Mammalian Respiratory System

The challenge:

The solution:

Nasal cavities:

Separated from oral cavity by hard and soft palates

Lined by mucosa

Olfactory receptors

When you inhale, your nasal cavity:
- Warms the air
- Moisturizes the air
- Filters the air
- Detects odor-causing chemicals

Pharynx:

Common opening between digestive and respiratory systems

Opening is nasopharynx

Leads into larynx

Larynx:

Cartilaginous complex below the epiglottis

Functions include
- control airflow during breathing
- protect the airway
- produce sound for speech using vocal cords

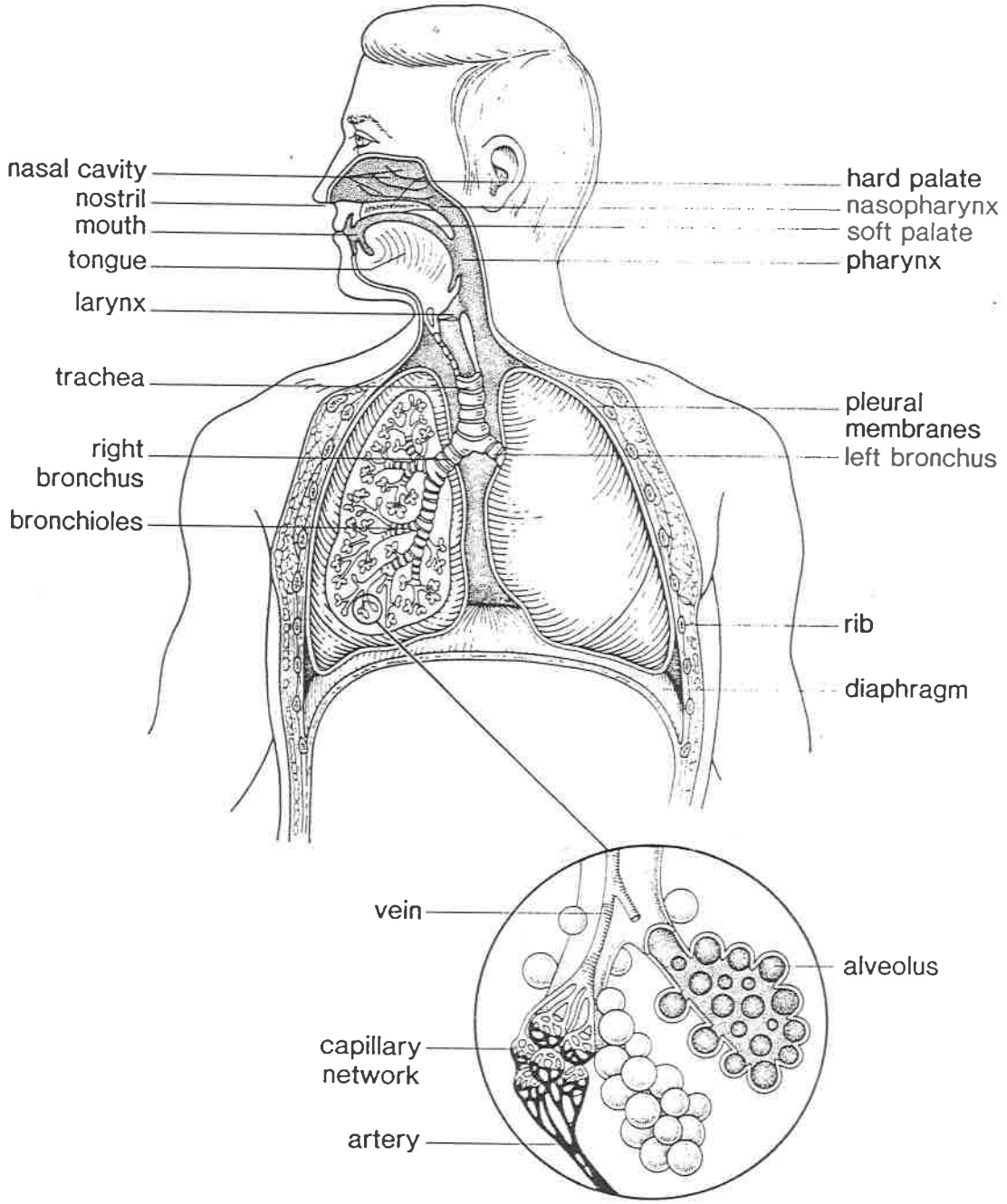
Trachea:

Ringed by cartilage

Lined by mucosa

Branch to two bronchi

21 Human Respiratory Tract (Fig. 13.1)



Respiration

Lungs:

Contain bronchioles, alveoli, blood vessels

Surface area = 80 m2

Lung volume = 6 L

Tidal volume
- 0.5 L (resting)
- 3 L (exercise)

Exchange rate
- 5 L (resting)
- 130 L (exercise)

Alveoli:

0.1 - 0.2 mm in diameter

300 million / lung

Diffusion of oxygen from aveolus to capillary:

Physical process

Oxygen concentration higher in lumen than capillary

Oxygen dissolves in fluid coating alveolus

Then to epithelial cell

Then to blood plasma

The Physiology of Breathing

Tidal Volume - Volume of air moving into and out of the lungs.

Vital Capacity - Maximum amount of air that can be expired after a forceful inspiration.
- Average for males is 4.6 L
- Average for females is 3.1 L

Rise in carbon dioxide causes blood pH to decline

Role of neurons in the aortic and carotid bodies

Impulses sent to diaphragm and external intercostal muscles

HOW A HUMAN BREATHES

(from Raven & Johnson 1989)

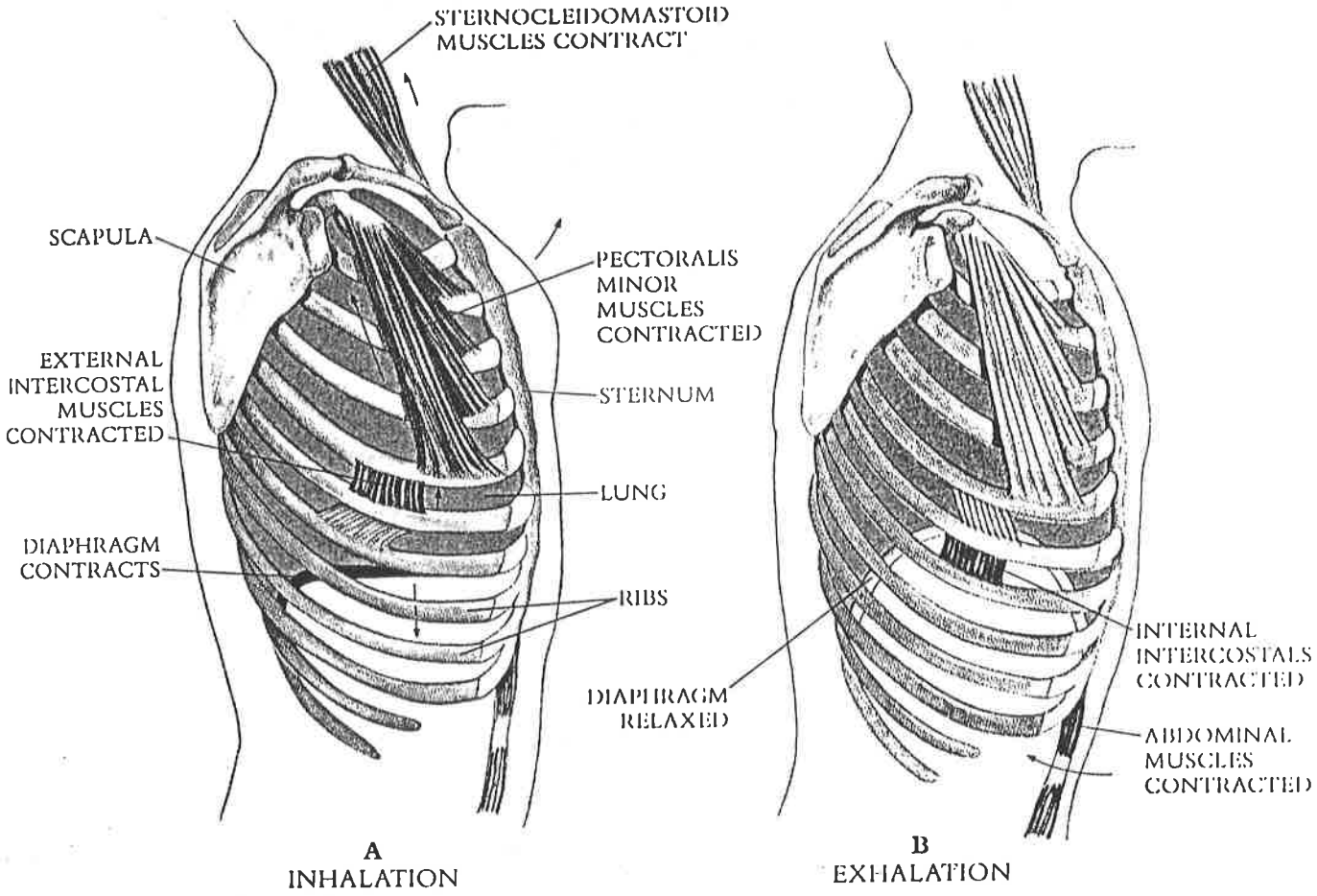
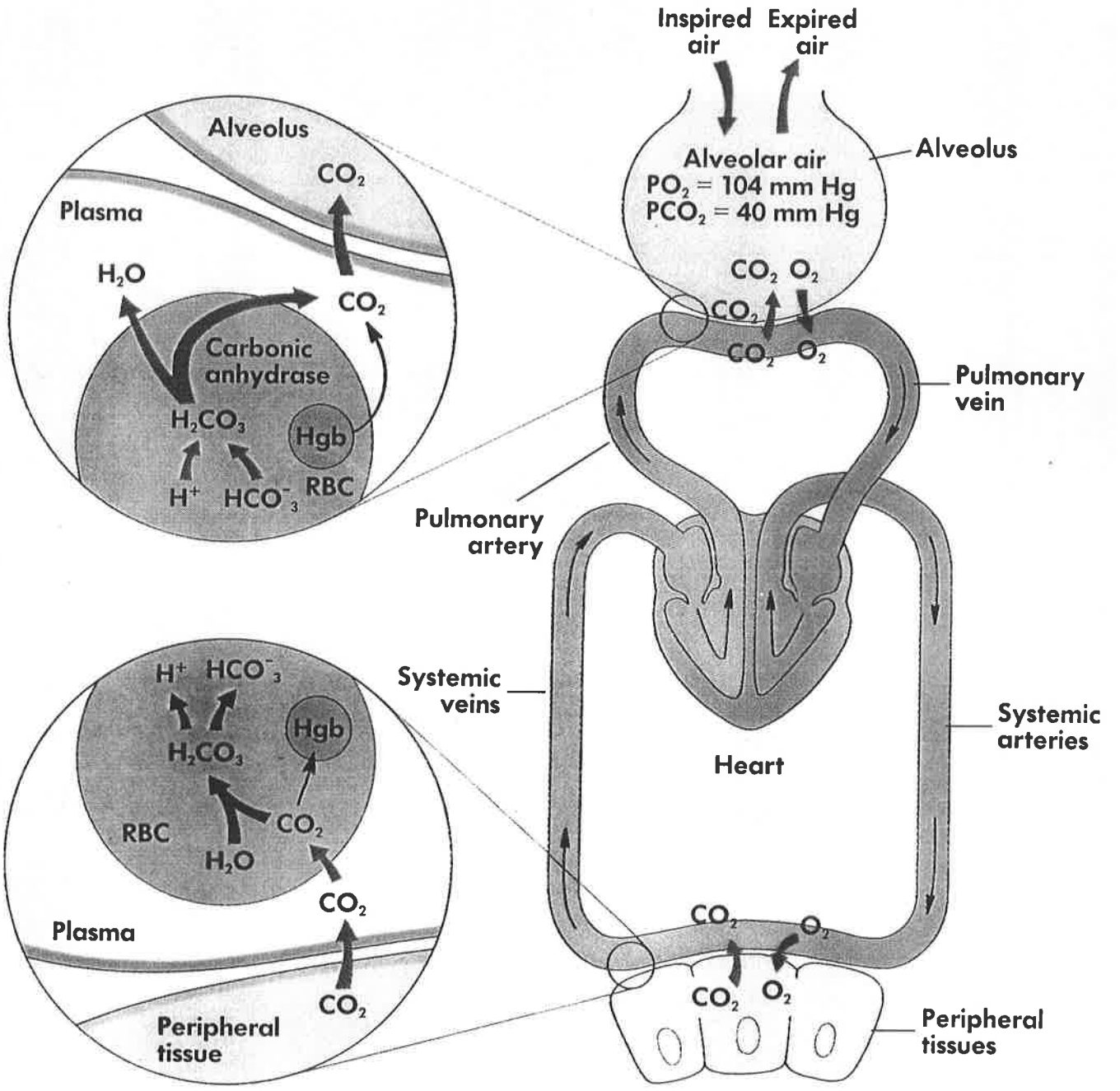


FIGURE 50-16

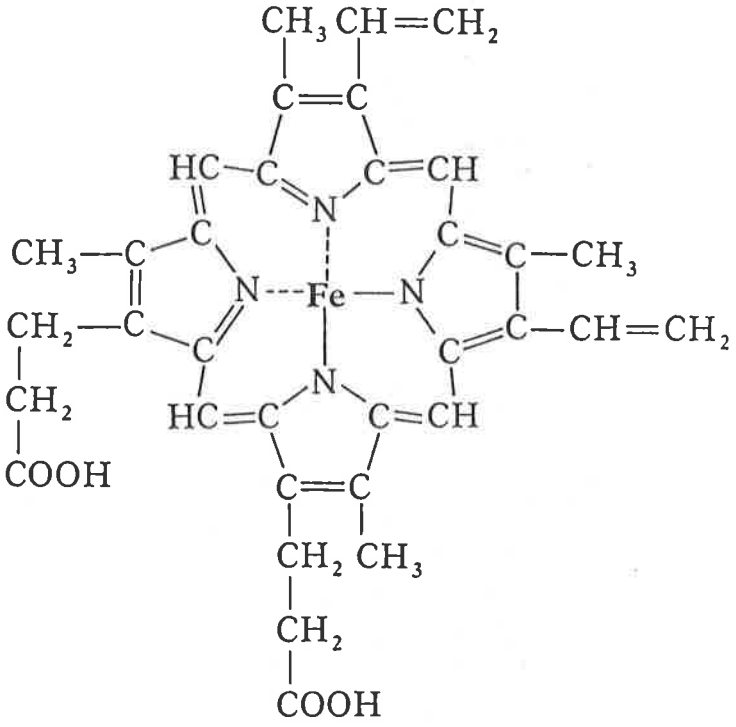
How a human breathes.
A Inhalation. The diaphragm and walls of the chest cavity expand, increasing its volume. As a result of the larger volume, air is sucked in through the trachea.
B Exhalation. The diaphragm and chest walls return to their normal positions, reducing the volume of the chest cavity and forcing air outward through the trachea.

T 96

The respiratory journey (Figure 50-19)



HEME AND HEMOGLOBIN



13.24 Structure of the heme group
A single molecule of hemoglobin has four of these iron-containing prosthetic groups.

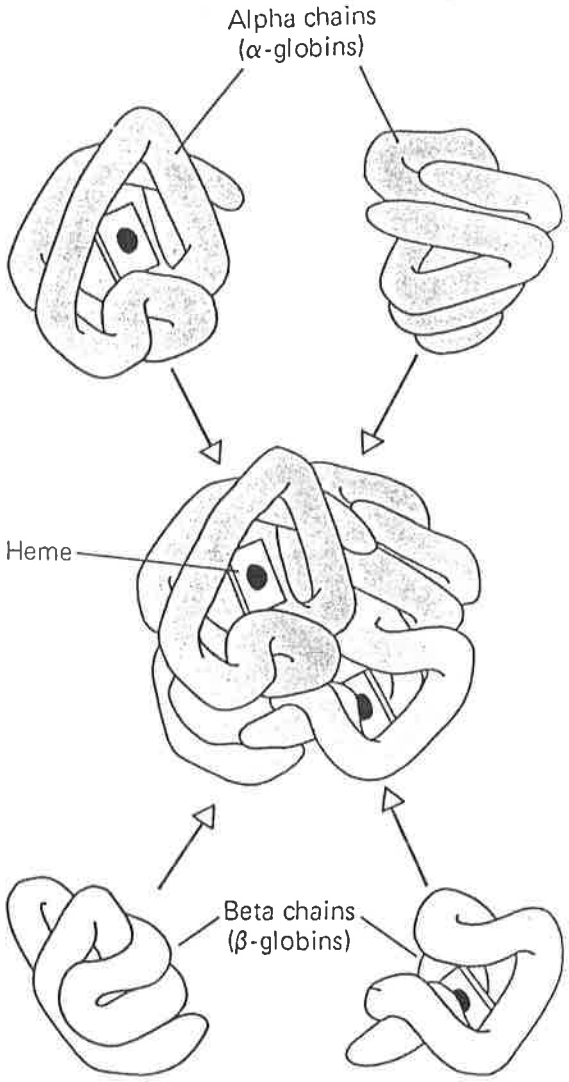
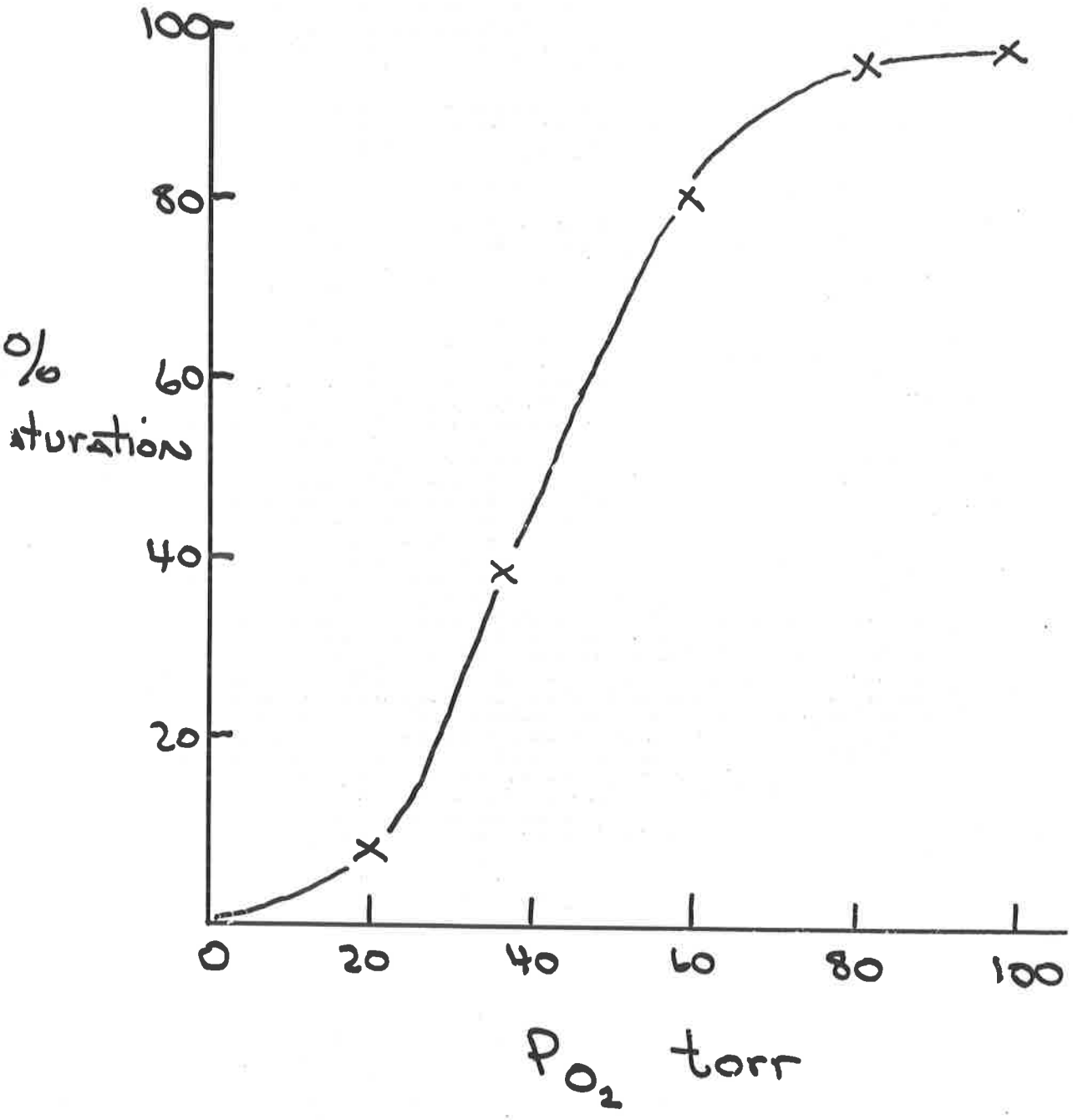
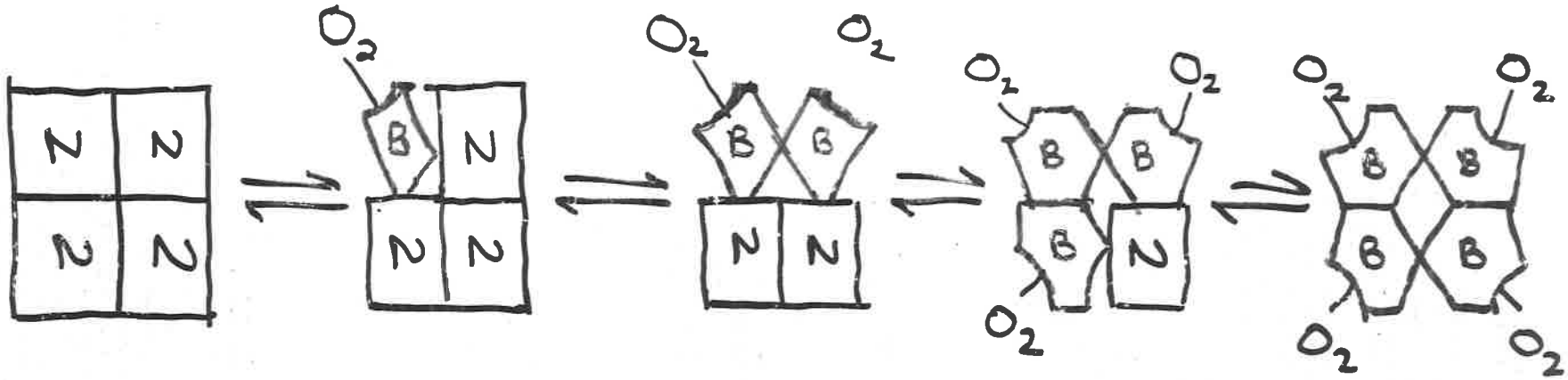


FIGURE 3–21 The protein hemoglobin (center) consists of four intricately folded polypeptide chains—two alpha chains (shown from different angles) and two beta chains. Only the "skeletons" of the chain are shown. In reality, these are obscured by numerous amino acid side groups. The heme groups are non-protein structures attached to the polypeptide chains. They contain iron atoms (black), which bind the oxygen molecules transported by hemoglobin.

Hemoglobin



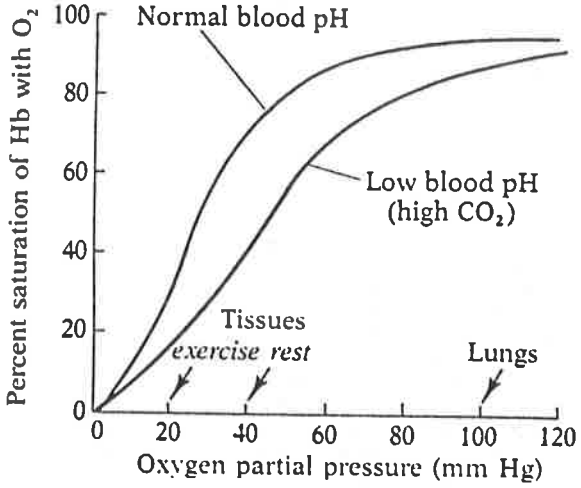
Association/Dissociation of Hemoglobin with oxygen



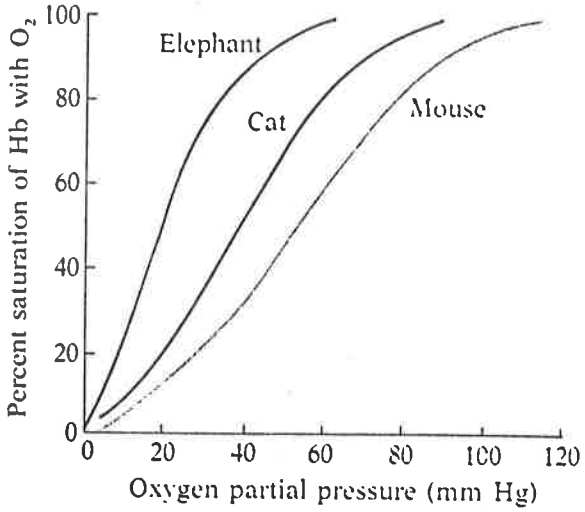
B - Binding form

N - Nonbinding form

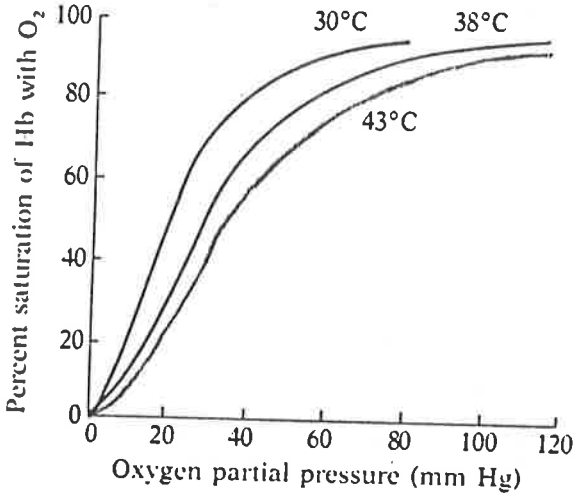
DISSOCIATION CURVES FOR HEMOGLOBIN



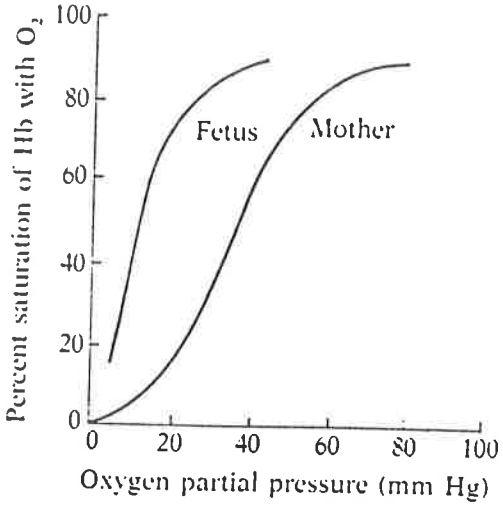
13.25 Dissociation curves of adult human hemoglobin at normal and low blood pH



13.27 Dissociation curves for the hemoglobin of different animals



13.26 The effect of temperature on the affinity of human hemoglobin for oxygen



13.28 Dissociation curves for fetal and maternal hemoglobin in the cow