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Perspective

Respiratory System: An Overview

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PERSPECTIVE

The respiratory system (also known as the respiratory apparatus or ventilatory system) is a biological system in animals and plants that consists of particular organs and structures for gas exchange. The anatomy and physiology that allows this to happen varies dramatically depending on the organism's size, environment, and evolutionary history. The respiratory surface of land animals is internalised as lungs linings. Millions of little air sacs in the lungs exchange gas; in mammals and reptiles, these are called alveoli, and in birds, they are called atria. The air is brought into close contact with the blood by these small air sacs, which have a plentiful blood supply. These air sacs interface with the outside world by a series of airways, or hollow tubes, the greatest of which is the trachea, which branches into the two main bronchi in the middle of the chest. These enter the lungs and branch into progressively narrower secondary and tertiary bronchi, which branch into a plethora of smaller tubes known as bronchioles. The bronchioles in birds are known as parabronchi. In mammals, it is the bronchioles, or parabronchi, that open into the microscopic alveoli, whereas in birds, it is the atria. The process of breathing, which involves the muscles of respiration, must pump air from the environment into the alveoli or atria. These air sacs interface with the outside world by a series of airways, or hollow tubes, the greatest of which is the trachea, which branches into the two main bronchi in the middle of the chest. These enter the lungs and branch into progressively narrower secondary and tertiary bronchi, which branch into a plethora of smaller tubes known as bronchioles.

The bronchioles in birds are known as parabronchi. In mammals, it is the bronchioles, or parabronchi, that open into the microscopic alveoli, whereas in birds, it is the atria. The process of breathing, which involves the muscles of respiration, must pump air from the environment into the alveoli or atria. The respiratory system of most fish and a variety of other aquatic species (including vertebrates and invertebrates) is made up of gills, which are partially or entirely external organs that are bathed in the aqueous environment. Water flows over the gills in a number of ways, both active and passive. The gills, which are made up of thin or extremely flat filaments, and the lammelae, which expose a huge surface area of highly vascularized tissue to the water, are where gas exchange takes place. Other creatures, such as insects, have relatively simple structural features in their respiratory systems, and in amphibians, even the skin plays an important part in gas exchange. Plants have respiratory systems as well, but their gas exchange directionality differs from that of animals. Plants' respiratory systems include anatomical elements such as stomata, which can be found throughout the plant. The respiratory tract is the architecture of a normal respiratory system in humans and other mammals.

The respiratory system is separated into two parts: upper and lower. The nose, nasal cavities, sinuses, pharynx, and the region of the larynx above the vocal folds make up the upper tract. The lower tract consists of the larynx's lower section, the trachea, bronchi, bronchioles, and alveoli. The respiratory tree, also known as the tracheobronchial tree, is a term used to describe the branching airways of the lower respiratory tract. Branching "generations" are the intervals between successive branch points along the various branches of the "tree," of which there are around 23 in an adult human. The trachea and bronchi, as well as the bigger bronchioles that merely operate as air conduits, transport air to the respiratory bronchioles, alveolar ducts, and alveoli (about generations 17–23), where gas exchange occurs. Bronchioles are small airways that do not have any cartilagenous support. The right and left major bronchi are the first to branch from the trachea. These bronchi (1-1.4 cm in diameter), which are second in diameter only to the trachea (1.8 cm), enter the lungs at each hilum, where they branch into narrower secondary bronchi known as lobar bronchi, which branch into narrower tertiary bronchi known as segmental bronchi. The 4th order, 5th order, and 6th order segmental bronchi, or sub-segmental bronchi, are further divisions of the segmental bronchi (1 to 6 mm in diameter). In comparison to the adult human's respiratory tree, which has 23 branchings on average, the mouse's respiratory tree has only about 13 branchings. The alveoli are the "tree's" dead end terminals, which mean that any air that enters must escape by the same path. A system like this creates dead space, which is a volume of air (about 150 ml in an adult human) that fills the airways after exhalation and is inhaled back into the alveoli before the ambient air reaches them. The airways are filled with ambient air at the end of inhalation, which is expelled without coming into touch with the gas exchanger.

During the breathing cycle, the lungs expand and collapse, pulling air in and out. Spirometry measures the volume of air moved in and out of the lungs under typical resting conditions (the

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resting tidal volume of roughly 500 ml), as well as the volumes moved during maximally forceful intake and exhalation. During maximally forceful exhalation, not all of the air in the lungs can be evacuated. This is the 1.0-1.5 litres of residual volume that cannot be quantified by spirometry. Spirometry cannot measure volumes that include the residual volume (i.e. functional residual capacity of around 2.5-3.0 litres and total lung capacity of about 6 litres). Their measurement necessitates the use of specialised methods. The following table shows the rates at which air is breathed in or out, either through the mouth or nose, or into or out of the alveoli, as well as how they are computed. The respiratory rate is defined as the number of breath cycles per minute.