GAS EXCHANGE AND GAS TRANSFER

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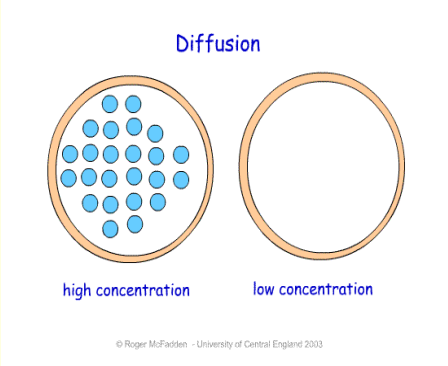
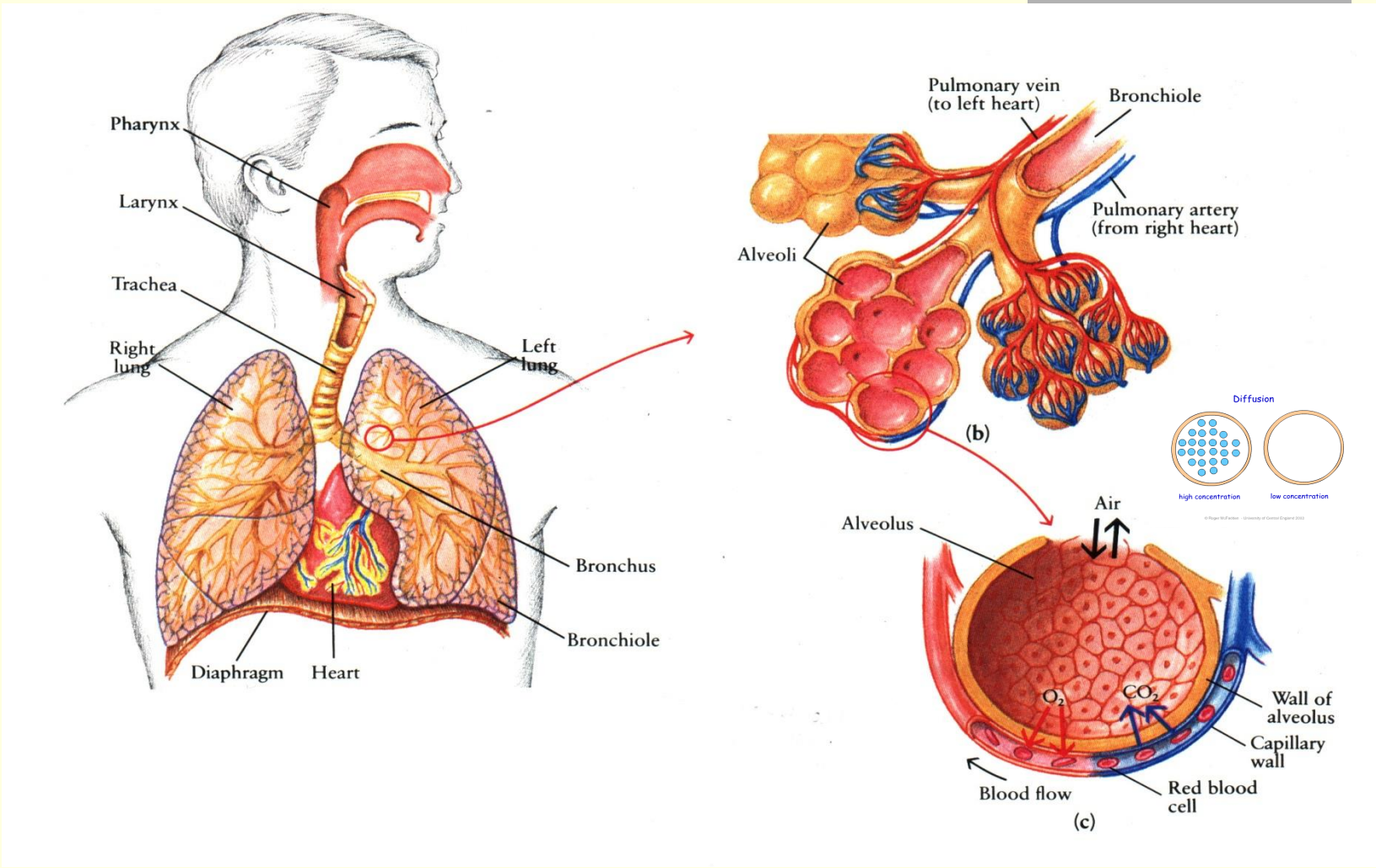
DIFFUSION OF GASES AND LAWS

- Henry's law
  - Gases diffuse from high pressure to low pressure.
- Diffusion rate depends upon
  - Pressure differential
  - Solubility of the gas in the fluid
  - The difference in the pressure of specific gases from the capillary blood to the alveoli dictates the direction of diffusion.



GAS EXCHANGE



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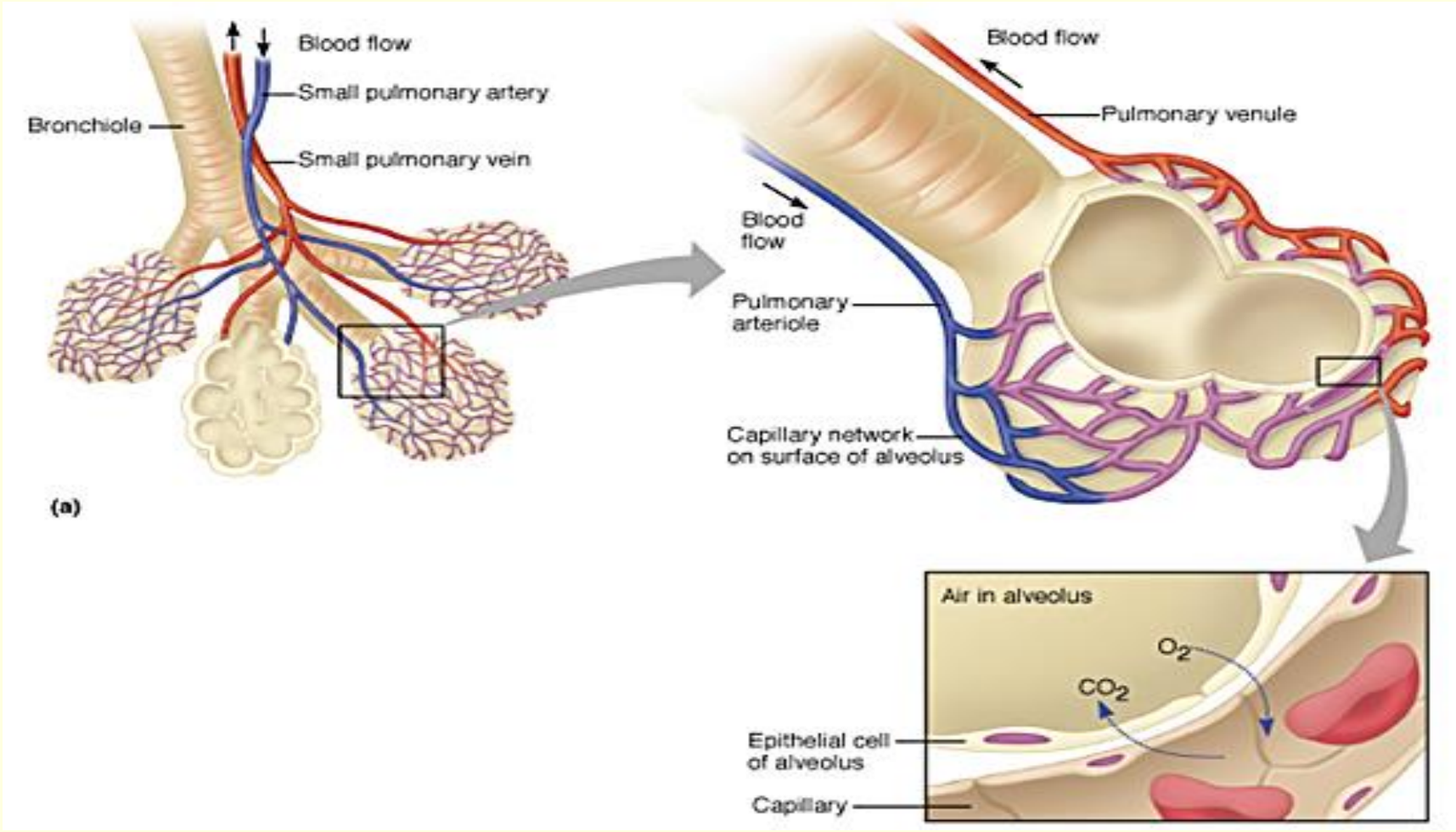

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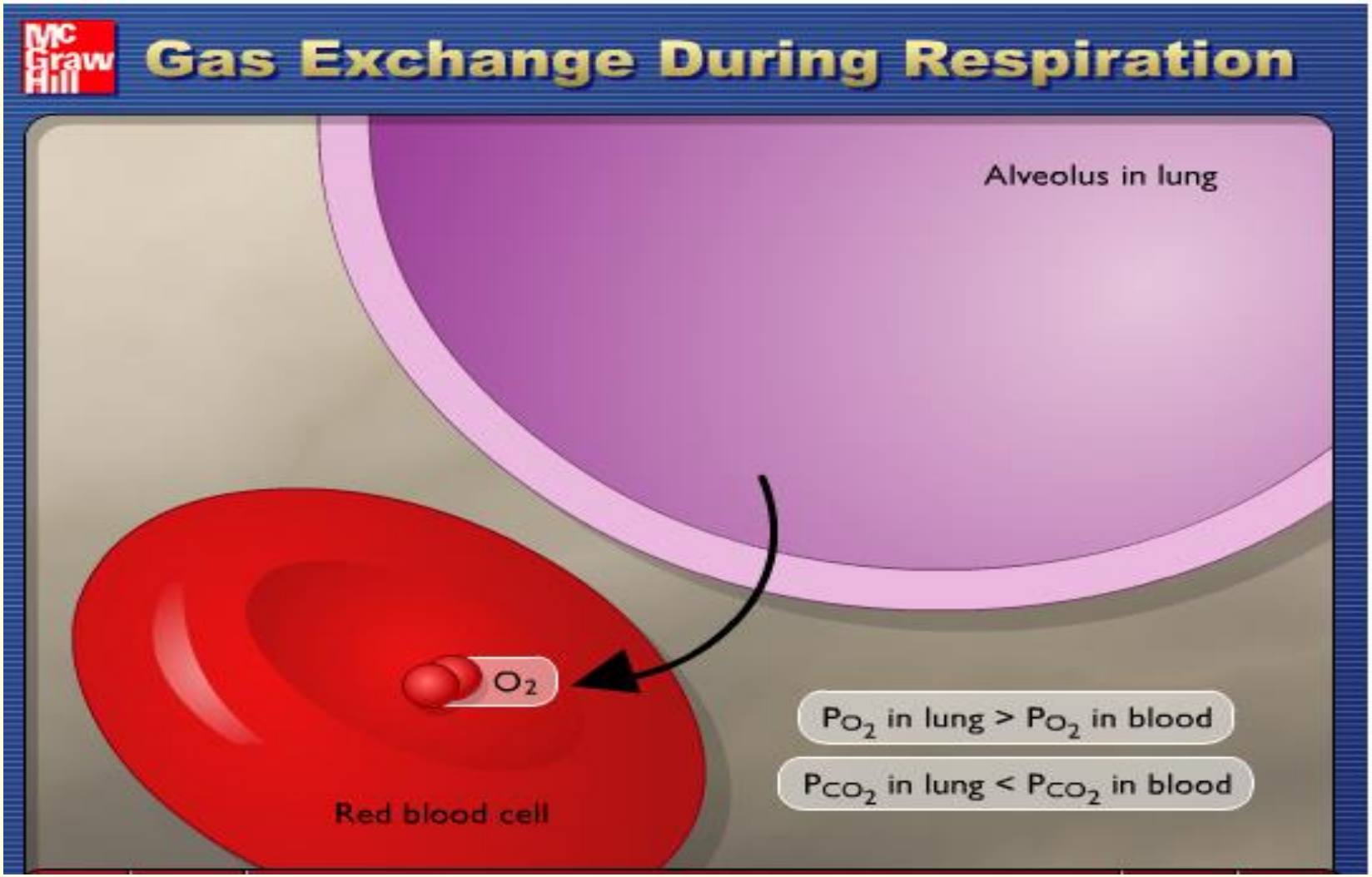

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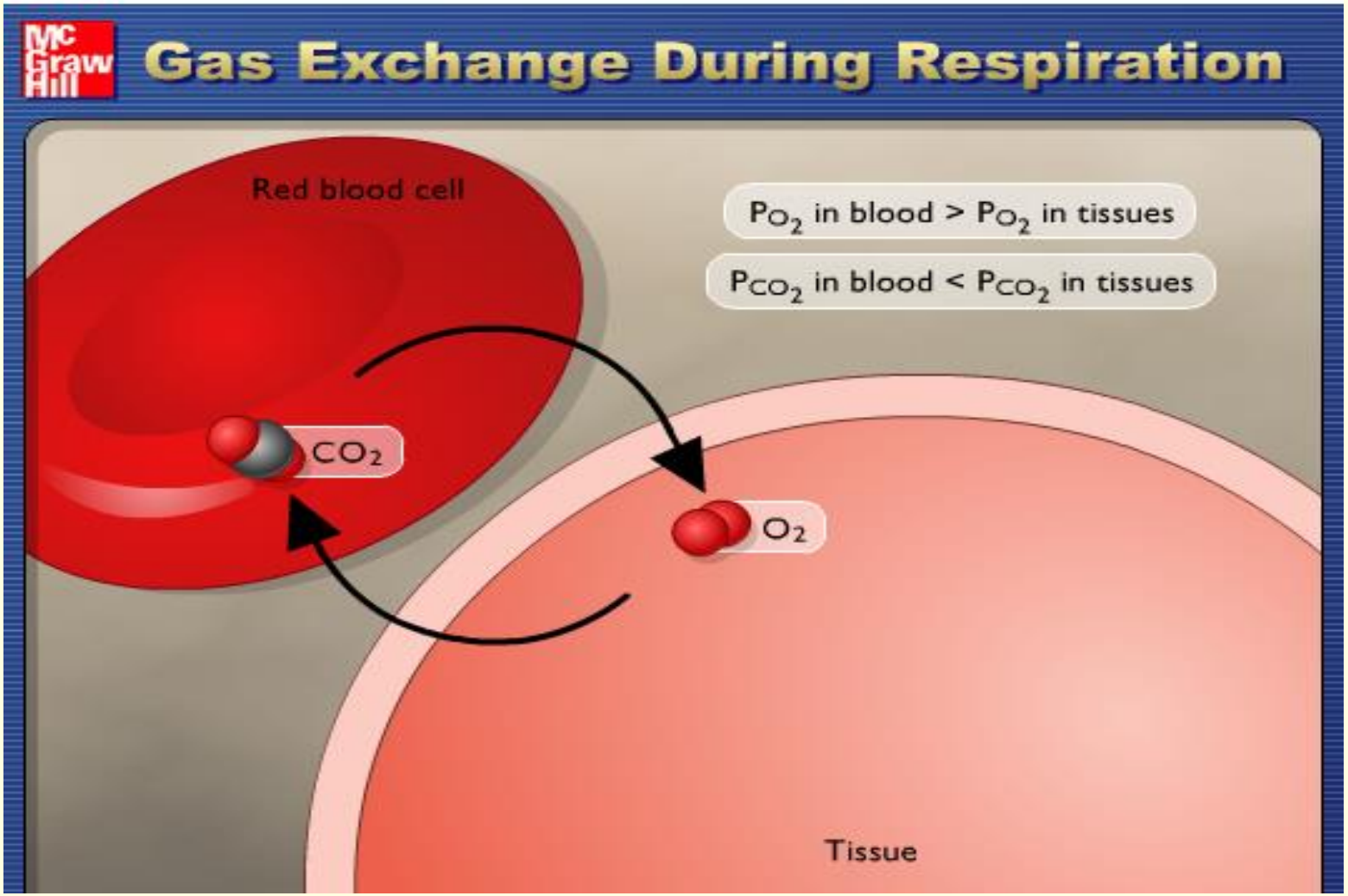
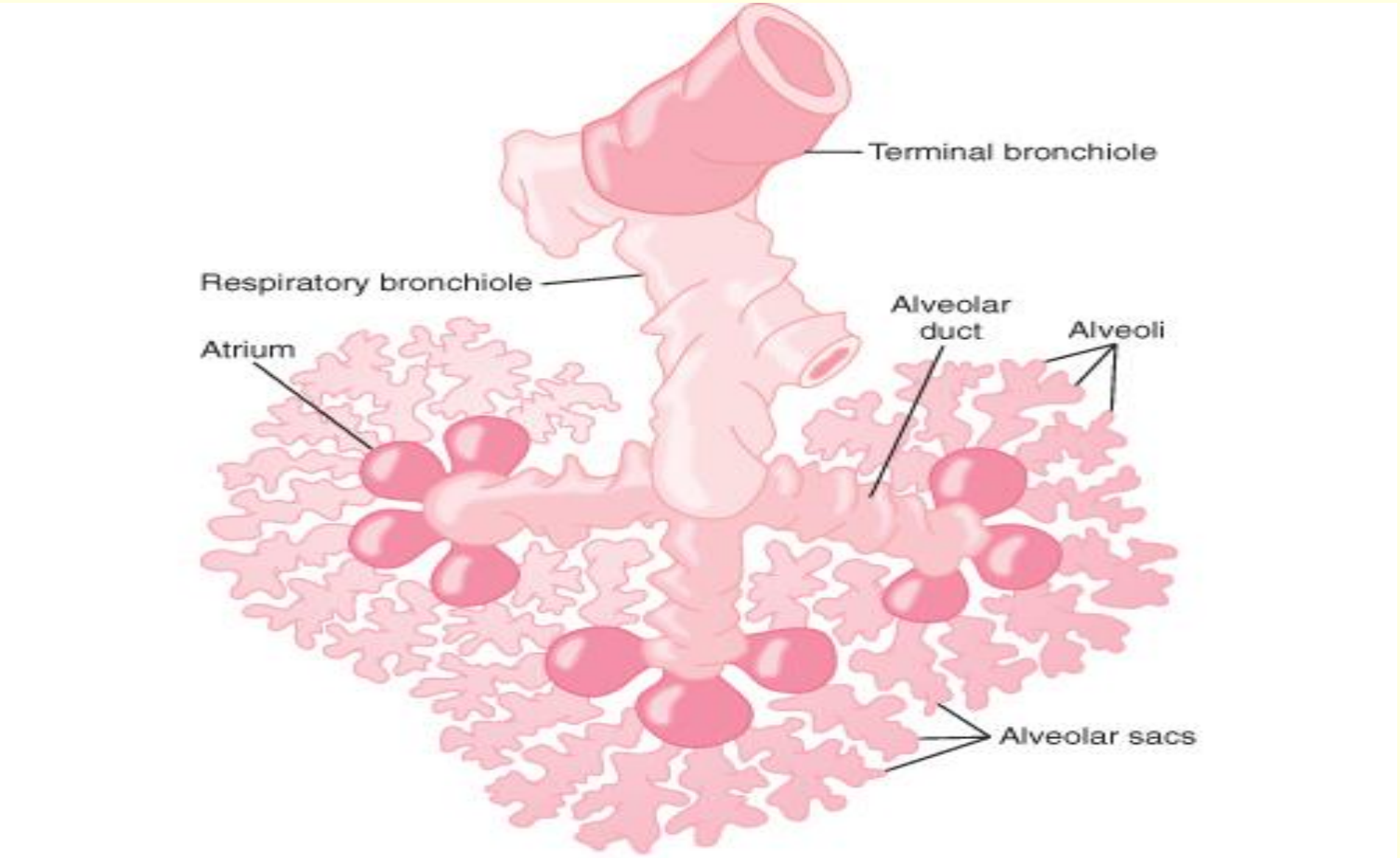


RESPIRATORY UNIT

Respiratory Unit: Also called “respiratory lobule”, which is composed of a respiratory bronchiole, alveolar ducts, atria, and alveoli.

There are about 300 million alveoli in the two lungs, and each alveolus has an average diameter of about 0.2 millimeter. The alveolar walls are extremely thin, and between the alveoli is an almost solid network of interconnecting capillaries,

RESPIRATORY UNIT

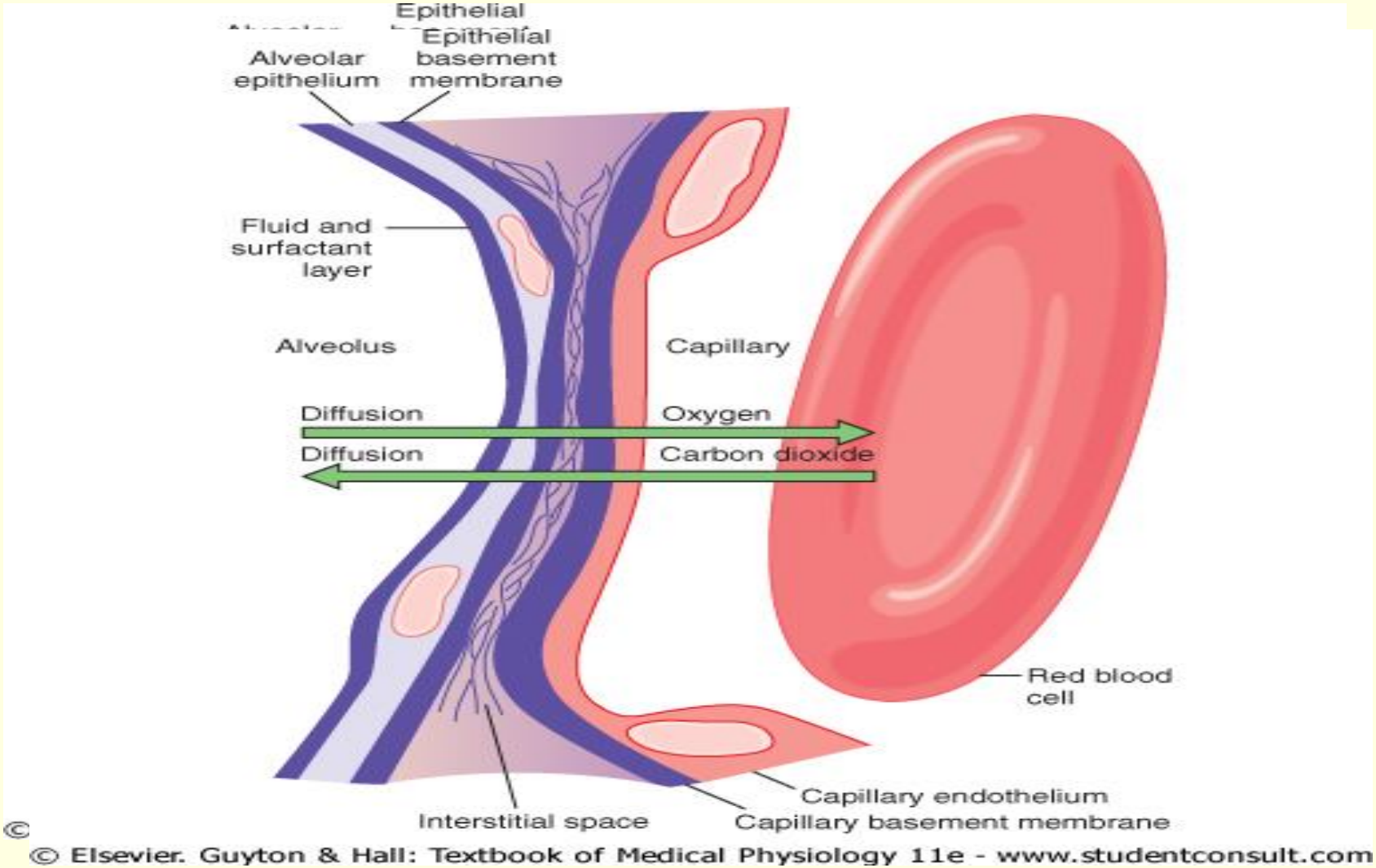


LAYERS OF THE RESPIRATORY MEMBRANE

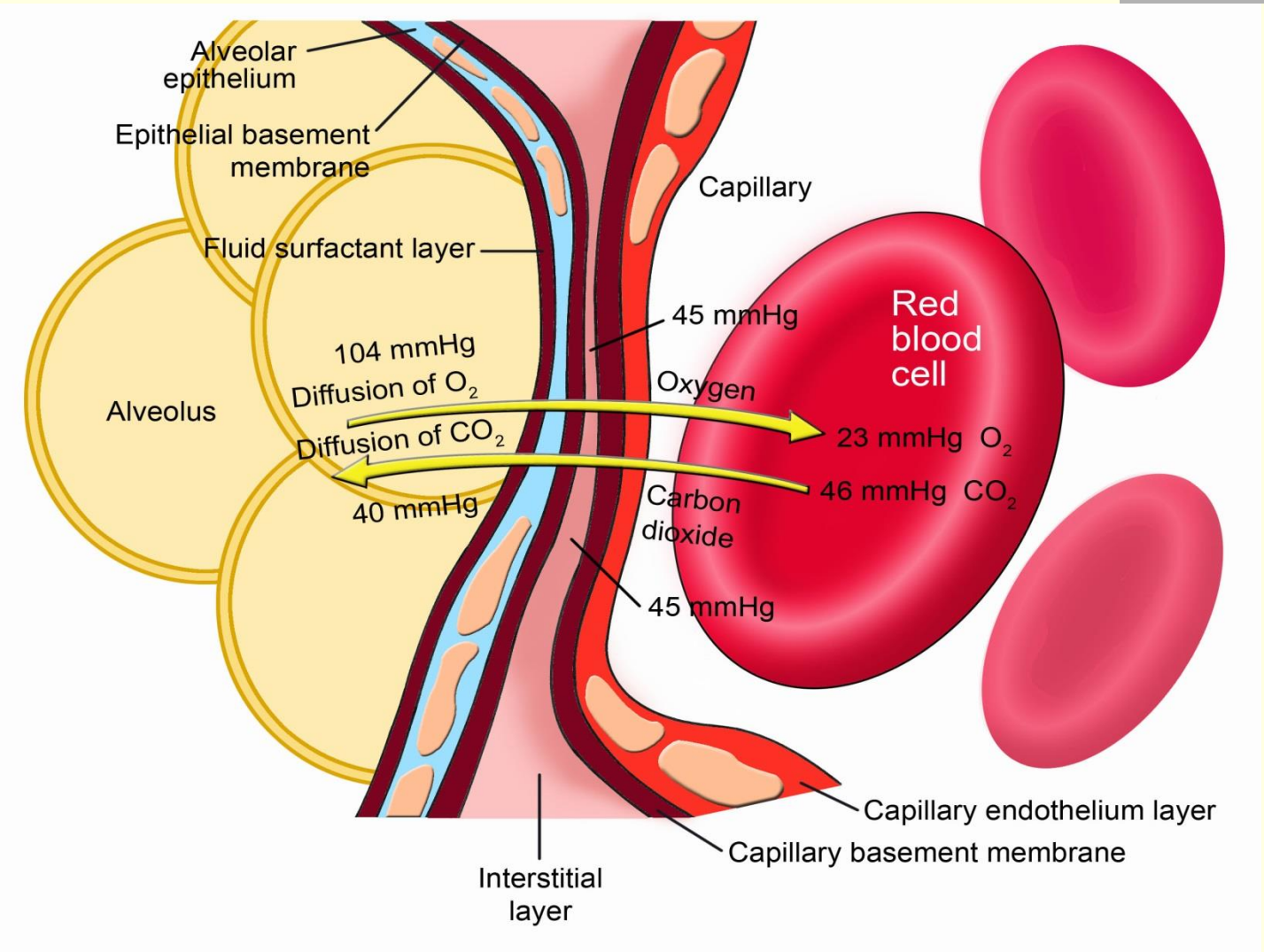
Diffusion of oxygen from the alveolus into the red blood cell and diffusion of carbon dioxide in the opposite direction. Note the following different layers of the respiratory membrane:

1. A layer of fluid lining the alveolus
2. The alveolar epithelium
3. An epithelial basement membrane
4. Interstitial space
5. Capillary basement membrane
6. The capillary endothelial membrane

LAYERS OF THE RESPIRATORY MEMBRANE



LAYERS OF THE RESPIRATORY MEMBRANE



CARBON DIOXIDE TRANSPORT AND CHLORIDE SHIFT

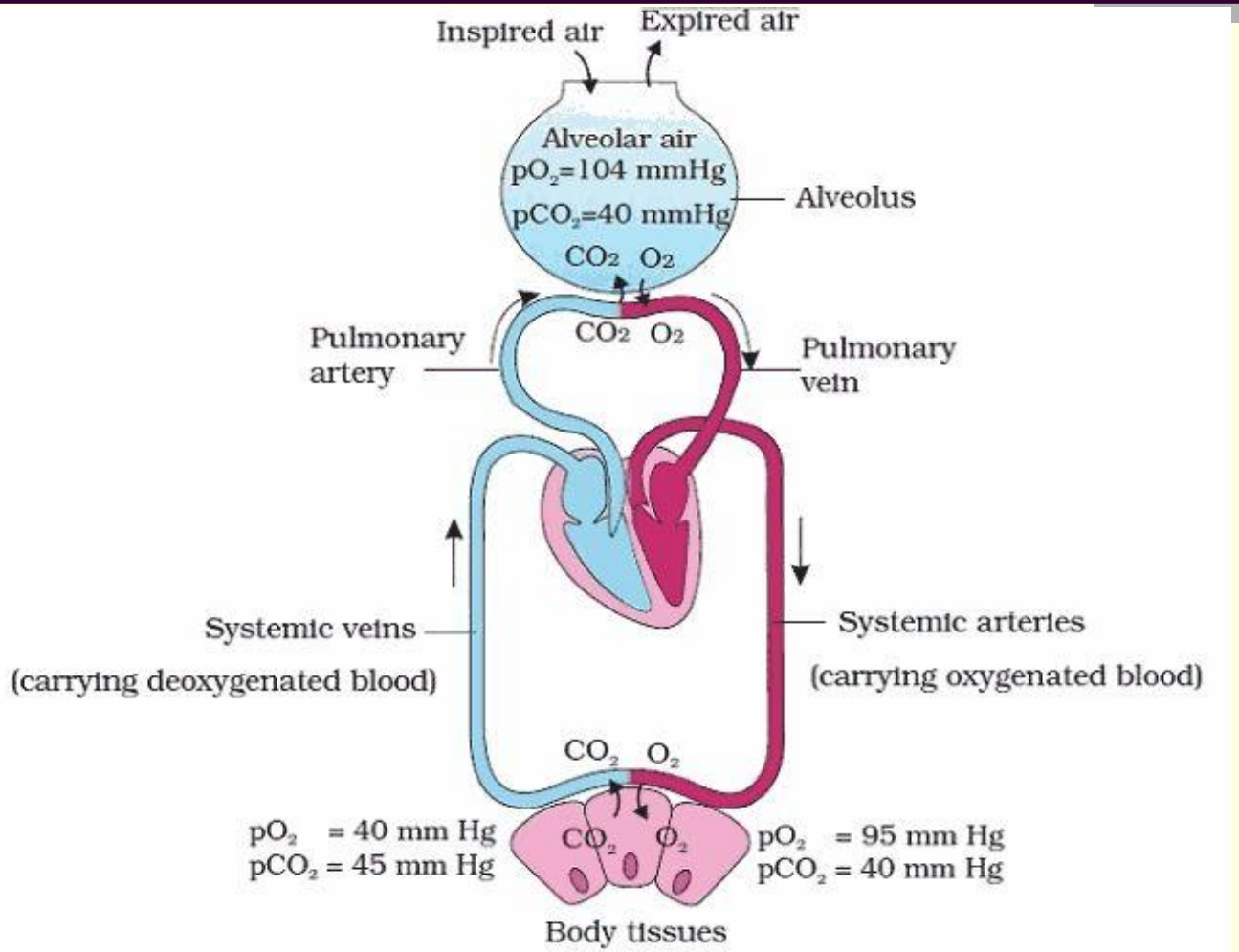
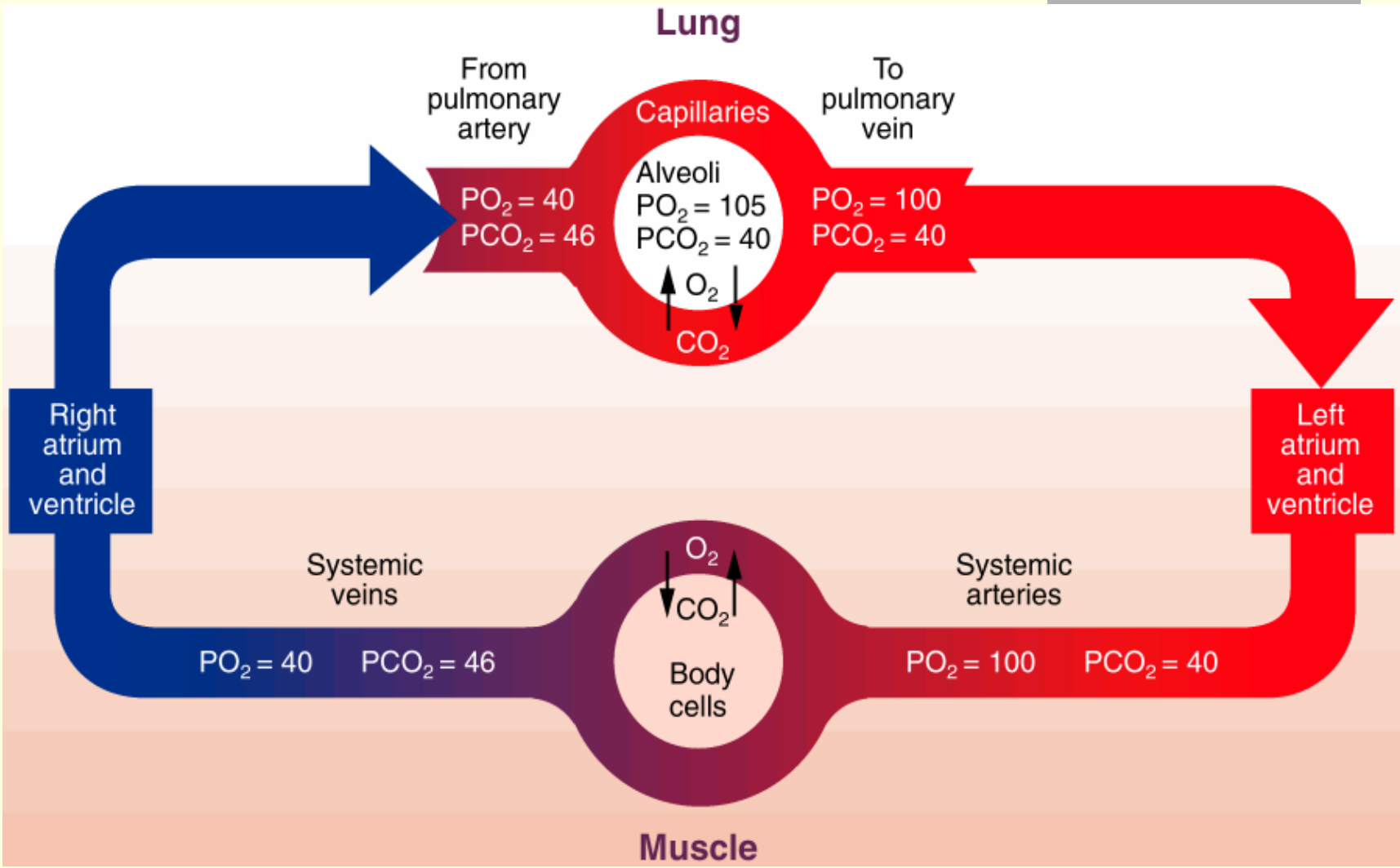
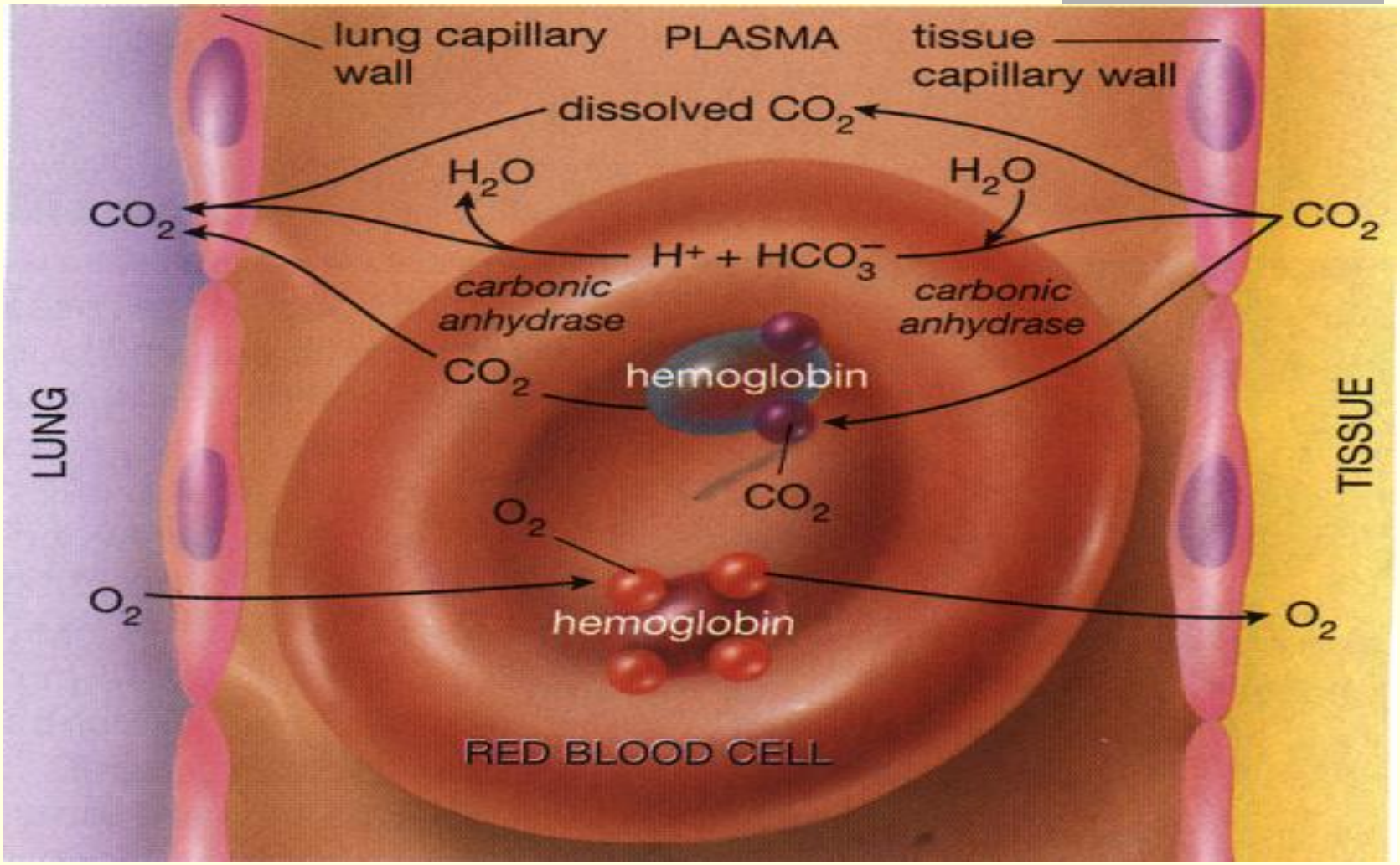


Figure 3. Diagrammatic representation of exchange of gases at the alveolus and the body tissues with blood and transport of oxygen and carbon dioxide

PARTIAL PRESSURE OF GASES




lung capillary wall
PLASMA
tissue capillary wall
dissolved CO_2
H_2O
H_2O
CO_2
CO_2
$H^+ + HCO_3^-$
carbonic anhydrase
carbonic anhydrase
CO_2
hemoglobin
LUNG
TISSUE
CO_2
O_2
O_2
hemoglobin
O_2
RED BLOOD CELL

DIFFUSION OF OXYGEN

Diffusion of oxygen from alveolus into pulmonary blood:

Partial pressure of oxygen in the alveolus is 104 mm Hg, whereas the PO_2 of the venous blood entering the capillary is an average 40 mm Hg since a large amount of O_2 has been removed from blood as it passes through the peripheral Pulmonary capillary is 104-40 = 64 mm Hg.

DIFFUSION OF OXYGEN

Diffusion of O_2 from capillaries into interstitial fluid

Partial pressure of O_2 in the arterial end of the capillaries is 95 mm Hg while in interstitial fluid it is 40 mm Hg. Therefore O_2 diffuses from arterial end of capillary into the interstitial fluid

Diffusion of O_2 from interstitial fluid into cells

The partial pressure of O_2 in interstitial fluid is 40 mm Hg, while that in the cells is 23 mm Hg therefore O_2 diffuses from interstitial fluid into the cells

DIFFUSION OF CO2

The diffusion of CO_2 occurs in the opposite direction of oxygen. It diffuses from the cells to the interstitial fluid and to alveoli

i. Diffusion of CO_2 from cells to interstitial fluid: Partial pressure of CO_2 within the cell is 46 mm Hg while its pressure in the interstitial fluid is 45 mm Hg. Thus it diffuses from the cells to the interstitial fluid

ii. Diffusion of CO_2 from interstitial fluid into capillaries: Partial pressure of CO_2 in interstitial fluid is 45 mm Hg while in the arterial end of the capillaries, is 40 mm Hg. Therefore, CO_2 diffuses from interstitial fluid into the capillaries.

DIFFUSION OF CO2

Diffusion of CO_2 from pulmonary blood into alveoli

Partial pressure of CO_2 in pulmonary blood is 45 mm Hg while in the alveolus, it is 40 mm Hg. So CO_2 diffuses from pulmonary blood into the alveoli.

FACTORS EFFECTING THE DIFFUSION OF GASES

- **Thickness of respiratory membrane:** Inversely proportional
- **Molecular Weight:** Inversely proportional
- **Surface area of respiratory membrane:** Directly proportional
- **Diffusion coefficient of gas:** Directly proportional
- **Pressure difference:** Directly proportional

THANK YOU