to

which eventually reaches

CO2 diffuses out