Defense Mechanisms of the Respiratory System

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The average person who is moderately active during the daytime breathes about 20,000 liters (more than 5,000 gallons) of air every 24 hours. Inevitably, this air (which would weigh more than 20 kilograms [44 pounds]) contains potentially harmful particles and gases. Particles, such as dust and soot, mold, fungi, bacteria, and viruses deposit on airway and alveolar surfaces. Fortunately, the respiratory system has defense mechanisms to clean and protect itself. Only extremely small particles, less than 3 to 5 microns (0.000118 to 0.000196 inches) in diameter, penetrate to the deep lung.

Cilia, tiny muscular, hair-like projections on the cells that line the airway, are one of the respiratory system's defense mechanisms. Cilia propel a liquid layer of mucus that covers the airways.

The **mucus layer** traps pathogens (potentially infectious microorganisms) and other particles, preventing them from reaching the lungs. Cilia beat more than 1,000 times a minute, moving the mucus that lines the trachea upwards about 0.5 to 1 centimeter per minute (0.197 to 0.4 inch per minute). Pathogens and particles that are trapped on the mucus layer are coughed out or moved to the mouth and swallowed.

Alveolar macrophages, a type of white blood cell on the surface of alveoli, are another defense mechanism for the lungs. Because of the requirements of gas exchange, alveoli are not protected by mucus and cilia—mucus is too thick and would slow movement of oxygen and carbon dioxide. Instead, alveolar macrophages seek out deposited particles, bind to them, ingest them, kill any that are living, and digest them. When the lungs are exposed to serious threats, additional white blood cells in the circulation, especially neutrophils, can be recruited to help ingest and kill pathogens. For example, when the person inhales a great deal of dust or is fighting a respiratory infection, more macrophages are produced and neutrophils are recruited.

(See also Overview of the Respiratory System.)