

The **respiratory tract**, with the assistance of the thoracic diaphragm and intercostal muscles, conducts air to the respiratory units of the lungs (*inspiration*), on average, in 500-milliliter quantities so that oxygen can be readily absorbed by the blood and carbon dioxide-laden air can be exhausted to the external atmosphere. The larynx (pronounced *lair-inks*) develops and refines sounds into potentially intelligible vocalization and can produce a range of sounds from beautiful melody to ripping angry invective. The tract helps to maintain the acid–base balance of the blood by blowing off excess acid in the form of carbon dioxide. Nowhere else in the body does the outside world, with all its creatures of microscopic dimension, have such easy access to the protected interior cavities of the body as it does at the air/blood interfaces of the lung. The body, however, does have a portfolio of means to protect itself, as you shall see. The respiratory tract consists of both air-conducting and respiratory (gas-exchange) parts.

The air-conduction tract includes an upper (**nasal cavity, pharynx, larynx**) and a lower tract (**trachea, primary bronchi, and bronchial tree**). The upper tract is lined with **respiratory mucosa**, except in the lower pharynx where it has a stratified squamous epithelial surface. Except for the nose and pharynx, the frame of the respiratory tract is cartilaginous down to the smallest airways (*bronchioles*), where the cartilage is replaced by smooth muscle. The parts associated with gas exchange are the smallest bronchioles and alveoli (respiratory units), which take up much of the lung's volume.

The muscular **diaphragm** provides much of the force necessary for the inspiration and expiration of air. Another 25% of that force is generated by the intercostal muscles moving the ribs.

The mucosa of the respiratory tract is largely lined with **pseudostratified columnar** and (in the bronchioles) simple cuboidal **epithelia** with mucus-secreting, goblet-shaped gland cells and cilia on the free surface. These cells transition to simple squamous epithelia in the respiratory bronchioles and alveoli (air cells). Just above these transition cells, excreted mucus traps foreign particulate matter on the bronchiolar/bronchial surfaces (well above the alveoli), where the power strokes of the cilia move the mucus toward the pharynx for excretion. Inhaled air is hydrated, putting oxygen in solution, and the air is heated from underlying **blood vessels**. The epithelial cells are supported by a loose, fibrous, vascular **lamina propria**, replete with fibroblasts, lymphocytes, and lymphoid follicles where phagocytic and immune responses are at work. Deep to this connective tissue layer is the submucosa, characterized by tubular seromucous **glands**, the ducts of which excrete mucus onto the surface of the trachea. The supporting tissue deep to the submucosa varies: It is bone in the nasal cavity; striated and some smooth muscle in the pharynx; hyaline cartilage in the larynx, trachea, and bronchi; smooth muscle in the bronchioles; and thin fibers supporting the air cells.