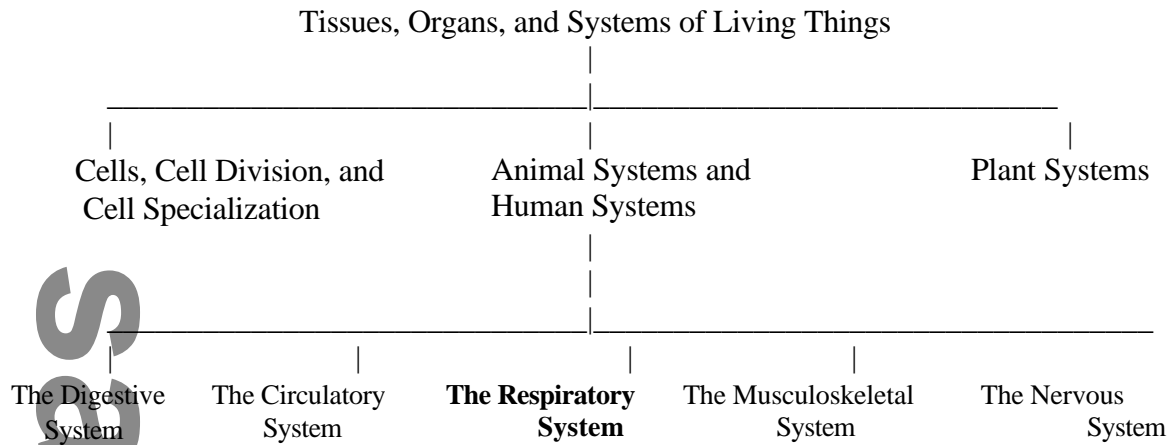


# Animal Systems: The Respiratory System



## The Respiratory System

An **organ system** is a group of organs that are co-ordinated to work together to perform specific tasks in the body. Organ systems are made up of groups of organs.

**Organs** are made up of tissues. **Tissues** are made up of specialized cells.

**Respiration:** is the process of taking in oxygen and releasing carbon dioxide. Oxygen reacts with nutrients in the mitochondria to release energy, whilst carbon dioxide is produced as the waste product.

**Respiratory system:** the organ system that is made up of the nose, mouth, trachea, bronchi and lungs, the system that provides oxygen for the body and allows carbon dioxide to leave the body.

*How does oxygen enter the body?*

The respiratory system is responsible for providing the oxygen required by the body and for removing the carbon dioxide produced as the body uses the energy for growth, repair and movement.

*How does the oxygen get to the body cells?*

The respiratory system works in conjunction with the circulatory system to distribute oxygen to the cells and to remove carbon dioxide. One system could not do its work without the proper functioning of the other.

The diagram below is a circle, with oxygenated air, (red blood), moving downward on the chart, from the lungs to the circulatory system to the tissues, and deoxygenated blood, (blue blood), running upward on the chart, from the tissues to the circulatory system to the lungs.

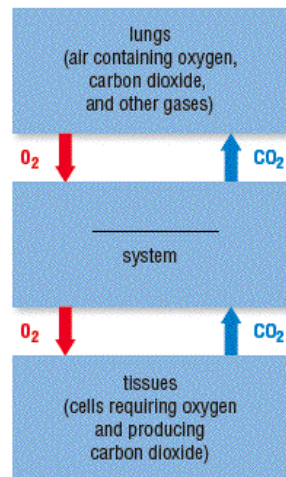
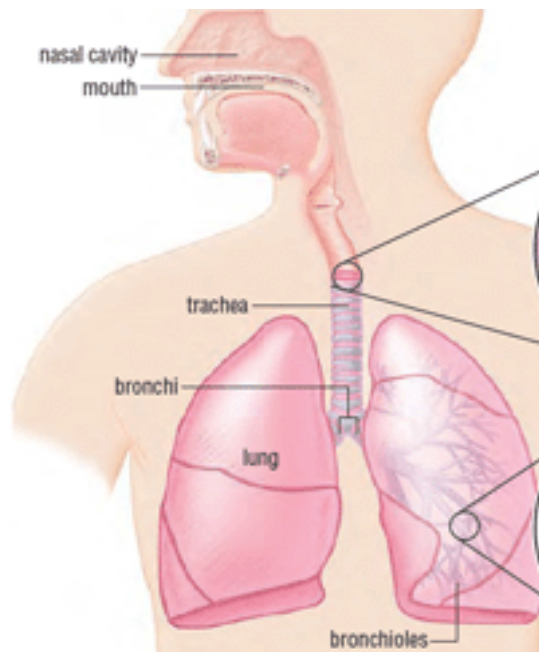


Diagram:

## The structure and function of the respiratory system



The respiratory system brings oxygen in through the **nasal cavity**. Dust and other foreign particles are trapped and filtered out of the air by tiny hairs and a layer of mucus that line these passages. The incoming air is also warmed and moistened by these surfaces.

Once through the nasal passages, it then passes through the **pharynx**, (i.e. the throat), and then the air moves down into the **trachea**, (i.e. the windpipe) towards the lungs; while food enters the esophagus and is passed to the stomach.

Unless swallowing, the epiglottis remains open so that the air can enter the trachea and travel to the **lungs**. [The **epiglottis** is a muscular flap-like structure of skin that covers the opening to the trachea whenever swallowing occurs. This safety mechanism of the body keeps the digestive system from interfering with the respiratory system. When food is in the passage, the epiglottis closes so no food gets in the trachea. “Food that went down the wrong way” refers to the fact that food likely got stuck in the larynx (i.e. the vocal cords), or the epiglottis did not prevent the food from entering the trachea.]

The trachea separates into two branches called **bronchi** (*singular bronchus*). The inhaled air moves down the trachea and into the two bronchi.

Each bronchus divides into smaller tubes called **bronchioles**—air enters the lungs through the bronchi and then into the extensive network of smaller tubes, i.e. the bronchioles.

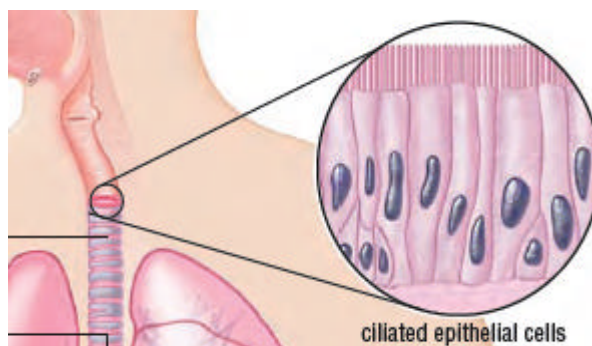
After entering the bronchioles, the air passes into increasingly smaller and smaller tubes, ending into tiny air sacs, with thin walls called **alveoli**, (*singular: alveolus*). It is in the alveoli that the actual exchange of gases between the air and the blood takes place. **See Page 3: Gas Exchange**, and **See Diagram: Alveolus on Page 4**

Each alveolus is surrounded by a network of **capillaries**. Alveoli depend on capillaries to provide a good supply of blood.

The **epithelial cells** that line the trachea and bronchi and bronchioles secrete mucus and have **cilia** (i.e., hair-like projections).

The purpose of the ciliated epithelial cells is to filter out any foreign material, such as dust, pollen, and bacteria that might enter the system; and to help move mucus.

**Diagram:** The purpose of the cells shown in the diagram is to filter out any foreign material, such as dirt and bacteria that might enter the system.



The lungs send the oxygen into alveoli, which are attached to capillaries.

The capillaries diffuse the oxygen into red blood cells while diffusing carbon dioxide back into the lungs.

The lungs then exhale the carbon dioxide up through the trachea and out through the mouth and nasal cavity.

The function of the lungs is to provide oxygen to the blood, which carries the oxygen throughout the body.

Epithelial tissues inside the lungs are moist.

This allows the oxygen coming in to be dissolved in the fluid and carried around the body in the bloodstream.

### **Gas Exchange** (See Diagram on Page 5)

There are some 300 million alveoli in two adult lungs, each measuring between 0.1 mm and 0.2 mm in diameter. These provide a surface area of some 160 m<sup>2</sup> (almost equal to the singles area of a tennis court and 80 times the area of our skin!).

Only in the alveoli does actual gas exchange takes place. A network of capillaries surrounds each cluster of alveoli.

Oxygen enters the bloodstream in the lungs by diffusion and carbon dioxide also leaves the bloodstream by diffusion.

**Diffusion:** movement of substances from an area of higher concentration to an area of lower concentration.

A large surface area allows for more places along the surface where materials can be transported.

The lungs contain thousands of alveoli that allow oxygen and carbon dioxide to diffuse between the lungs and the bloodstream.

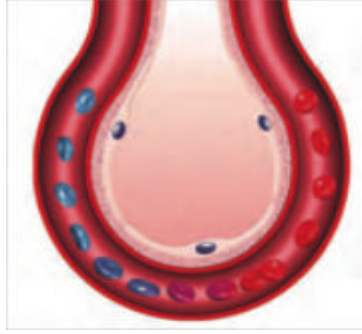
The large surface area means that gas exchange can take place more efficiently.

When blood enters the lungs, it contains a higher concentration of carbon dioxide than the air in the alveoli does.

Therefore carbon dioxide diffuses out of the blood and into the alveoli, (area of higher concentration in lungs to lower concentration of the alveoli).

Also, the air in the alveoli contains a higher concentration of oxygen than the blood does returning to the lungs, so oxygen diffuses out of the air ( in the alveoli) into the blood.

**Diagram of the Alveolus:** Capillaries bring red blood cells to the alveolus. Carbon dioxide is diffused out of the blood cells, and oxygen is diffused into the blood cells to be delivered to the body.



**Breathing:** is the intake, (inhale) and output of air, (exhale). Breathing involves muscles that move the ribs, making the rib cage expand and contract. Breathing also involves the **diaphragm**— this is a muscle in the abdomen that moves up and down, forcing air in and out of the lungs; and it is entirely made up of connective tissue.

As it moves up, air is expelled out of the lungs, as it moves down, air is sucked into the lungs through your nose or mouth, ( to equalize internal and external air pressure).

**Hiccups:** Sometimes the diaphragm becomes irritated , causing it to experience muscle spasms. This forces air rapidly through the larynx creating the sounds that is called the “hiccups”.

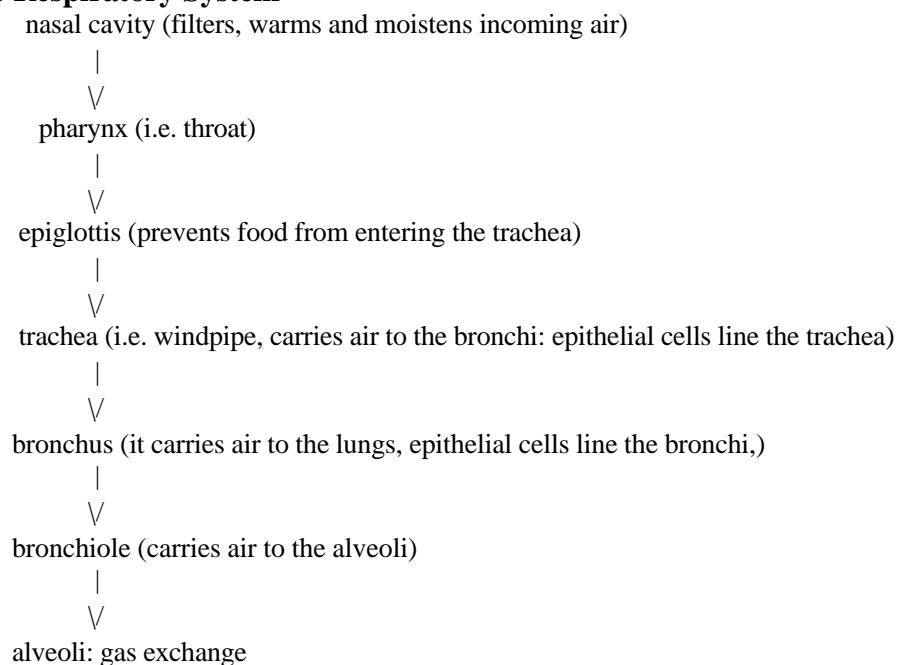
### Diseases of the Respiratory System

The delicate surfaces of the human respiratory system are in continual contact with the air, thus exposing the moist thin tissues of the system to damage and disease from pathogens and chemical pollutants; thus decreasing the supply of oxygen to the body.

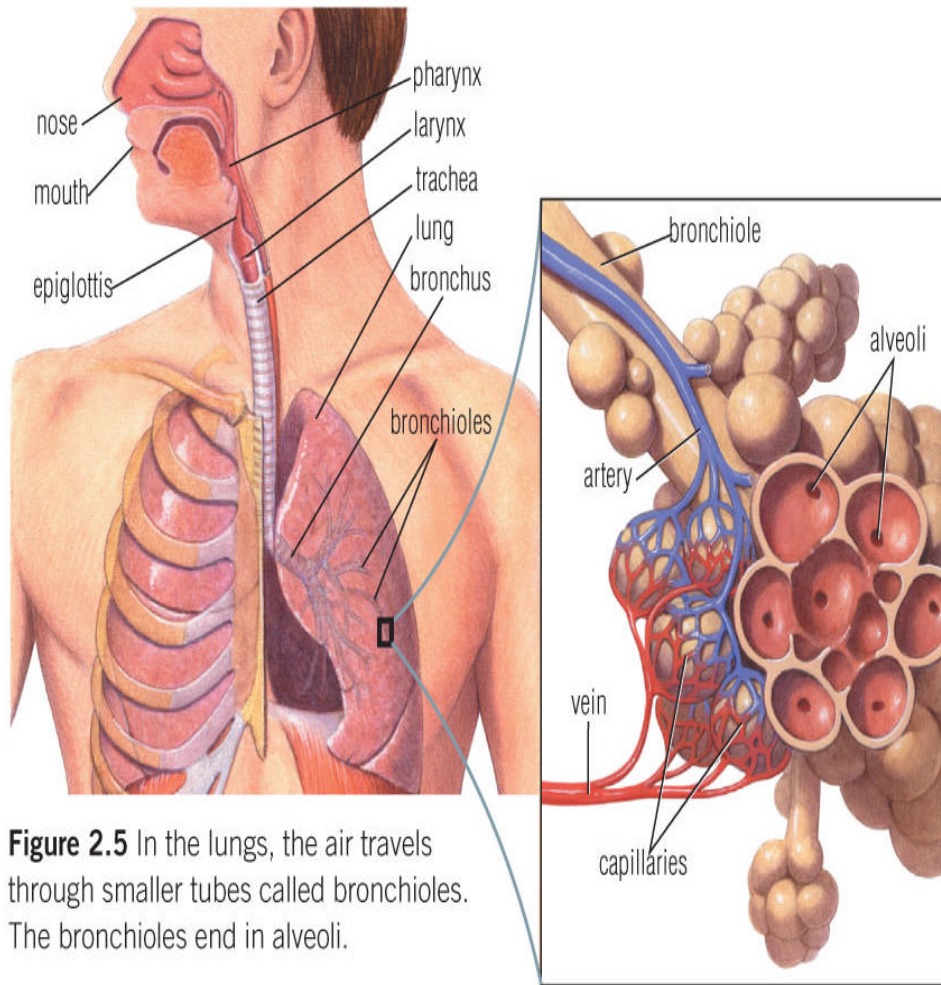
This can lead to diseases such as asthma, Lung Cancer, Severe Acute Respiratory Syndrome: SARS

**Tuberculosis (TB):** an infectious disease, diagnosed by X-ray, but to confirm TB stomach and lung secretions must be examined, caused by bacteria, cured by antibiotics, however now strains of TB have become resistant to antibiotics.

### Summary: The Respiratory System



# The Human Respiratory System



**Figure 2.5** In the lungs, the air travels through smaller tubes called bronchioles. The bronchioles end in alveoli.

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## Assignment

1. Name the main organs and structures of the respiratory system.
2. What is the function of the epithelial tissue line the trachea and the bronchi?
3. What is the relationship between the circulatory system and the respiratory system of an organism?
4. What is the advantage of having a large surface area for gas exchange in the alveoli?
5. Describe what happens in the alveoli.
6. List the structures, in order from outside the body to inside the body, that a molecule of oxygen travels through on its way to the bloodstream.
7. Which cells in the respiratory system secrete mucus? Why is mucus important?
8. State the main functions of the following:
  - a. Epiglottis
  - b. Trachea
  - c. Cilia
  - d. Alveoli
9. What features of the respiratory system make it particularly vulnerable to pollutants or infections?
10. Write a paragraph that explains the interrelationship between the following terms: oxygen cellular respiration, carbon dioxide, food, and energy.