TRANSPORT OF OXYGEN AND CARBON DIOXIDE

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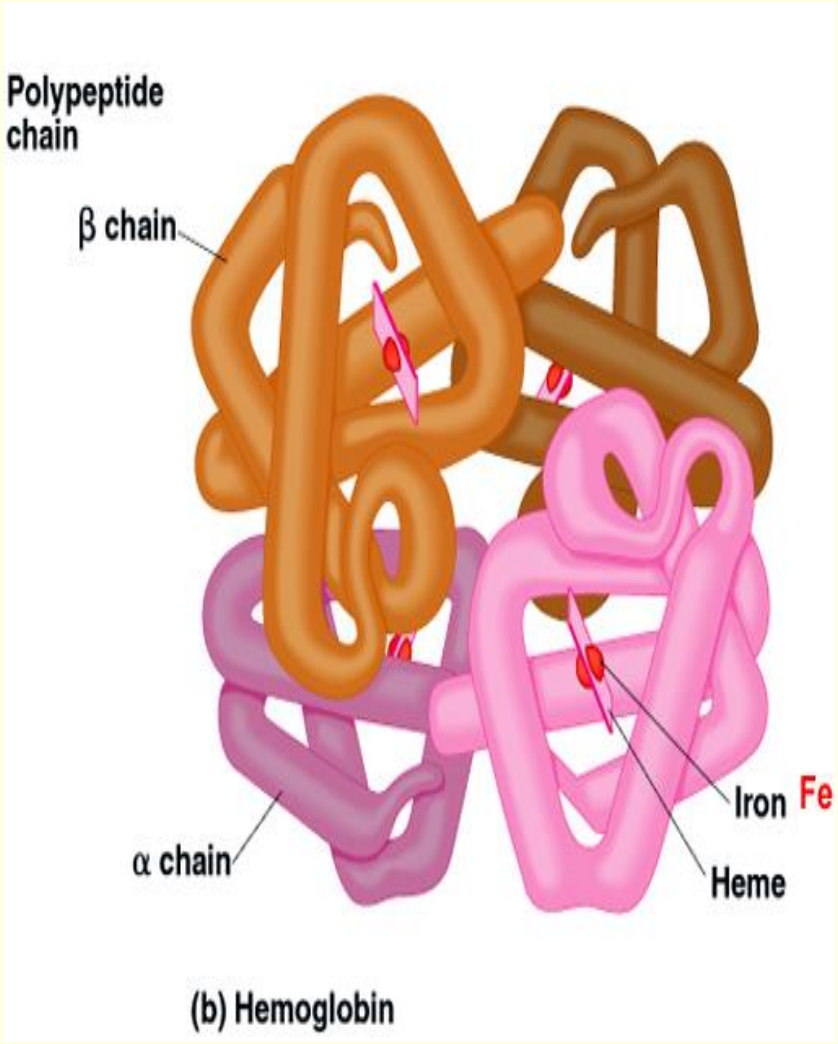
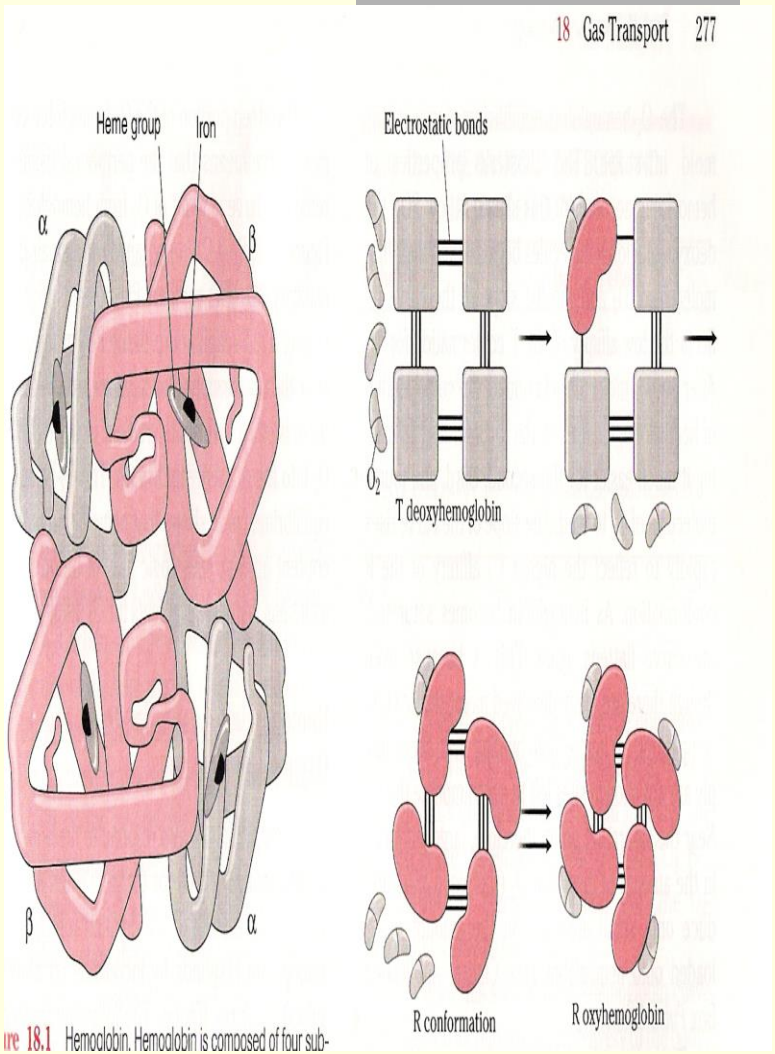
HEMOGLOBIN


Polypeptide chain
β chain
α chain
Iron Fe
Heme
(b) Hemoglobin


18 Gas Transport 277
Heme group
Iron
α
β
β
α
Electrostatic bonds
O_2
T deoxyhemoglobin
R conformation
R oxyhemoglobin
ıre 18.1 Hemoglobin. Hemoglobin is composed of four sub-

HEMOGLOBIN

Oxygen molecule combines loosely and reversibly with the Hem portion of the hemoglobin.

When PO2 is high, as in the pulmonary capillaries, oxygen binds with the hemoglobin.

When PO2 is low, as in the tissue capillaries, oxygen is released from the hemoglobin.

TRANSPORT OF O2

Transport of respiratory gases between the lungs and body tissues is the main function of blood.

- 97 % of the oxygen transported from the lungs to the tissues is carried in chemical combination with hemoglobin
- 3 % is carried by physically being dissolved in plasma.

$$Hb + 4O_2 \rightarrow Hb(O_2)_4$$

TRANSPORT OF O2

Transport of O_2 by haemoglobin: Hb combines with oxygen the compound formed is called oxyhaemoglobin.

The amount of O_2 carried in the blood in oxyhaemoglobin depends on the amount of Hb present in the blood.

The normal amount of Hb in young adults is about 14-16 gm/dl of the blood. Each gram of Hb can bind with 1.34 ml of O_2. Thus, if a person has a Hb is 16 gm/dl of blood his blood can carry

16 x 1.34 = 21.44 ml of O_2/dl.

TRANSPORT OF O2

The haem part of the hemoglobin contains 4 atoms of iron, each capable of combining with a molecule of oxygen. Oxygen can combine loosely and reversibly with hemoglobin.

- $Hb + O_2 \qquad HbO_2$

The important factor which determines how much oxygen combines with Hb when the haemoglobin (deoxygenated Hb) is converted to HbO_2, is the PO_2. When the PO_2 is high, it binds with Hb, but when the PO_2 is low O_2 is released from Hb.

TRANSPORT OF CO2

- Large amount of CO_2 is continuously produced in the body.

Under normal resting conditions each 100 ml of deoxygenated blood contains 4 ml of CO_2 which is carried in the blood in three forms:

- 70% of CO_2 is transported in bicarbonate form.
- 23% combines with the globin part of haemoglobin to form carbamino haemoglobin
- 7% is dissolved in plasma

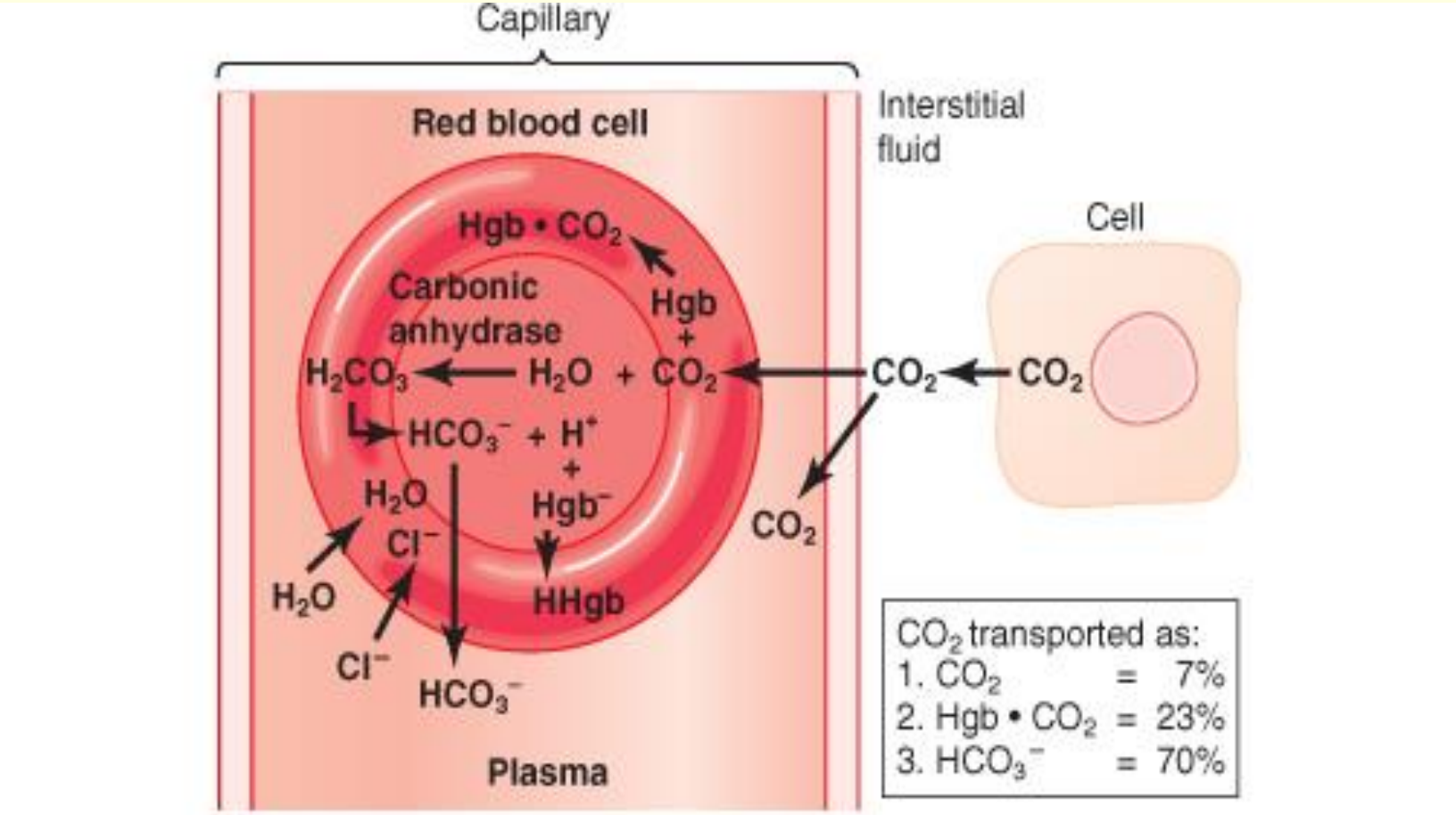
TRANSPORT OF CO2

Transport of CO_2 dissolved in plasma: Little carbon dioxide is transported in the dissolved state to the lungs. PCO_2 of venous blood is 45 mm Hg and the PCO_2 of arterial blood is 40 mmHg. The amount of CO_2 dissolved in the blood at 45 mmHg is 2.7 ml/dl (2.7%).

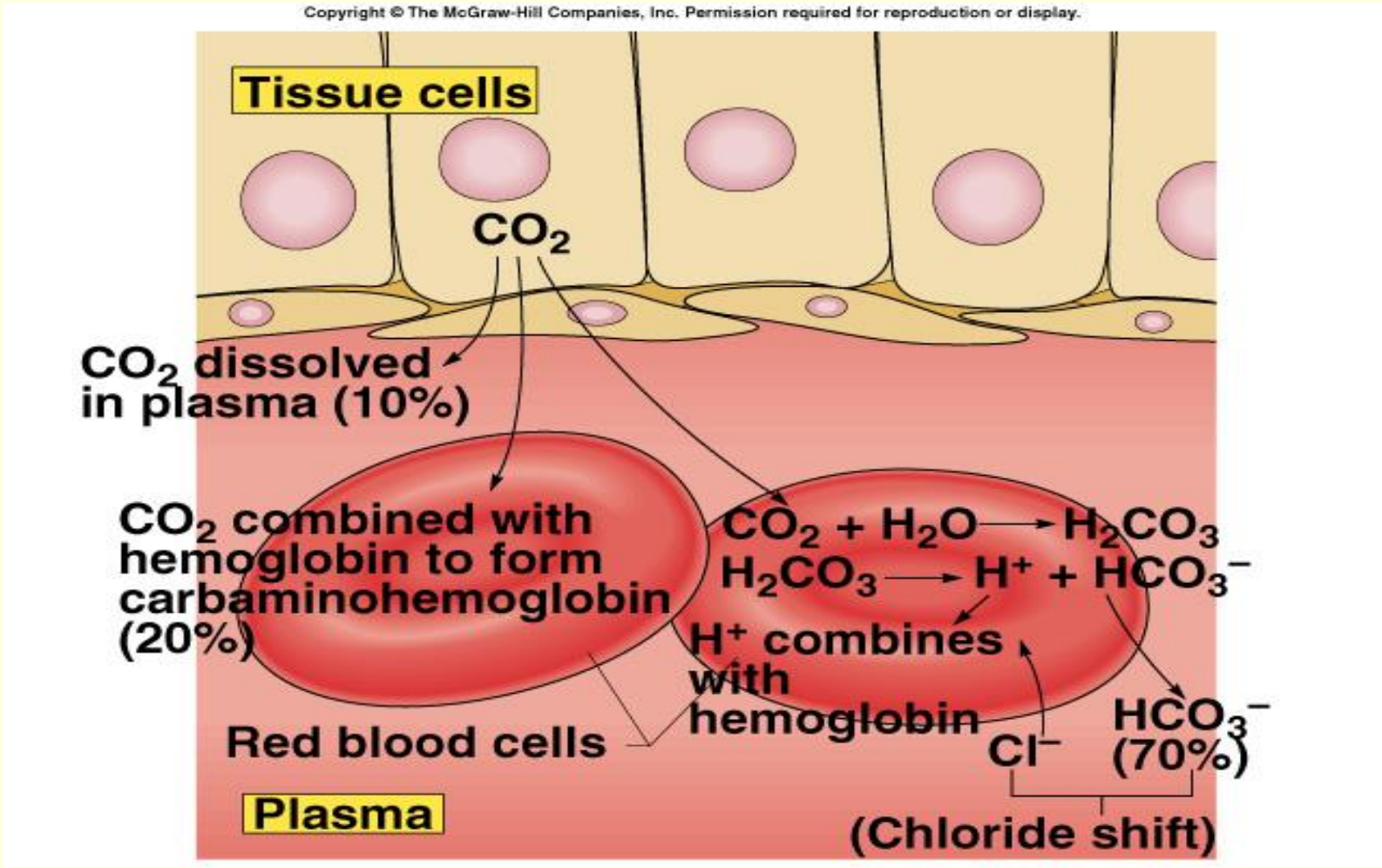
The amount of CO_2 dissolved at 40 mmHg is about 2.4 ml. The difference between 2.7 and 2.4 is only 0.3 ml.

About 0.3 ml CO_2 is transported in the form of dissolved CO_2 by each 100 ml of blood. It is about 7 % of all CO_2 is transported in this form.

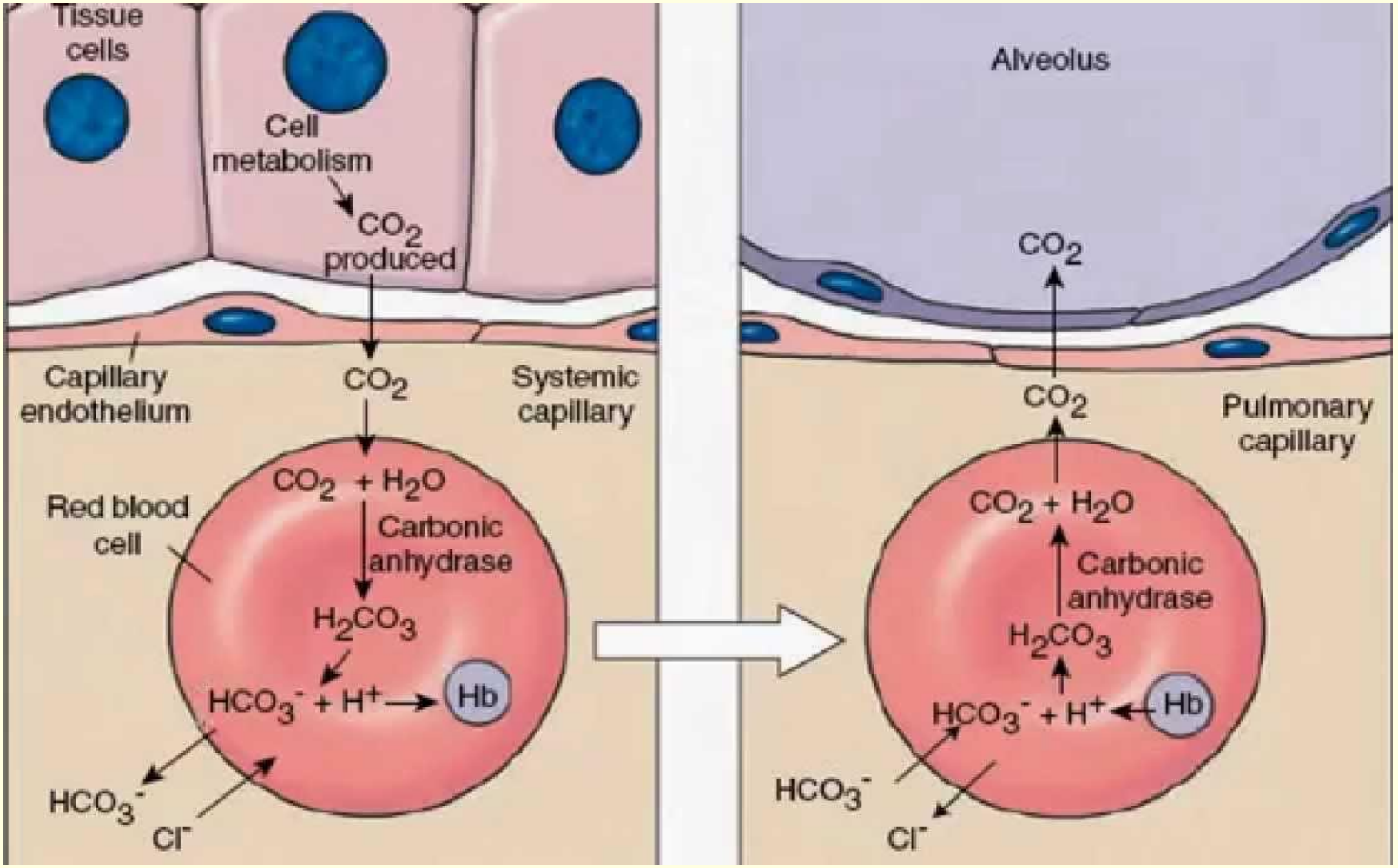
TRANSPORT OF CO2



CARBON DIOXIDE TRANSPORT AND CHLORIDE SHIFT



CARBON DIOXIDE TRANSPORT AND CHLORIDE SHIFT



OXYHEMOGLOBIN DISSOCIATION CURVE

This is a curve which denotes the relationship between the percent O_2 saturation of Hb and the partial pressure of O_2.

Right shift of oxy-Hb-dissociation curve: When the oxy-haemoglobin dissociation curve is shifted to the right, it means oxygen is dissociated or released from haemoglobin.

Factors shifting the curve to the right: Increase H^+ concentration or decrease pH, Increase CO_2, Increase temperature, Increase 2, 3 DPG

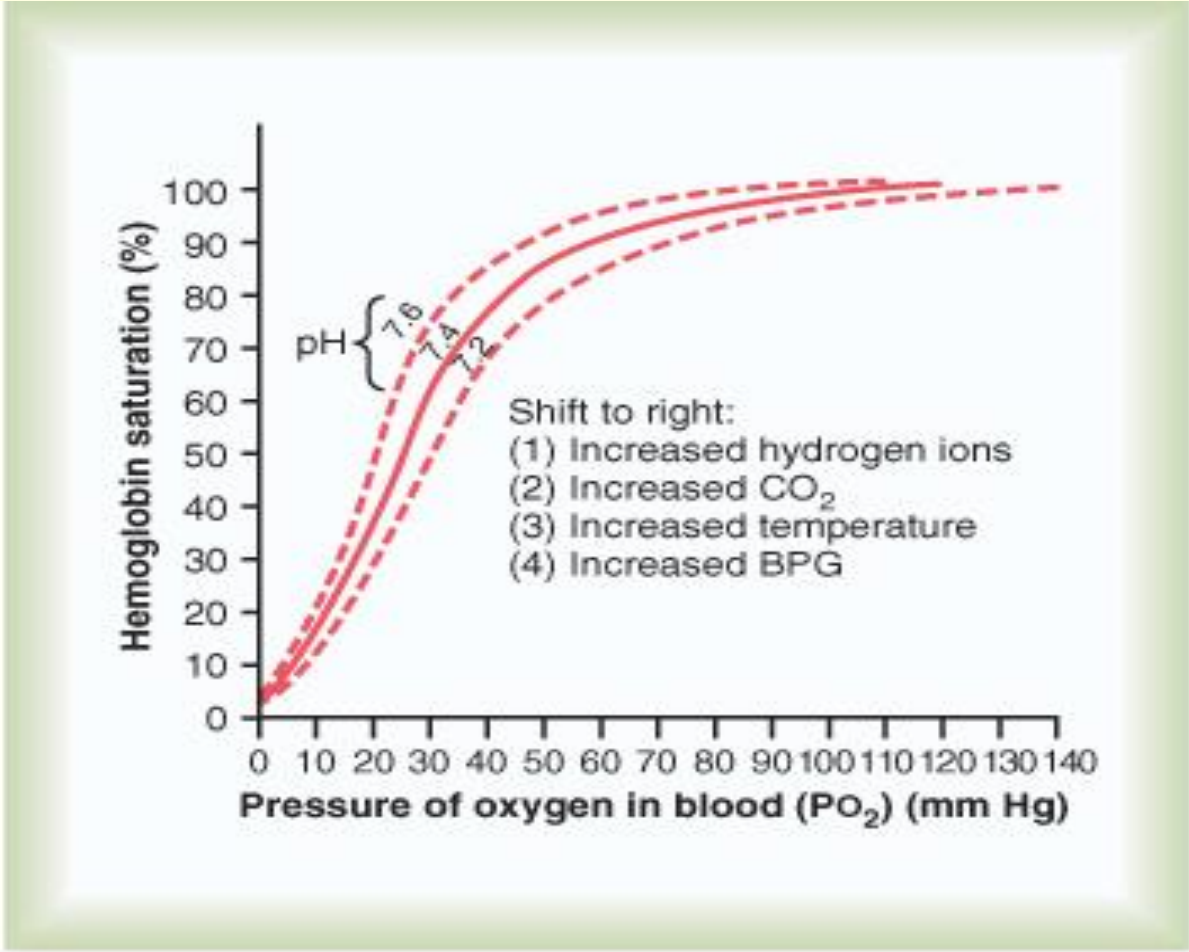
OXYHEMOGLOBIN DISSOCIATION CURVE

- **Left shift of oxy-haemoglobin dissociation curve:**

When the oxy-hemoglobin dissociation curve is shifted to the left. It shows that hemoglobin affinity for oxygen is increased.

- **Factors shifting the curve to the left:**
- Decrease H^+ concentration or increase pH
- Decrease CO_2
- Decrease temperature
- Decrease 2, 3 DPG
- Fetal haemoglobin

FACTORS EFFECTING OXYHEMOGLOBIN DISSOCIATION CURVE



FACTORS EFFECTING OXYHEMOGLOBIN DISSOCIATION CURVE

Table 16.9 Factors That Affect the Affinity of Hemoglobin for Oxygen and the Position of the Oxyhemoglobin Dissociation Curve

Factor	Affinity	Position of Curve	Comments
↓pH	Decreased	Shift to the right	Called the Bohr effect; increases oxygen delivery during hypercapnia
↑Temperature	Decreased	Shift to the right	Increases oxygen unloading during exercise and fever
↑2,3-DPG	Decreased	Shift to the right	Increases oxygen unloading when there is a decrease in total hemoglobin or total oxygen content; an adaptation to anemia and high-altitude living

THANK YOU