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Physics of the lung and Breathing

By

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Objectives: after the end of this lecture, the student must know:

1- How blood and lungs interact

2- Role of surfactant in preventing lung collapse

3- Physics of certain lung diseases.

We breath 6 liters of air per minute (this is also about the volume of blood the heart pumps each minute). Men breath 12 times per minute at rest while women and infants breath 20 times, 60 times per second respectively.

The air we inspire about (80 % N_2 + 20 % O_2), the air we expire (80% N_2+16 % O_2 + 4%CO_2.(

The lungs have large convoluted shape with surface area about 80m^2.

The Air Ways

The air passes through windpipe (trachea), each bronchus divide multiple times (about 15 times) until it reach to a sac like structure called alveoli of 0.2mm diameter and 0.4 μm wall thickness, each alveolus surrounded by blood capillary. So O_2 can diffuse from alveolus into RBC and CO_2 diffuse from blood into air in the alveolus.

1-Large chunks removed by cough

2- Small particles carried upward to the mouth by millions of small hairs or cilia of 0.1mm long that have wave like motion.

Each cilia vibrates about 1000 times a minute. The mucus moves 1-2 cm/min (1 mile/week). Cilia as escalator system of trachea. It takes 30

min for particle of dust to be cleared out of the bronchi and trachea into throat where it is expelled or swallowed.