

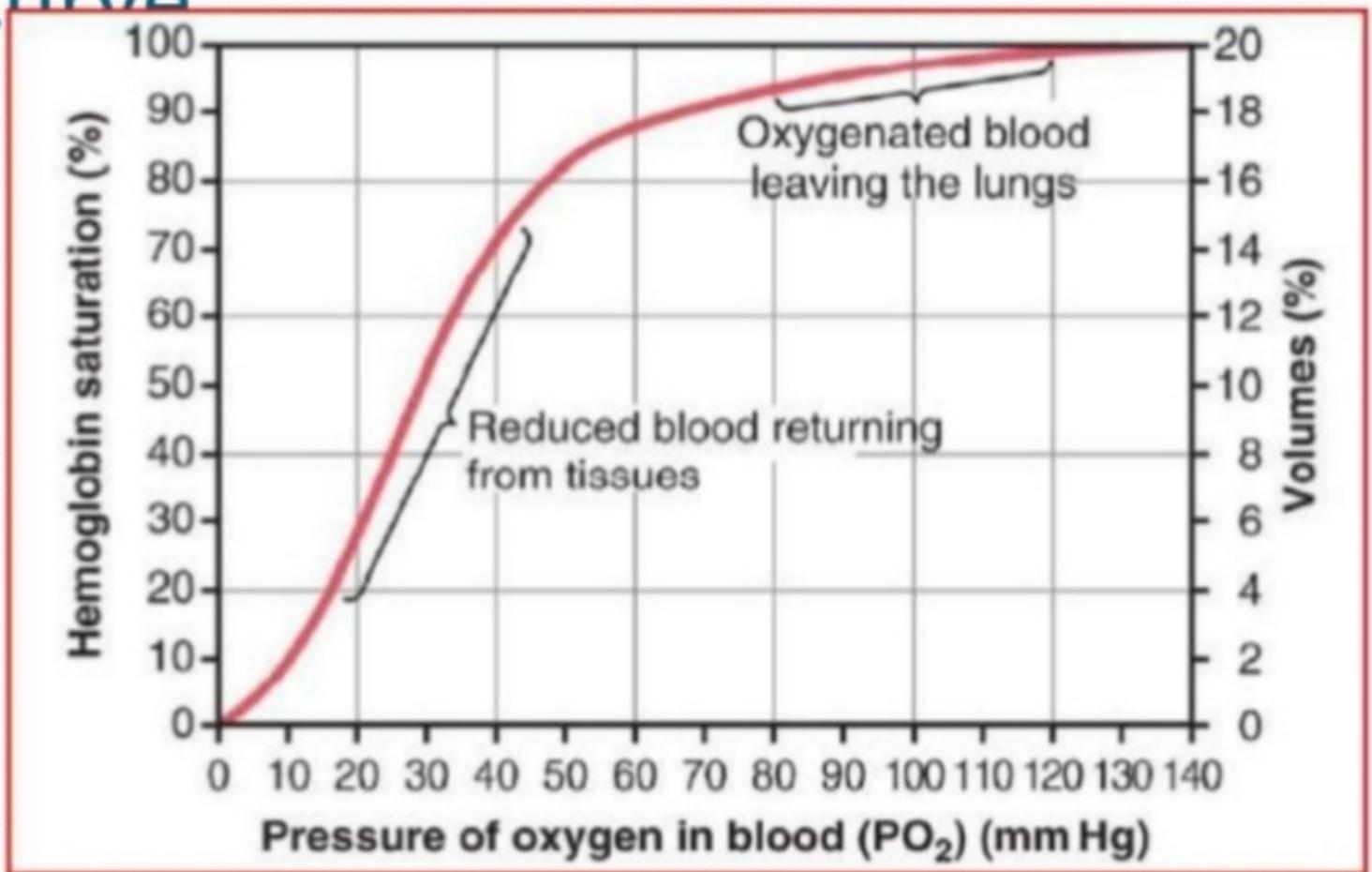
Oxygen-Hemoglobin Dissociation Curve

- It is a curve represents the relationship between blood PO_2 (on the horizontal axis) and % Hb saturation (on the vertical axis) .

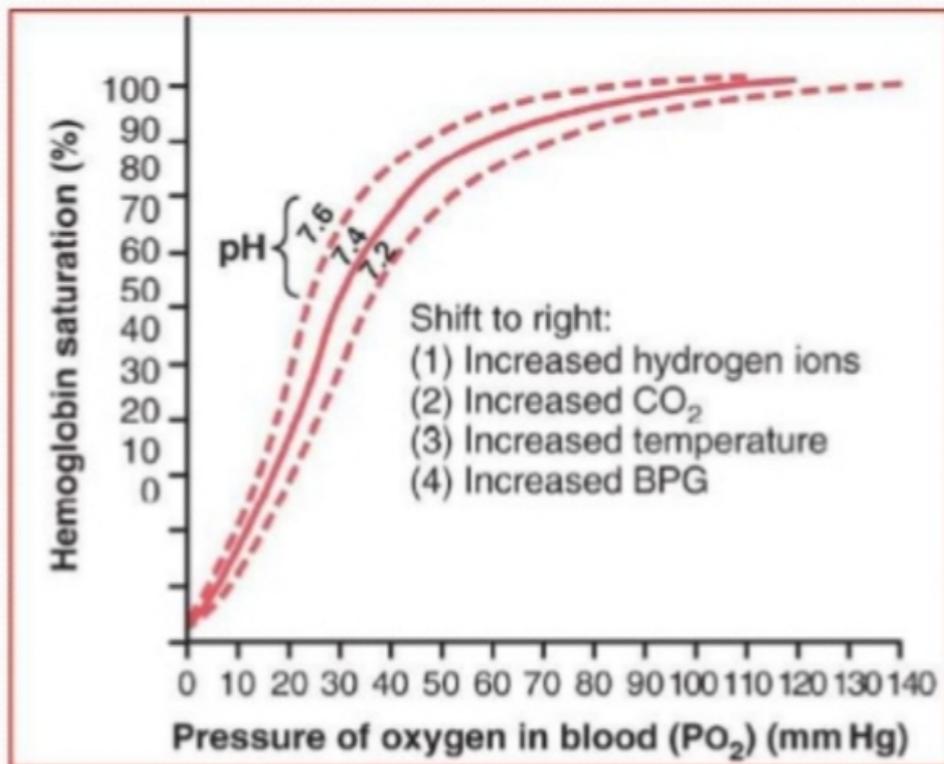
Because the % of hemoglobin saturation depends on the PO_2 of the blood.

- It is not linear.
- It is an S-shaped curve that has 2 parts:
 - upper flat (plateau) part.
 - lower steep part.

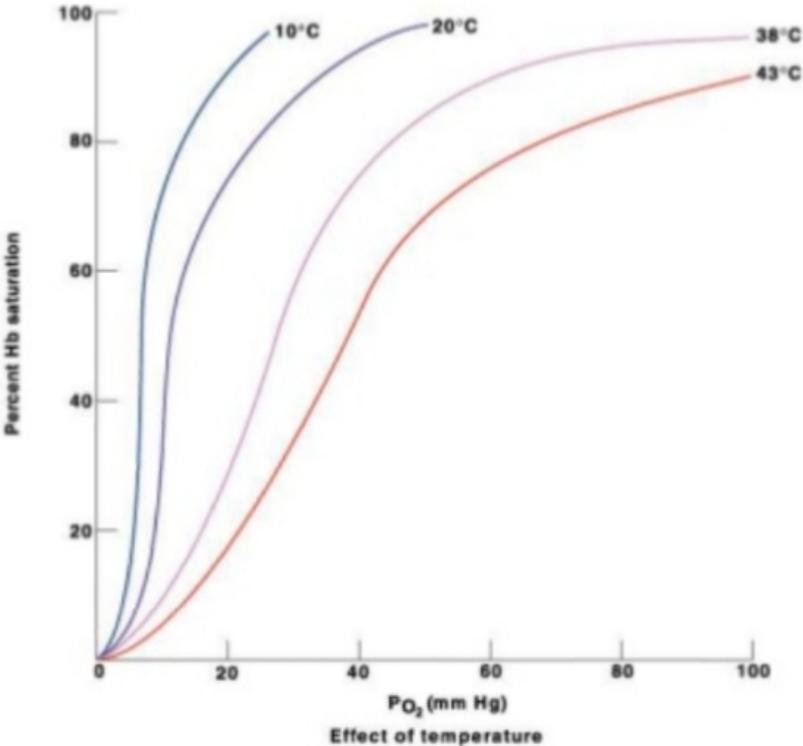
Oxygen-Hemoglobin Dissociation Curve



Factors That Shift the Oxygen-Hemoglobin Dissociation Curve



Temperature effects:



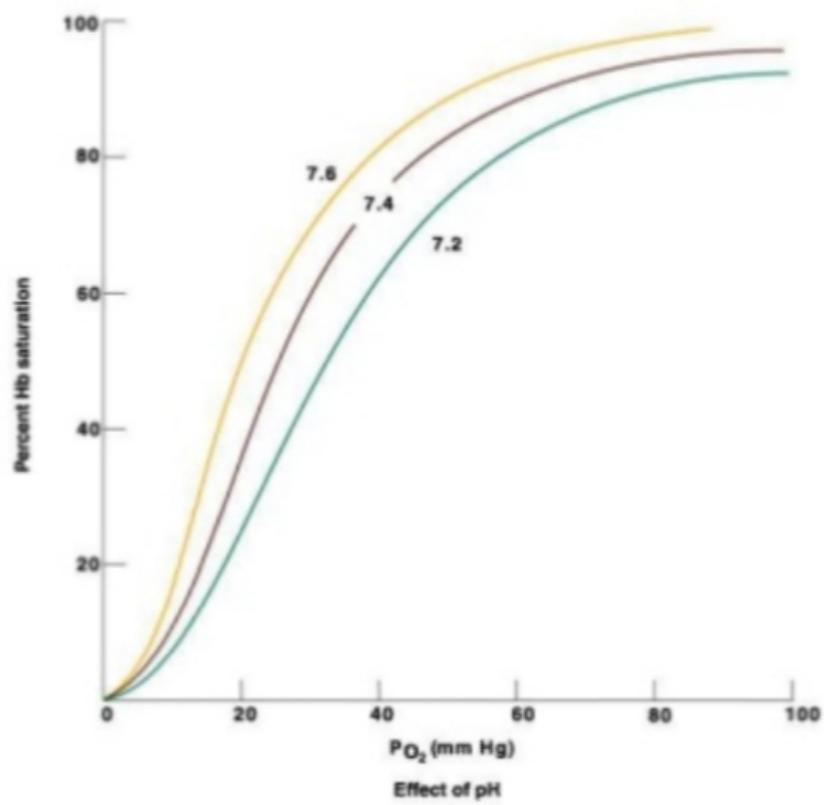
The Bohr Effect

- *A shift of the curve to the right in response to increases in blood CO_2 and hydrogen ions* has a significant effect:
 - 1) enhance the release of oxygen from the blood in the tissues.
 - 2) enhance the oxygenation of the blood in the lungs.

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- As the blood passes through the tissues, CO_2 diffuses from the tissue cells into the blood.
 - This **increases the blood PCO_2** , which in turn **raises the blood H_2CO_3^- (carbonic acid) and the hydrogen ion concentration.**
 - These effects **shift the curve to the right and downward.**

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- **in the lungs**, the CO_2 diffuses from the blood into the alveoli.
 - This reduces the blood PCO_2 and decreases the hydrogen ion concentration, **shifting the curve to the left and upward**.
 - Therefore, the quantity of oxygen that binds with the hemoglobin at any given alveolar PO_2 becomes considerably increased, thus allowing greater oxygen transport to the tissues.

Bohr effect:

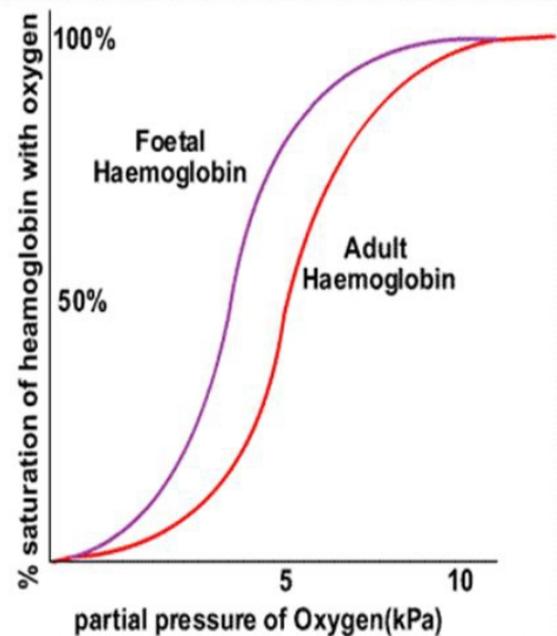


Effect of BPG to Cause Rightward Shift of the Oxygen-Hemoglobin Dissociation Curve

- The normal BPG in the blood keeps the curve shifted slightly to the right all the time.
- **In hypoxic conditions** the quantity of **BPG** in the blood **increases** considerably, thus **shifting the curve** even farther **to the right**.
- This causes oxygen to be released to the tissues at as much as 10 mm Hg higher tissue oxygen pressure than would be the case without this increased BPG.

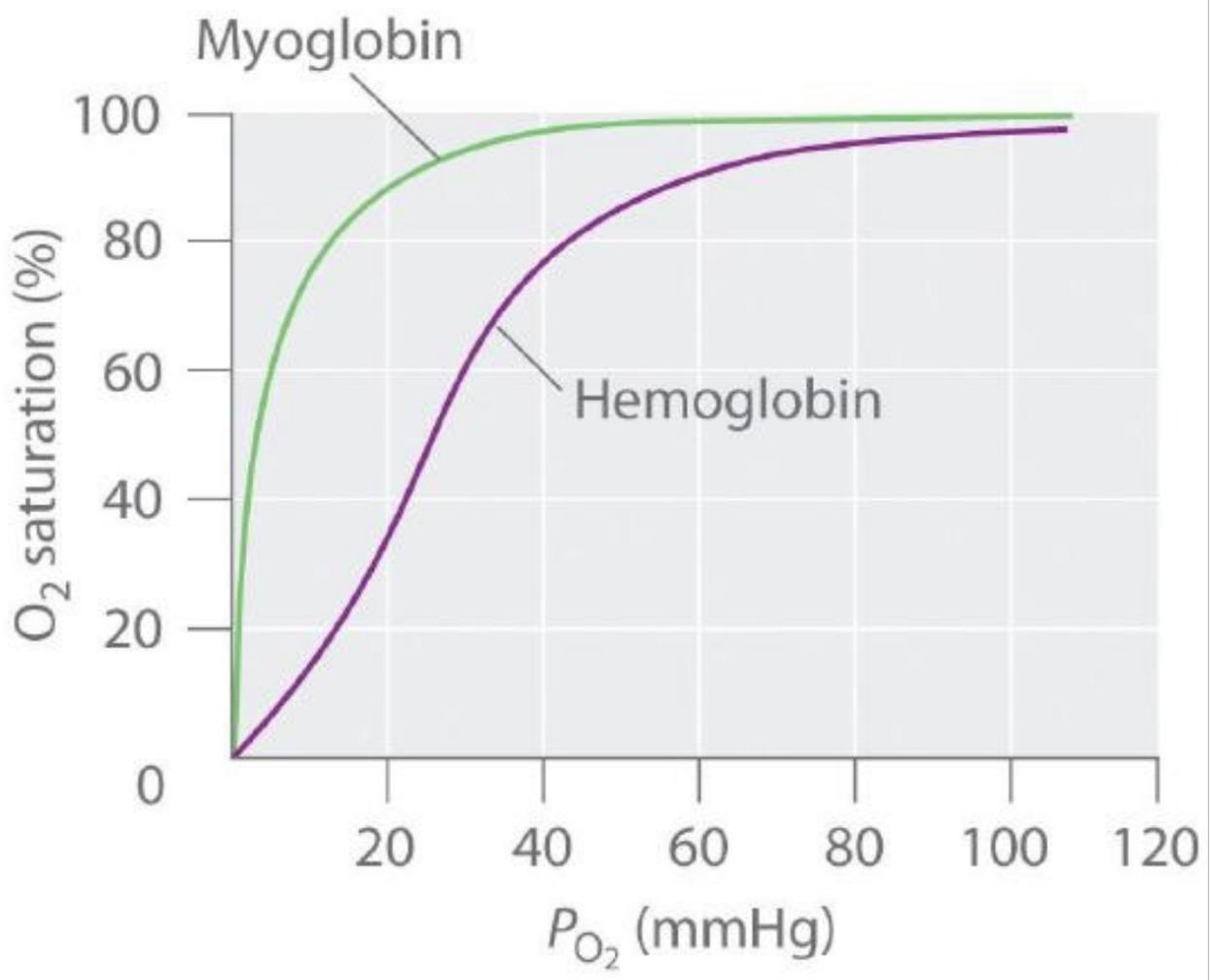
Fetal Hemoglobin

- Fetal hemoglobin has a higher affinity for O_2 at all partial pressures.
- This ensures that O_2 is transferred to the fetus from the maternal blood across the placenta.
- The PO_2 in fetal tissues is very low due to the high metabolic rate associated with fetal growth rates.
- Although fetal Hb has a higher affinity for oxygen in such a low partial pressure environment of the fetal tissue it unloads oxygen readily.
- At birth the foetal Hb is replaced with adult type Hb.



O₂ dissociation curve of myoglobin

- One molecule of myoglobin has **one ferrous atom** (Hb has 4 ferrous atoms).
- One molecule of myoglobin can **combine with only one molecule of O₂** .
- The **O₂-myoglobin curve is rectangular in shape and to the left of the O₂-Hb dissociation curve.**
- **So, it gives its O₂ to the tissue at very low PO₂.**
- **So, it acts as O₂ store used in severe muscular exercise when PO₂ becomes very low.**



Rightward Shift of the Oxygen-Hemoglobin Dissociation Curve During Exercise

- **The exercising muscles** release CO₂ which increase the hydrogen ion concentration in the muscle capillary blood.
- the **temperature** of the muscle often **rises 2° to 3°C**, which can **increase oxygen delivery** to the muscle fibers.
- All these factors act together to **shift the curve to the right**.

- *This rightward shift of the curve forces oxygen to be released from the blood hemoglobin to the muscle* at PO₂ levels as great as 40 mm Hg, even when 70 % of the oxygen has already been removed from the hemoglobin.
- Then, *in the lungs, the shift occurs in the opposite direction*, allowing the pickup of extra amounts of oxygen from the alveoli.

Advantages of the sigmoid shape of the curve :

(1) The shape of the curve is such that at normal alveolar PO_2 , —the haemoglobin of the blood leaving the lungs is almost completely saturated. Any further increase in alveolar PO_2 , under normal circumstances, e.g. O_2 inhalation is of no advantage in so far as percentage saturation of haemoglobin is concerned.

(2) The flat upper part of the curve indicates that relatively little reduction in percentage saturation of haemoglobin occurs unless the oxygen tension of the alveolar air falls below 60 mm Hg. Due to fall in barometric pressure—this level of alveolar PO_2 is attained at an altitude of 3 km or 10,000 feet. It is obvious, therefore, that the effect of oxygen lack on the body will not be

manifested till one ascends to an altitude higher than 3 km or 10,000 feet.

(3) The steep slope of the oxygen dissociation curve at lower range of oxygen tension indicates that there occurs rapid breakdown of Oxy-Hb and consequent release of O_2 in the oxygen tension (40 mm Hg to 20 mm Hg) prevailing in the tissue.

(4) Increase CO_2 , CH , temperature and DPG all favour rapid release of oxygen in the tissues during activity.

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