1. **Pick up** Name Folder

- Pick up name folder and set it up at seat.

2. **Sit** with your lab group.

- laptops almost closed (avoid distracting)

3. **Clicker** Attendance

- Launch your Top Hat, and get ready to click.

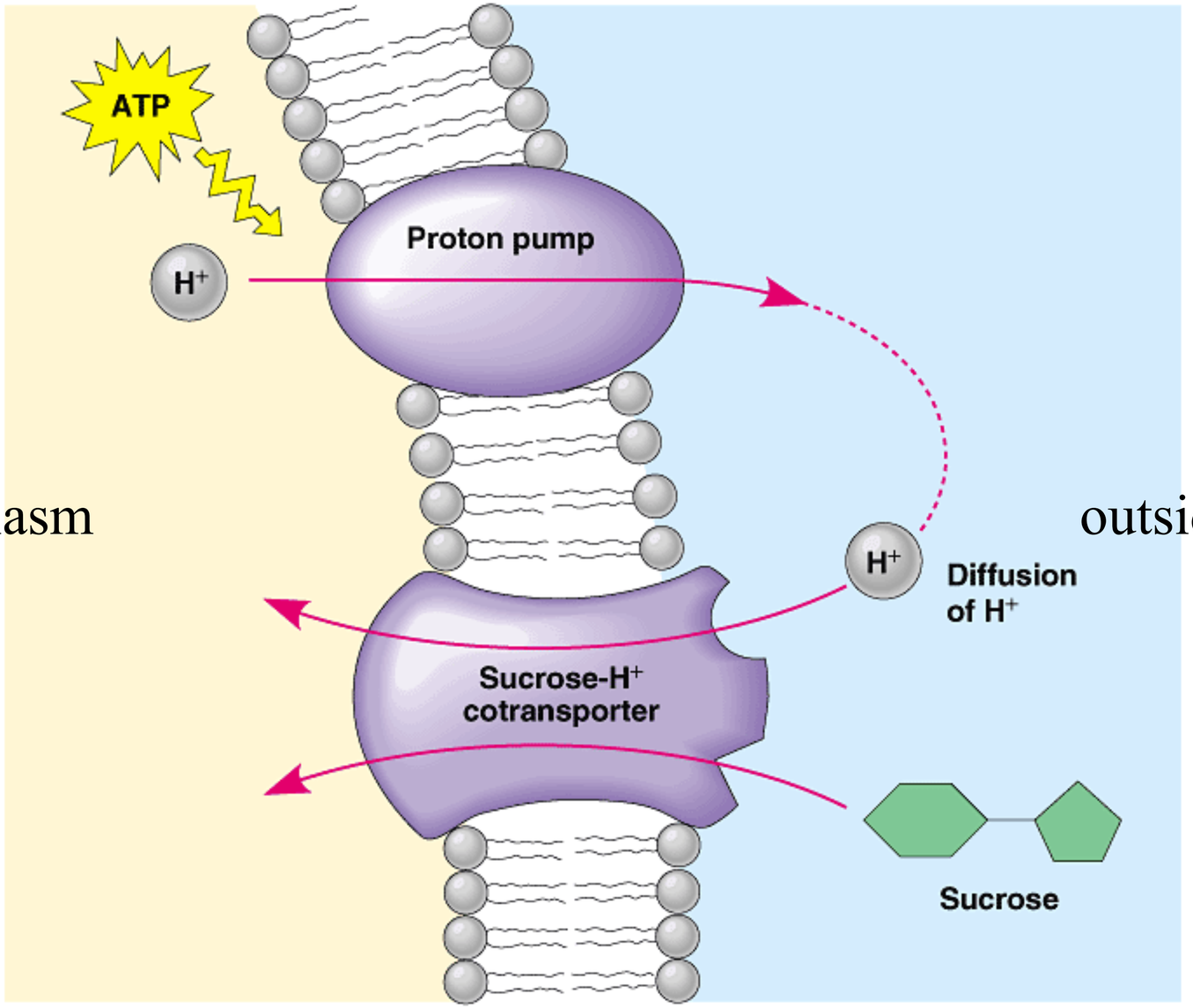
Monet's 1891 canva
"Meule" or
"Grainstack" fetche
$81.4 million with
fees.

CHRISTIE'S IMAGES LT

Announcements

1. Turn in your Take-home **Exam** now (please B-PIDS only, on your hard copy of text and illustration answers, with cover sheet initialed).
2. No **Office Hours** today (because we will be grading exams)
3. Questions about In-class Exam on Wednesday, process or wording of exam questions, etc?

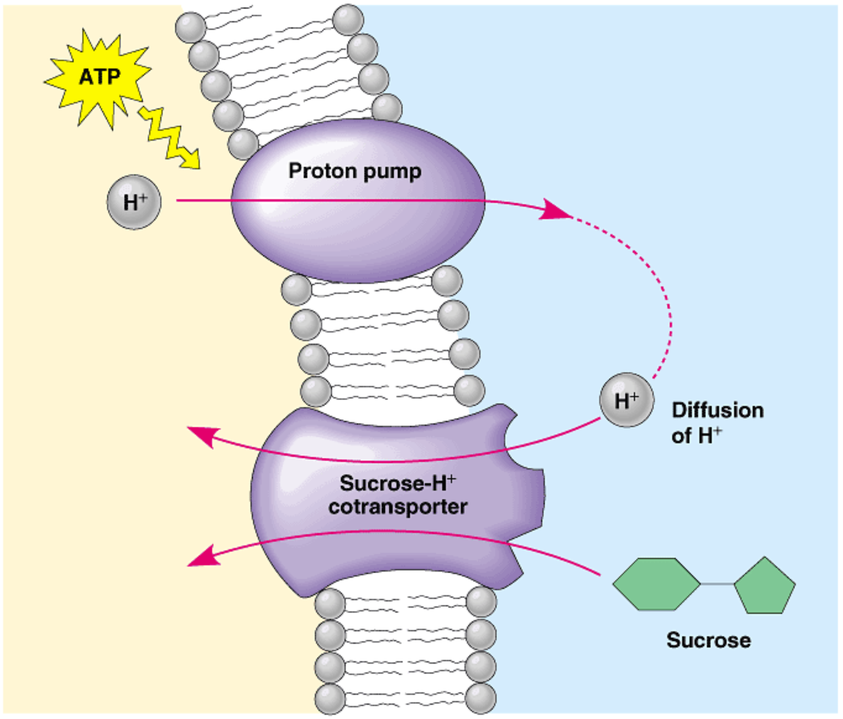
cytoplasm



outside cell

Which change would increase the rate of sucrose absorption?
Alter: 1. [sucrose]? 2. [ATP]? 3. pH? (but on which side?)

cytoplasm

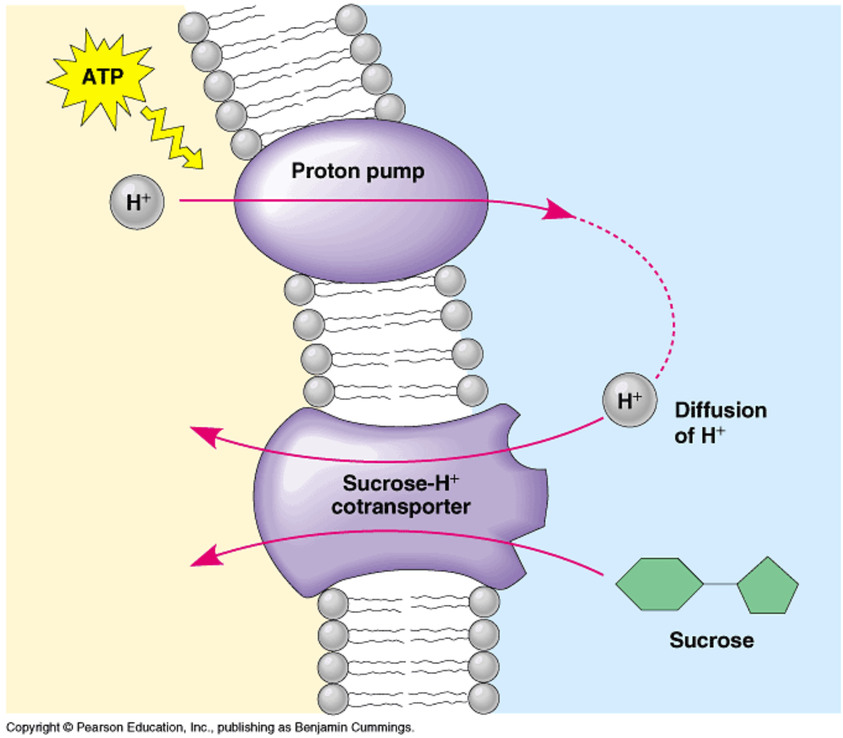


outside cell

Based on the model of sucrose uptake shown, which of the following treatments would increase the rate of sucrose transport into the cell.

a. Decreasing extracellular sucrose concentration.
b. Decreasing extracellular pH
c. Decreasing cytoplasmic pH
d. Adding an inhibitor that blocks the creation of ATP.
e. Adding a substance that makes the membrane more permeable to H+

cytoplasm



outside cell

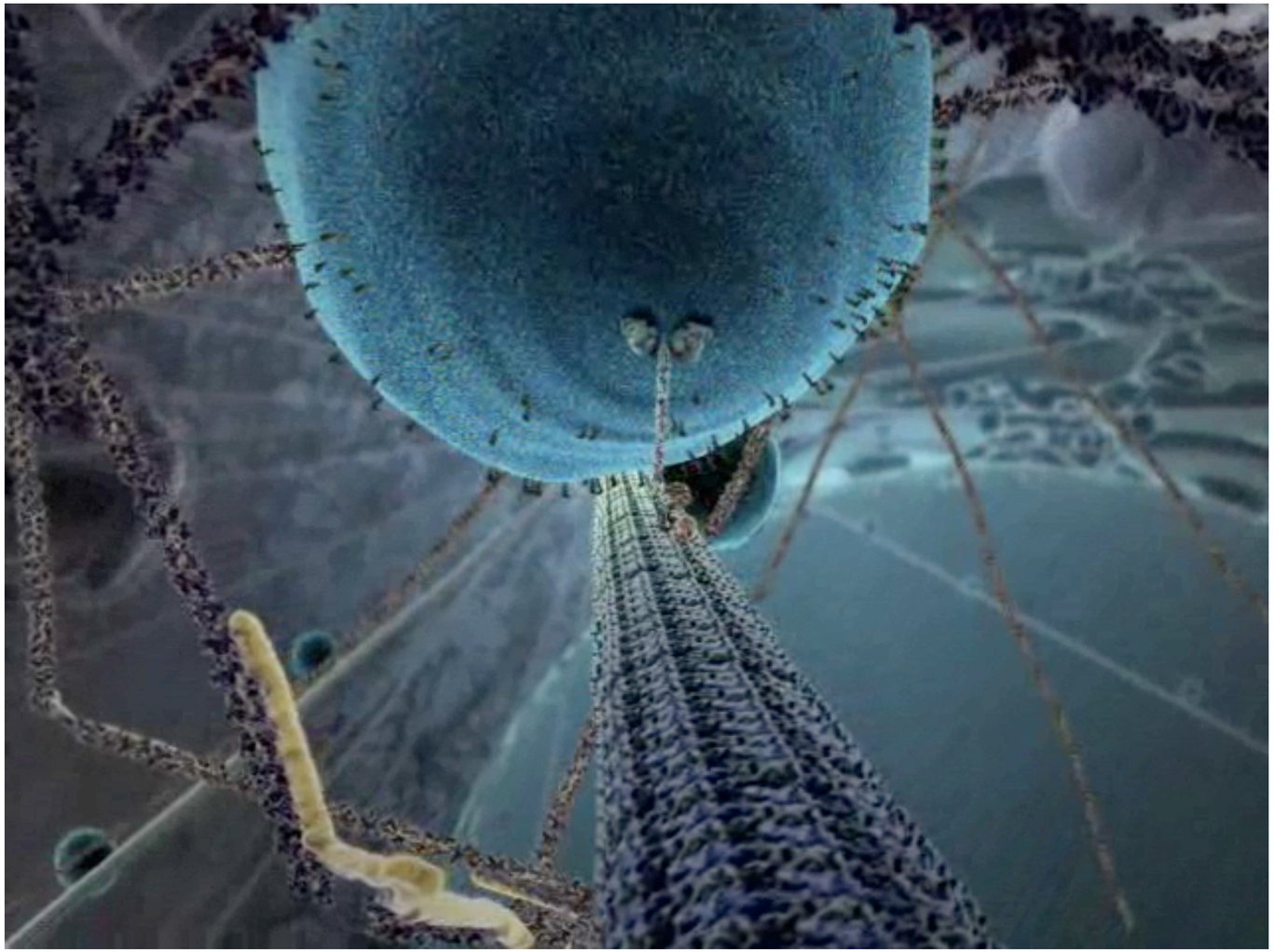
Predict: How would severely decreasing extracellular sucrose concentration alter extracellular pH?

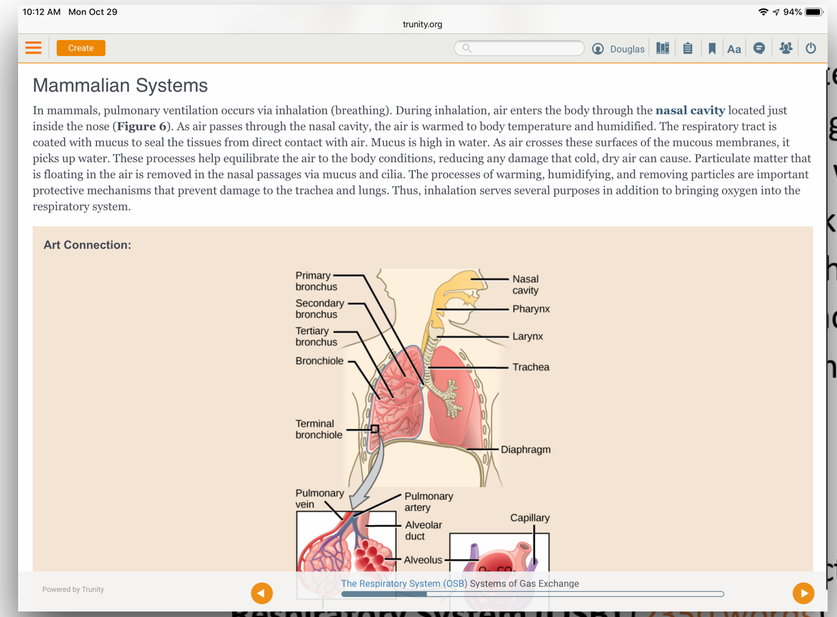
Cell Biology *Post-test*

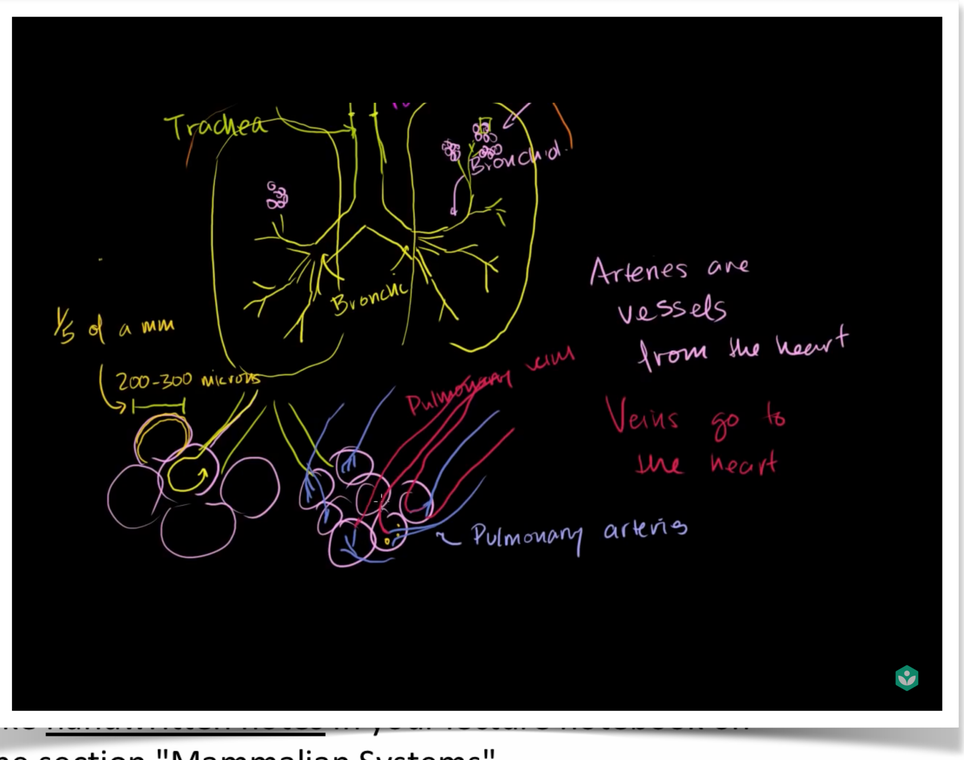
(get your paper ready)

Structure Function

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.







Respiratory System (OSB) (2350 words). Ta… the second half of the reading, starting at the section "Mammalian Systems".

2. _____ (flipped classroom) Watch the really helpful **20-min lecture from the Khan Academy** provided where he gives you an explanation of the topics of ventilation and respiration. Add to your notes any interesting points he makes that helped you better understand what they are all about.

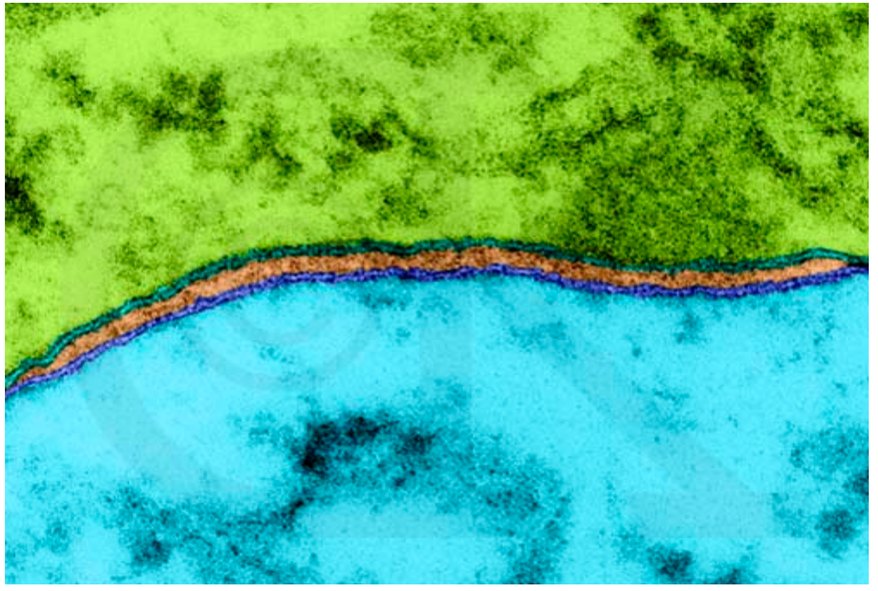
3. _____ **Advanced**: Take a sneak peek at the images and movies in this chapter's section on "Breathing" on the mechanics of breathing particularly related to humans.

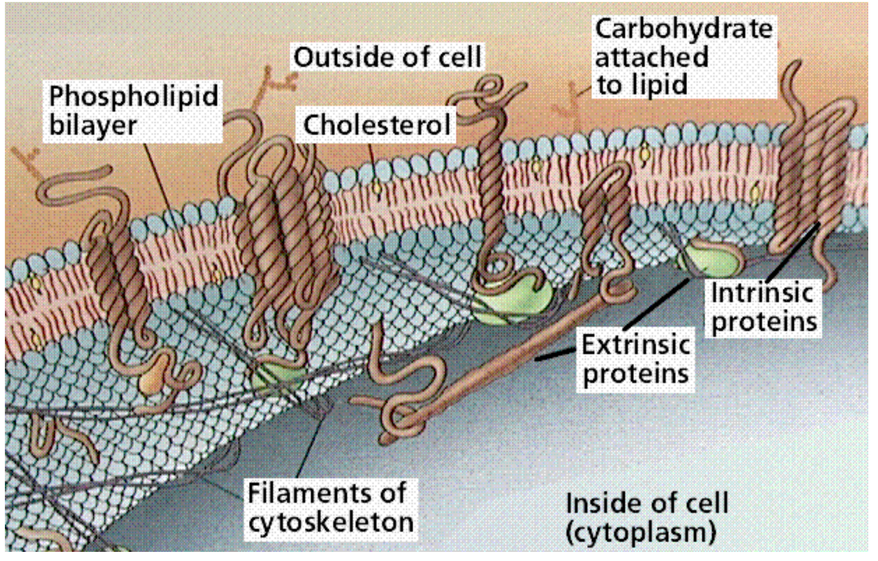
Which would you prefer to do next?

A. We talk about lungs and breathing

B. We review the basics of cystic fibrosis

CF Research Lab @ MSU





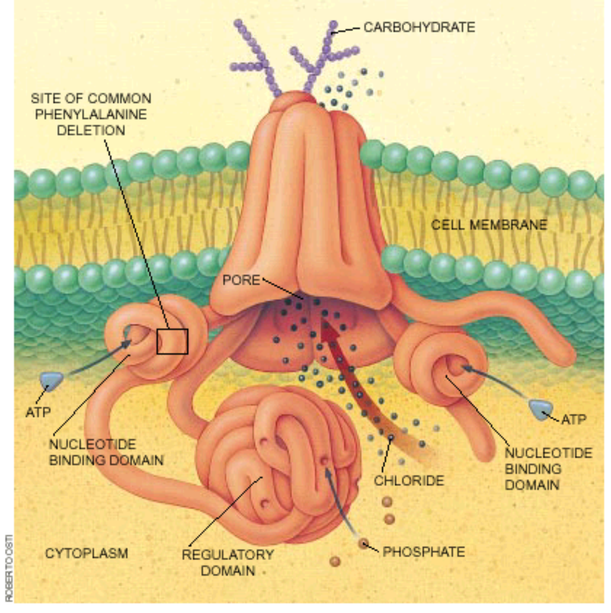
ABC Transporter Family

Clinical Relevance

MDR- Cancer

SUR- Diabetes

CFTR- Cystic Fibrosis



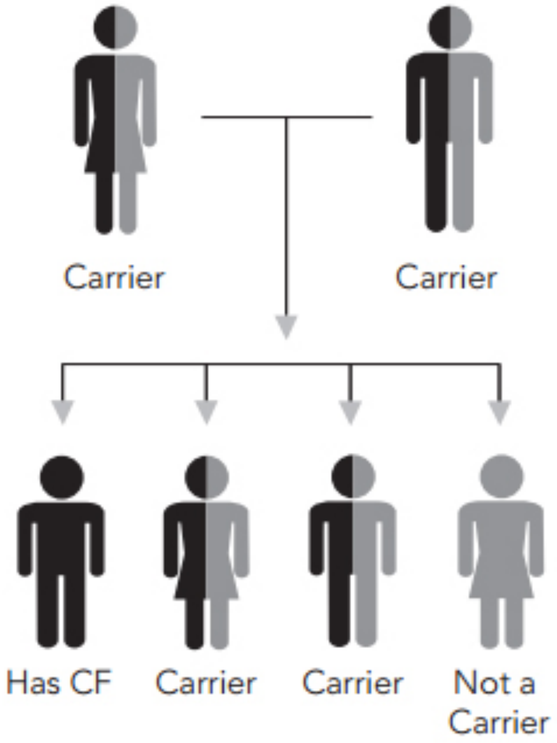
SCIENTIFIC AMERICAN *December 1995*

Cystic Fibrosis

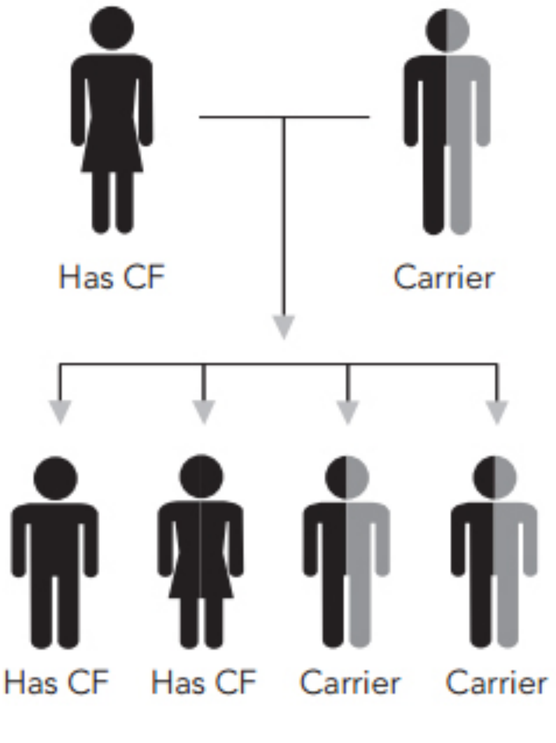
How a Person Gets CF

To have CF, you must get one copy of the CF gene from each parent.
That means that each parent must be a carrier of the CF gene.

When two people who are carriers have a child, there is a 25 percent chance of having a child with CF.



When one parent has CF and one parent is a carrier, there is a 50 percent chance having a child with CF.

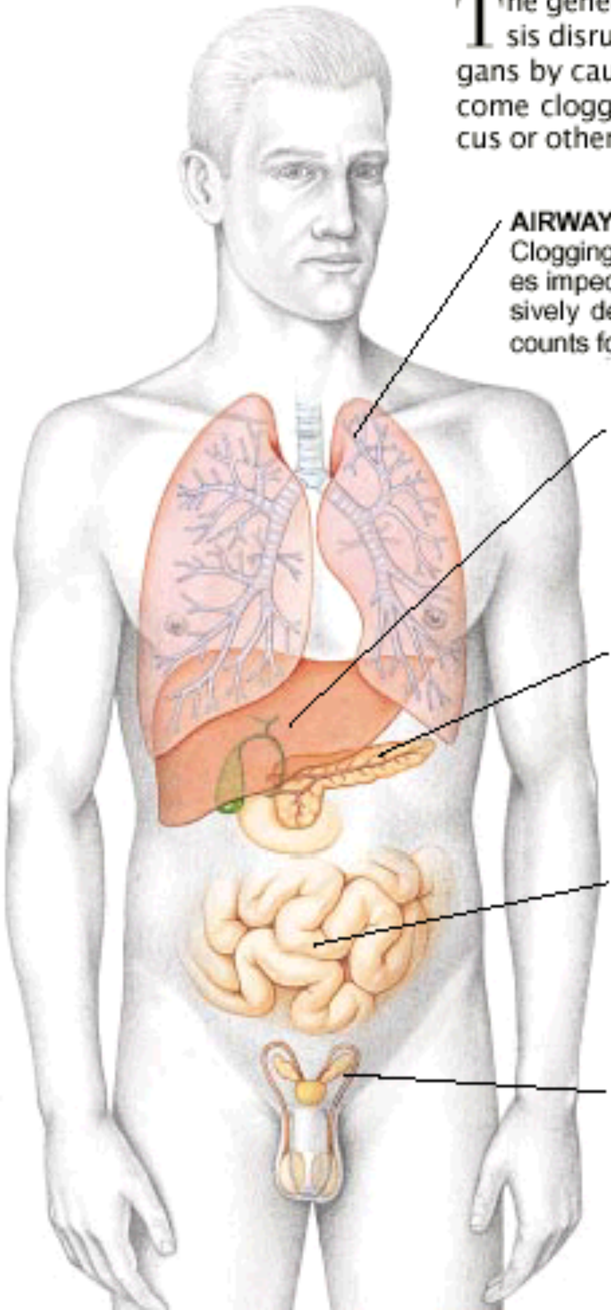


Exercise #1:

'What *causes* the disease cystic fibrosis?'

Organs Affected by Cystic Fibrosis

The genetic defect underlying cystic fibrosis disrupts the functioning of several organs by causing ducts or other tubes to become clogged, usually by thick, sticky mucus or other secretions.



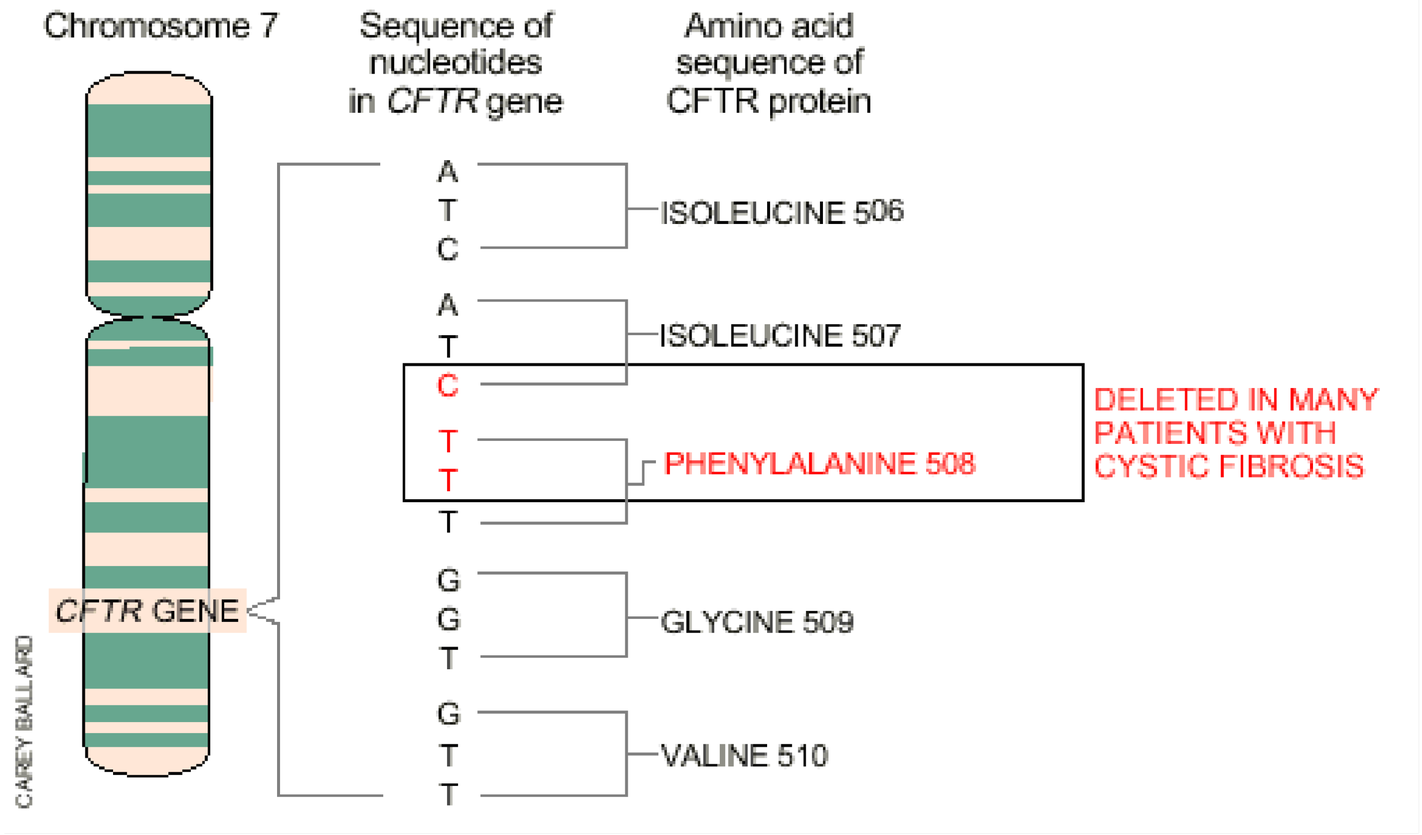
AIRWAYS
Clogging and infection of bronchial passages impede breathing. The infections progressively destroy the lungs. Lung disease accounts for most deaths from cystic fibrosis.

LIVER
Plugging of small bile ducts impedes digestion and disrupts liver function in perhaps 5 percent of patients.

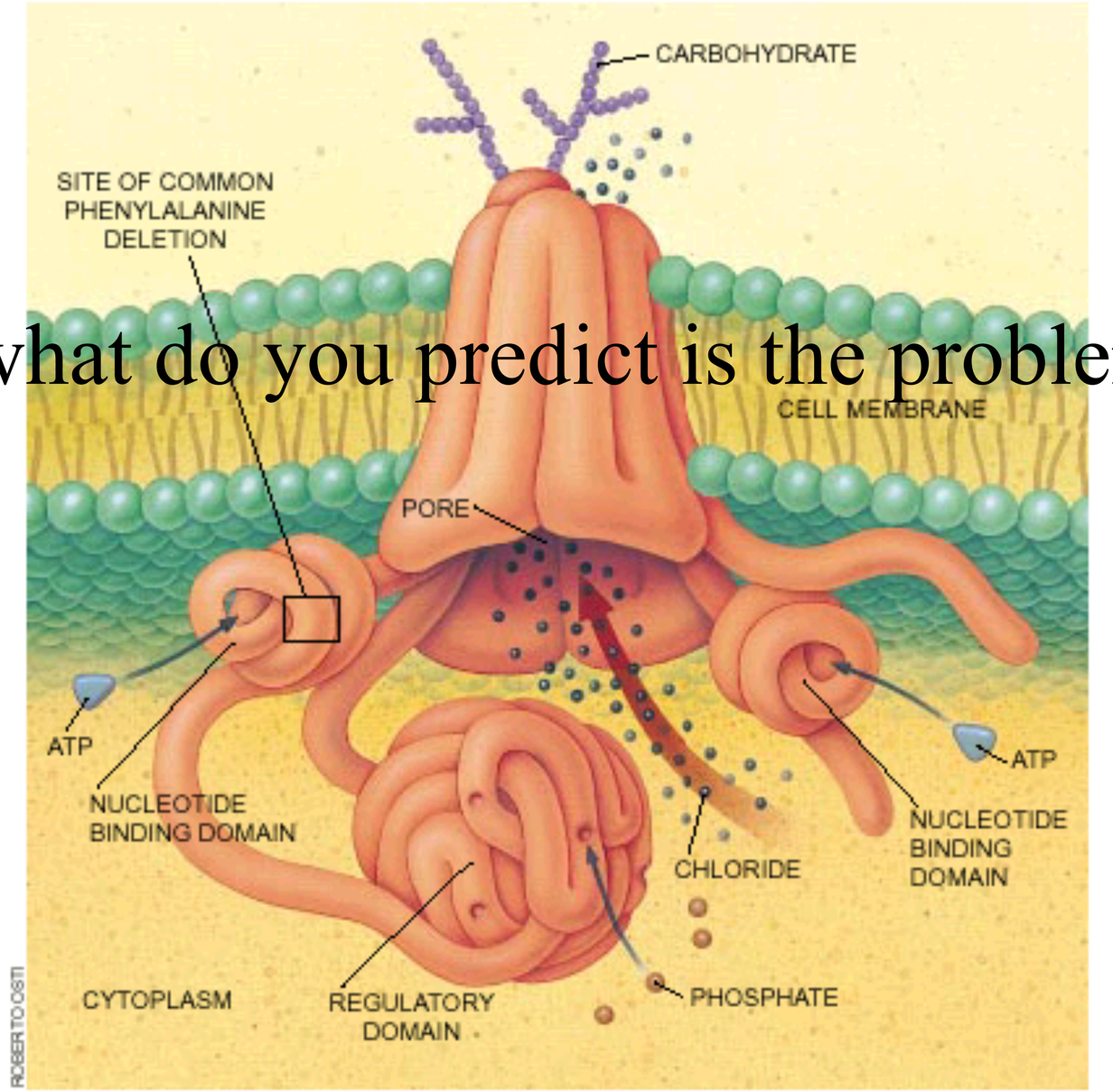
PANCREAS
Occlusion of ducts prevents the pancreas from delivering critical digestive enzymes to the bowel in 85 percent of patients. Diabetes can result as well.

SMALL INTESTINE
Obstruction of the gut by thick stool necessitates surgery in about 10 percent of newborns.

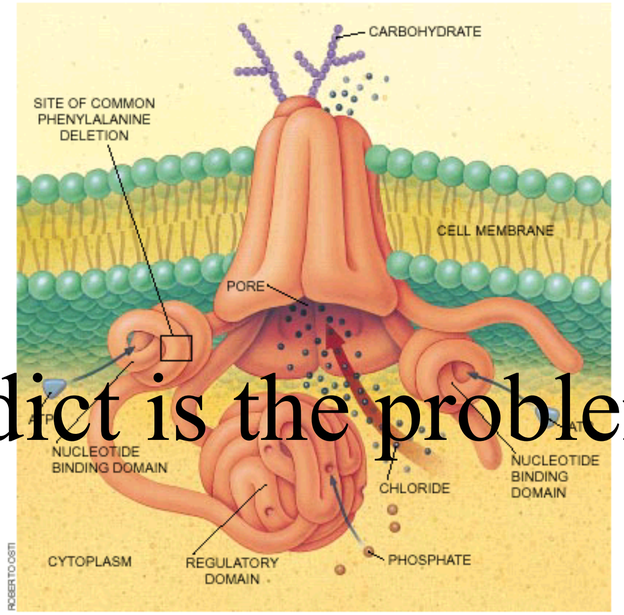
REPRODUCTIVE TRACT
Absence of fine ducts, such as the vas deferens, renders 95 percent of males infertile. Occasionally, women are made infertile by a dense plug of mucus that blocks sperm from entering the uterus.


Chromosome 7
Sequence of nucleotides in *CFTR* gene
Amino acid sequence of CFTR protein
CFTR GENE
A
T
C
ISOLEUCINE 506
A
T
C
ISOLEUCINE 507
T
T
T
PHENYLALANINE 508
DELETED IN MANY PATIENTS WITH CYSTIC FIBROSIS
G
G
T
GLYCINE 509
G
T
T
VALINE 510
CAREY BALLARD

So what do you predict is the problem?



So what do you predict is the problem?



A. The deletion alters gating, thus blocking the CFTR.

B. The deletion alters ATP binding, thus stopping CFTR.

C. The deletion alters the folding, but CFTR still works.

D. None of the above cause the disease.

Where are the CFTR channels found normally [in a healthy person]?

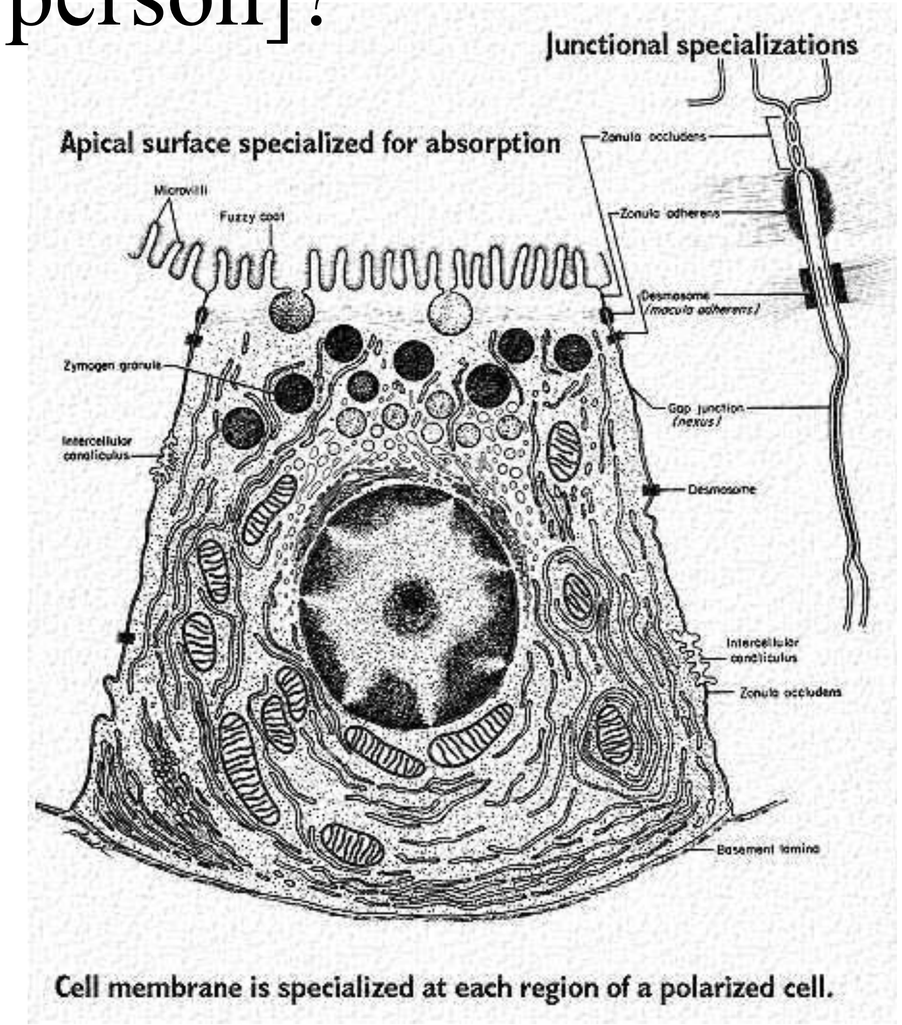
A. the apical surface ->

B. inside the ER

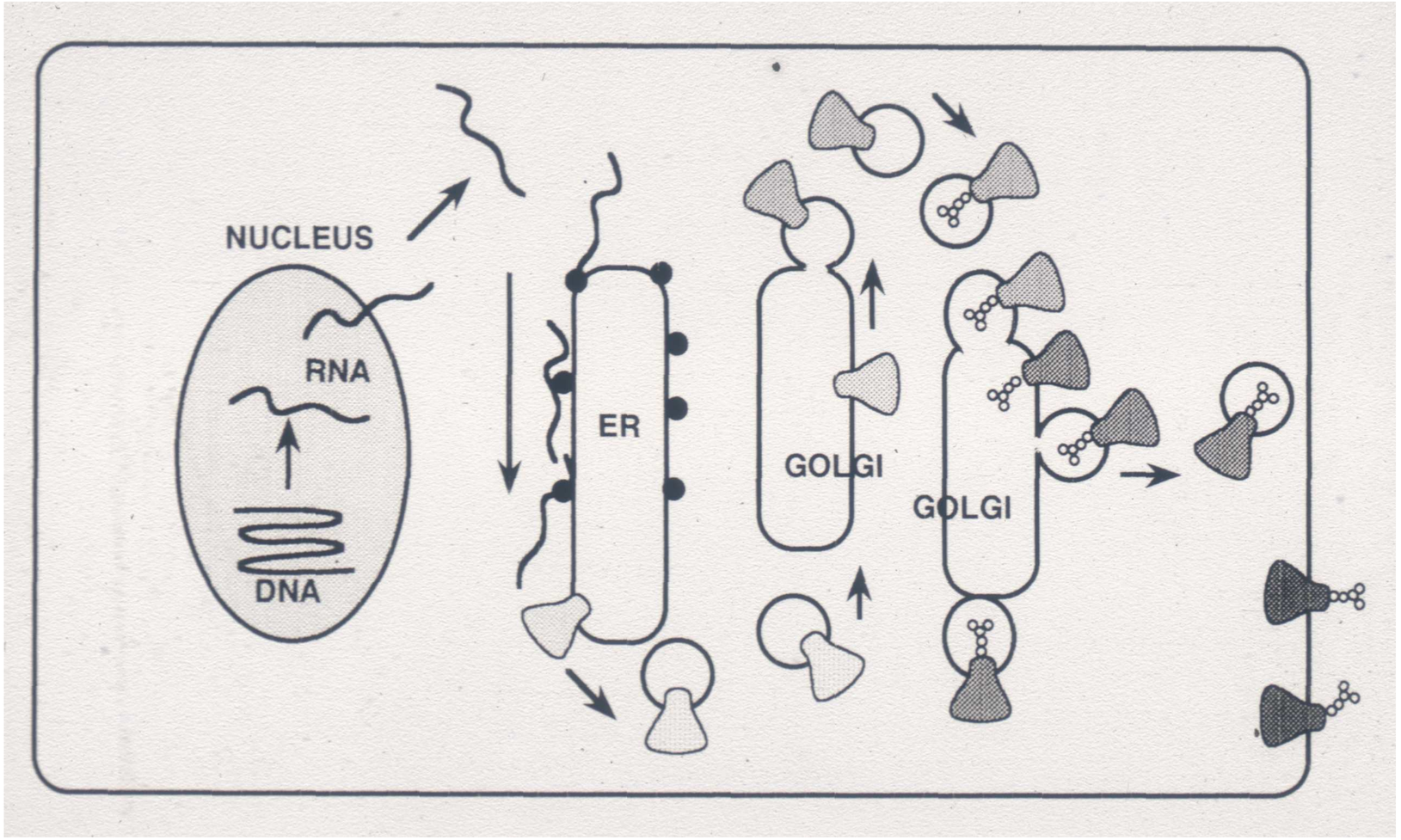
C. the lateral surface ->

D. in the lysosome

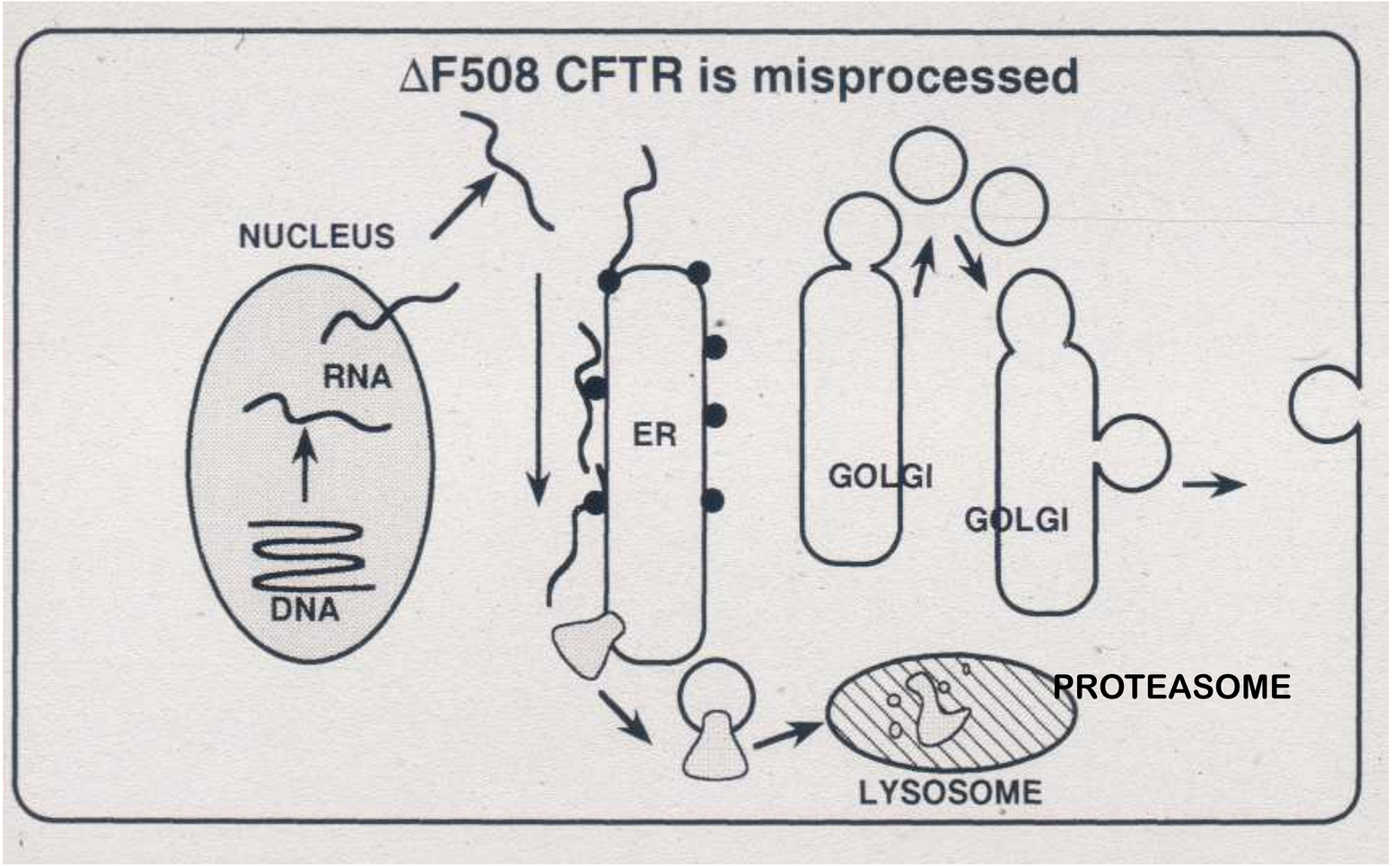
E. the basal surface ->



biosynthesis of normal wild-type CFTR



biosynthesis of mutant CFTR



How many CFTR channels are on the surface of a cell of a CF patient?? (normal=100)

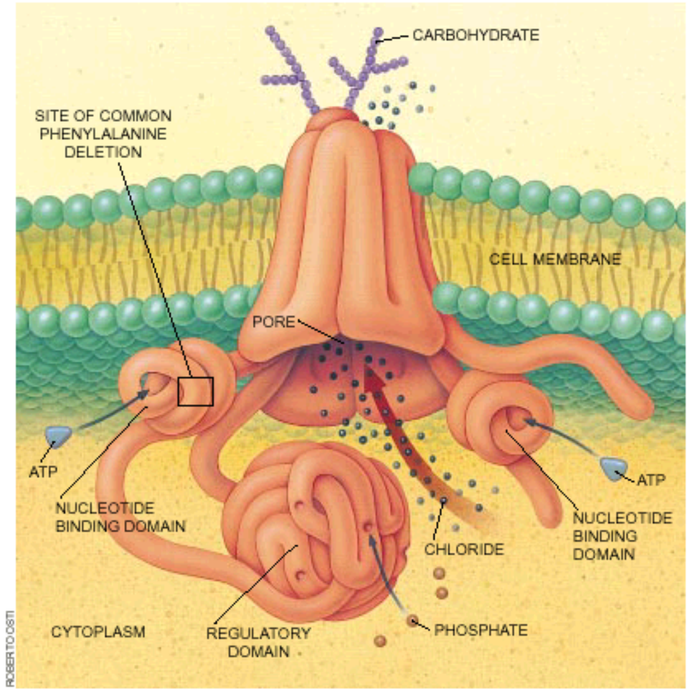
A. 50

B. 25

C. 10

D. 5

E. 0



How many CFTR channels are on the surface of a cell of a **CF carrier** [heterozygote]?? (normal=100)

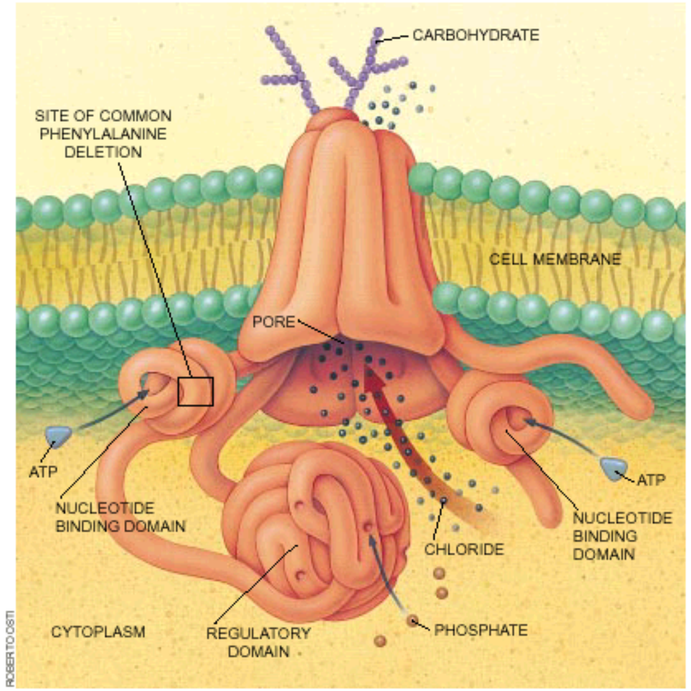
A. 50

B. 25

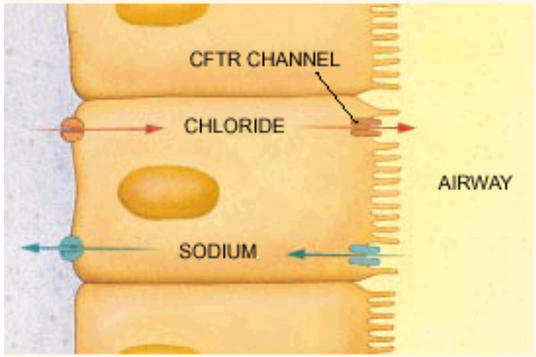
C. 10

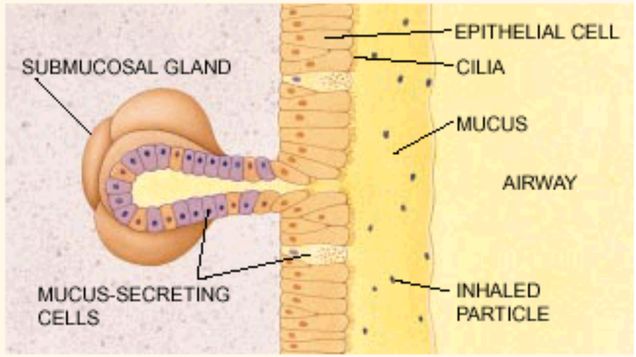
D. 5

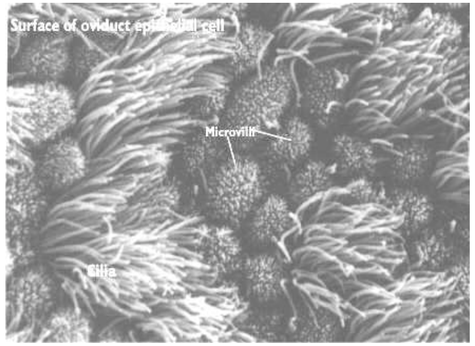
E. None of the above are correct.

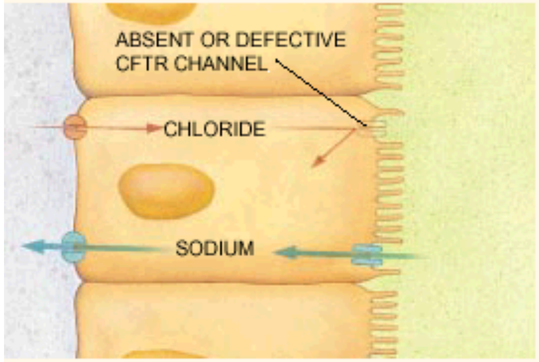


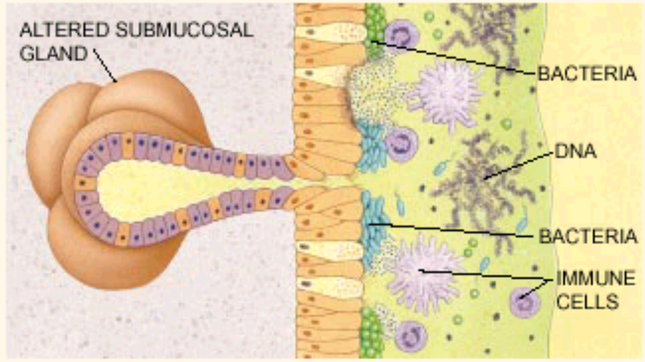
Healthy (normal)

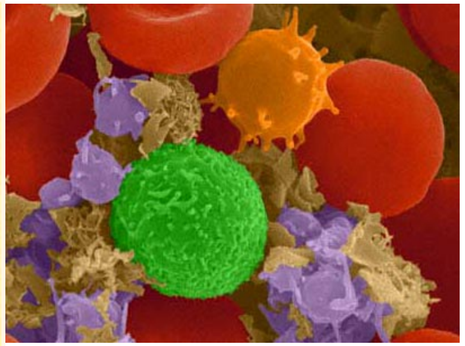




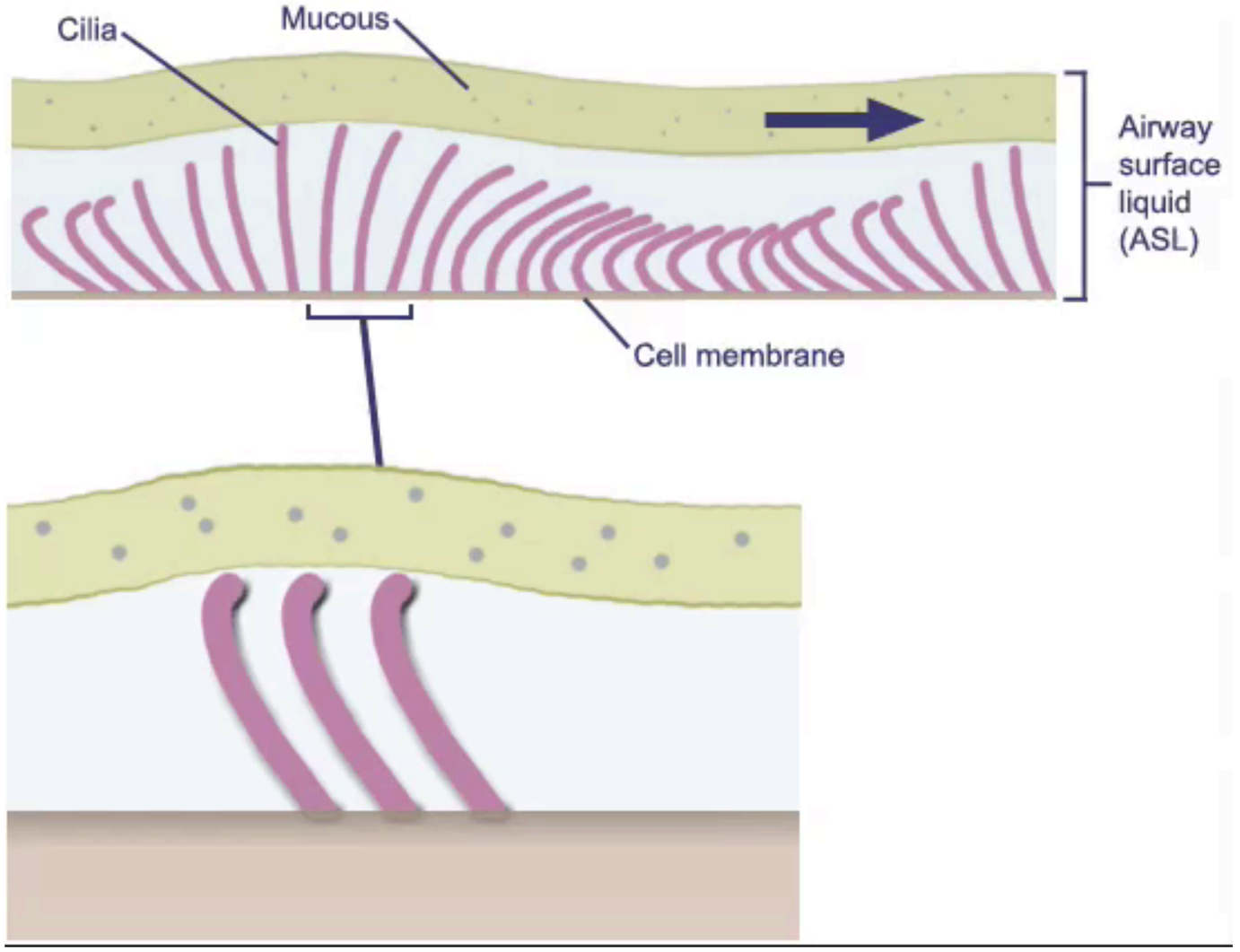




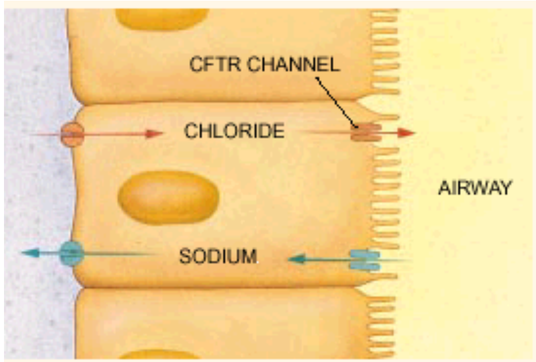


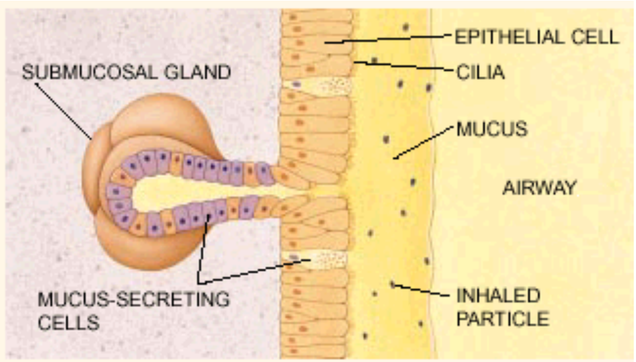


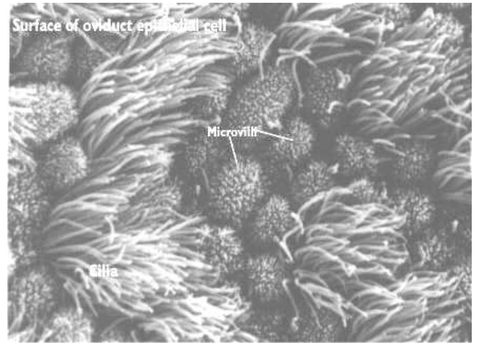
Sick (cystic fibrosis)

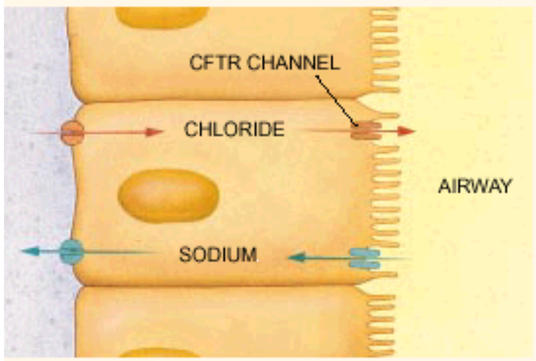

Cilia
Mucous
Airway surface liquid (ASL)
Cell membrane

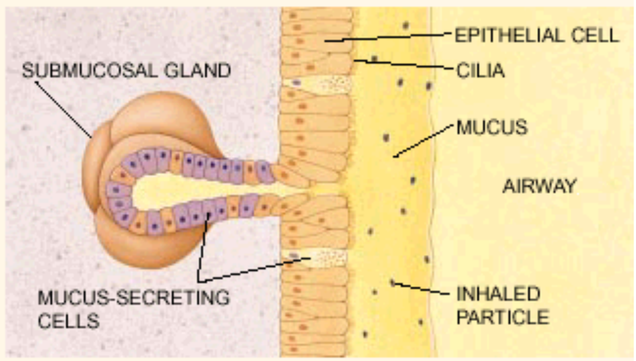
Healthy (normal)

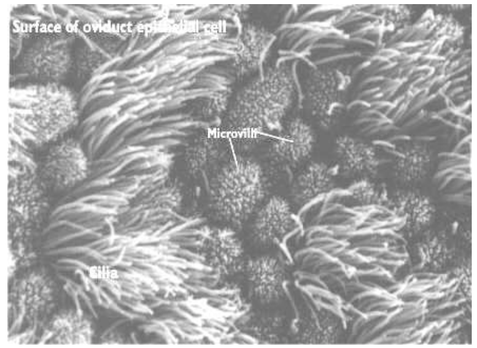






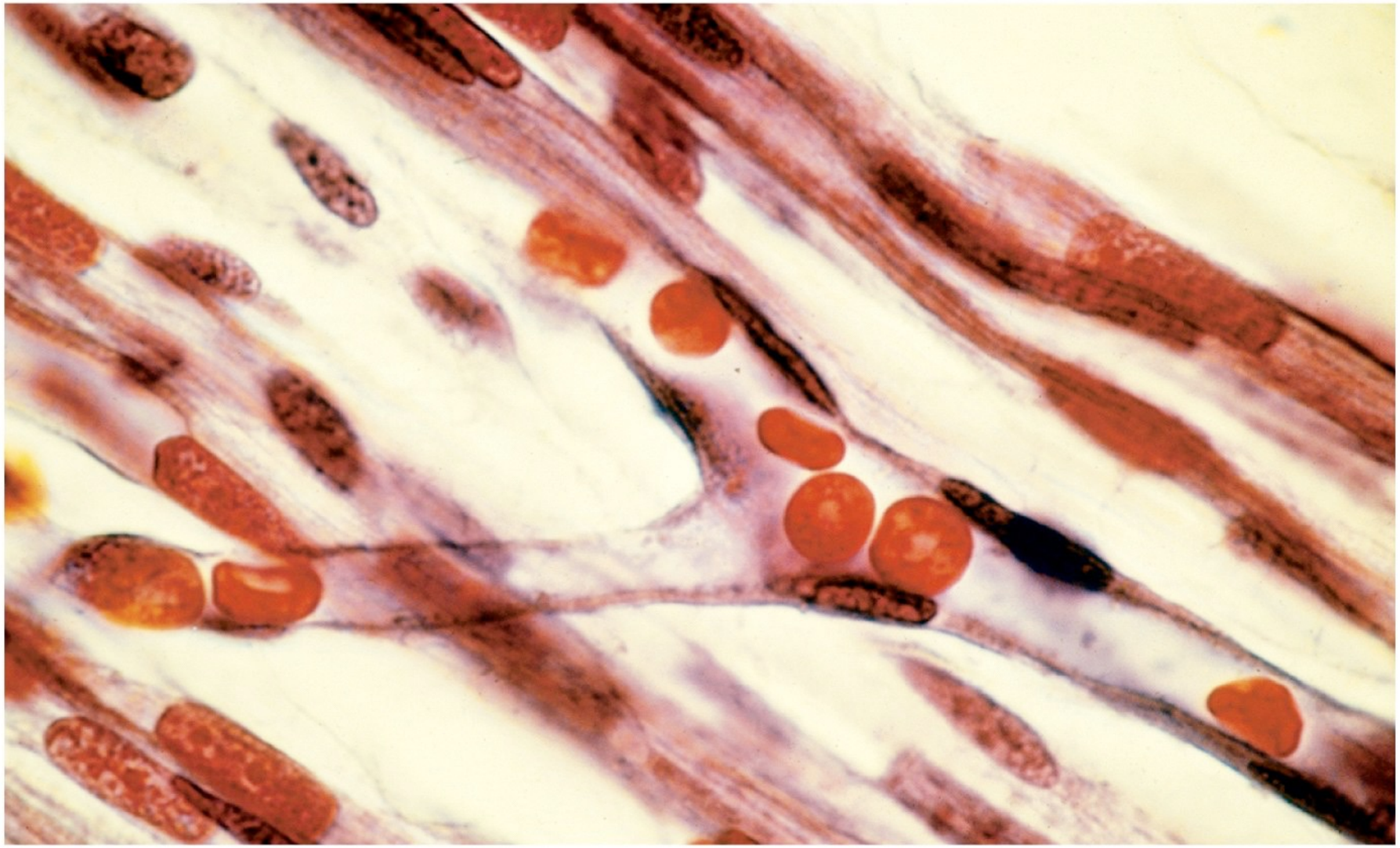


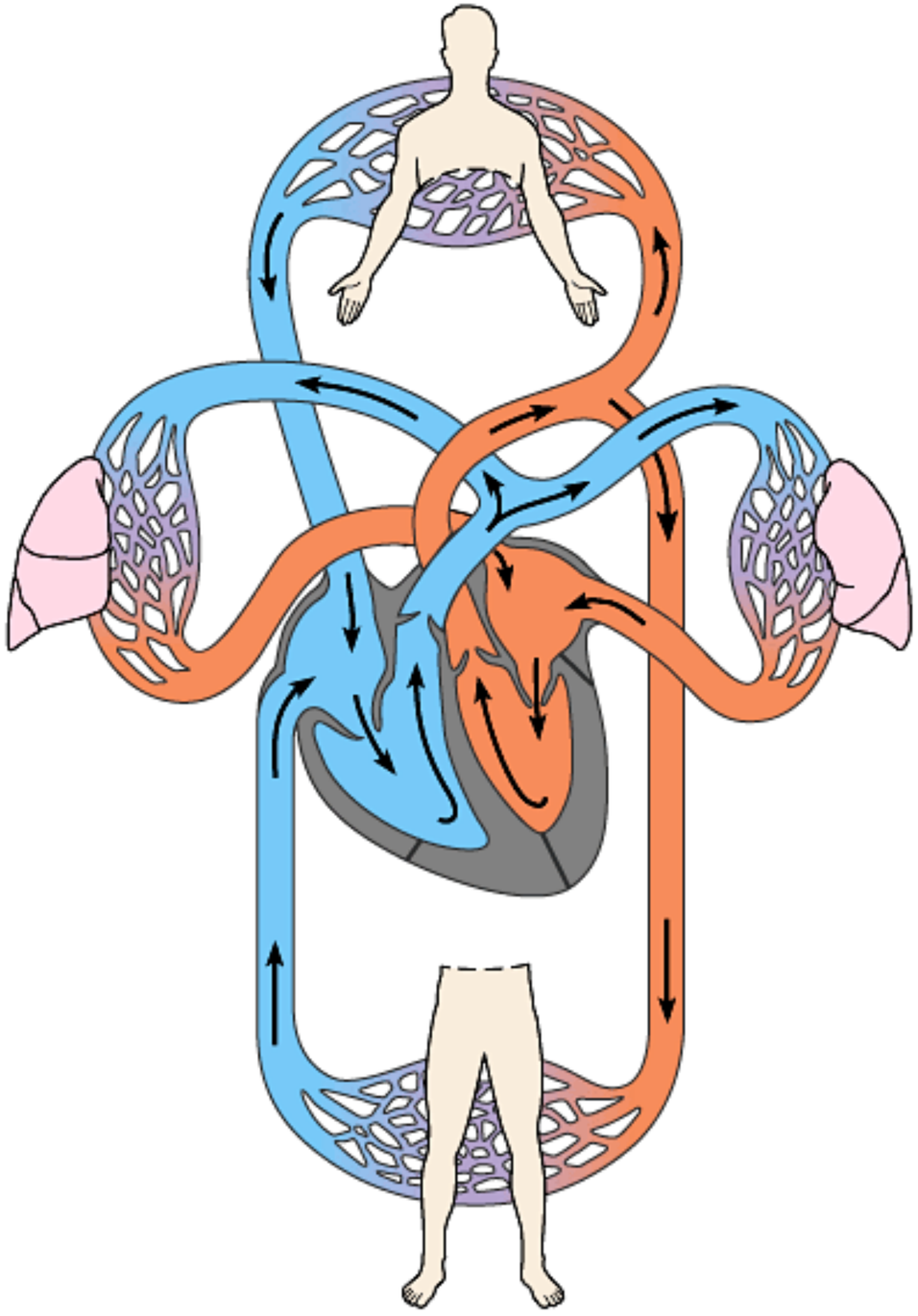


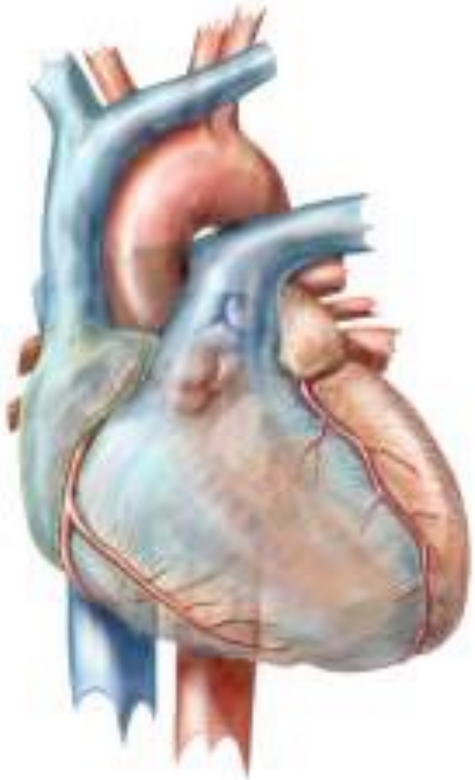


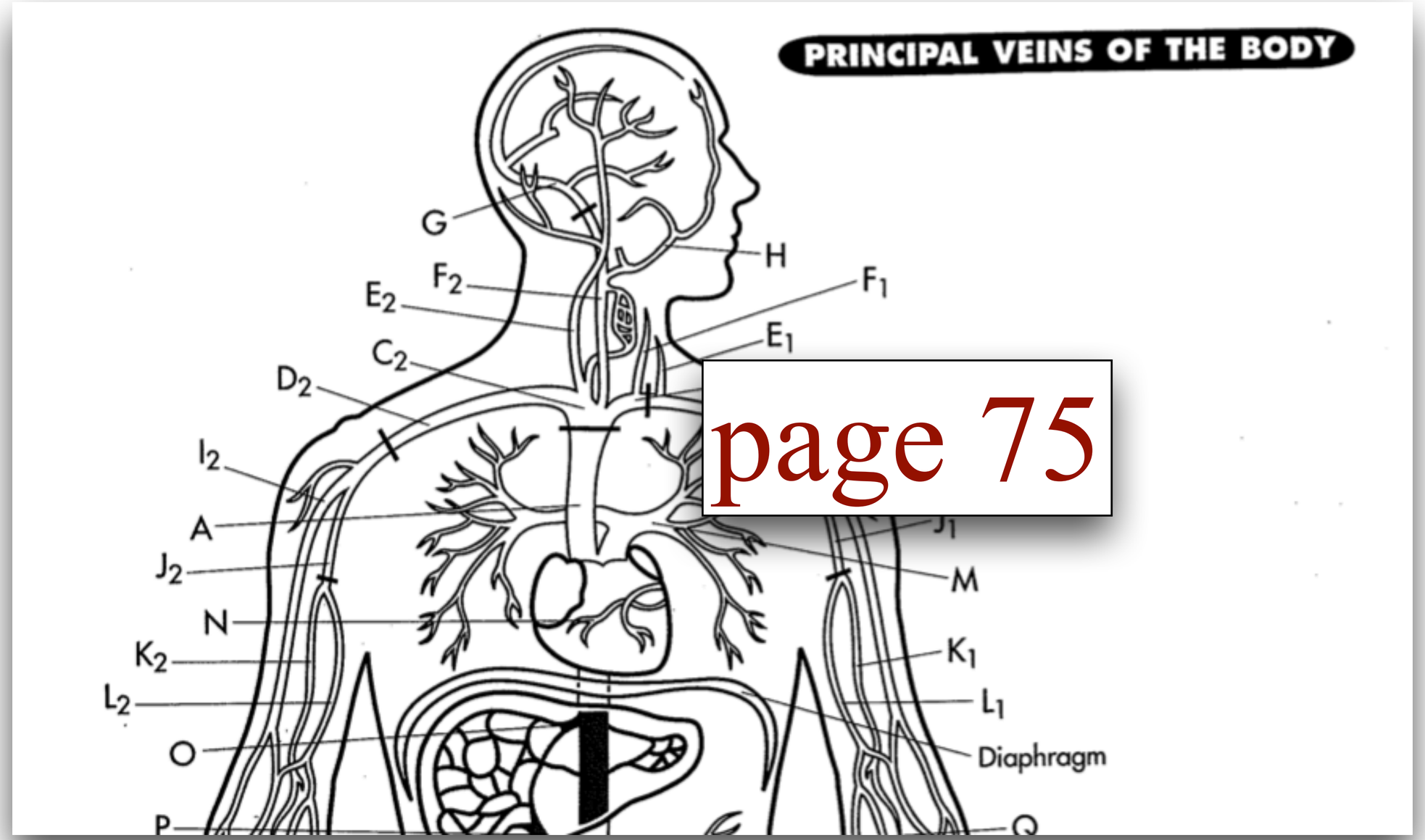
Sick (cilia dyskinesia)

Capillaries are small and extremely thin walled.



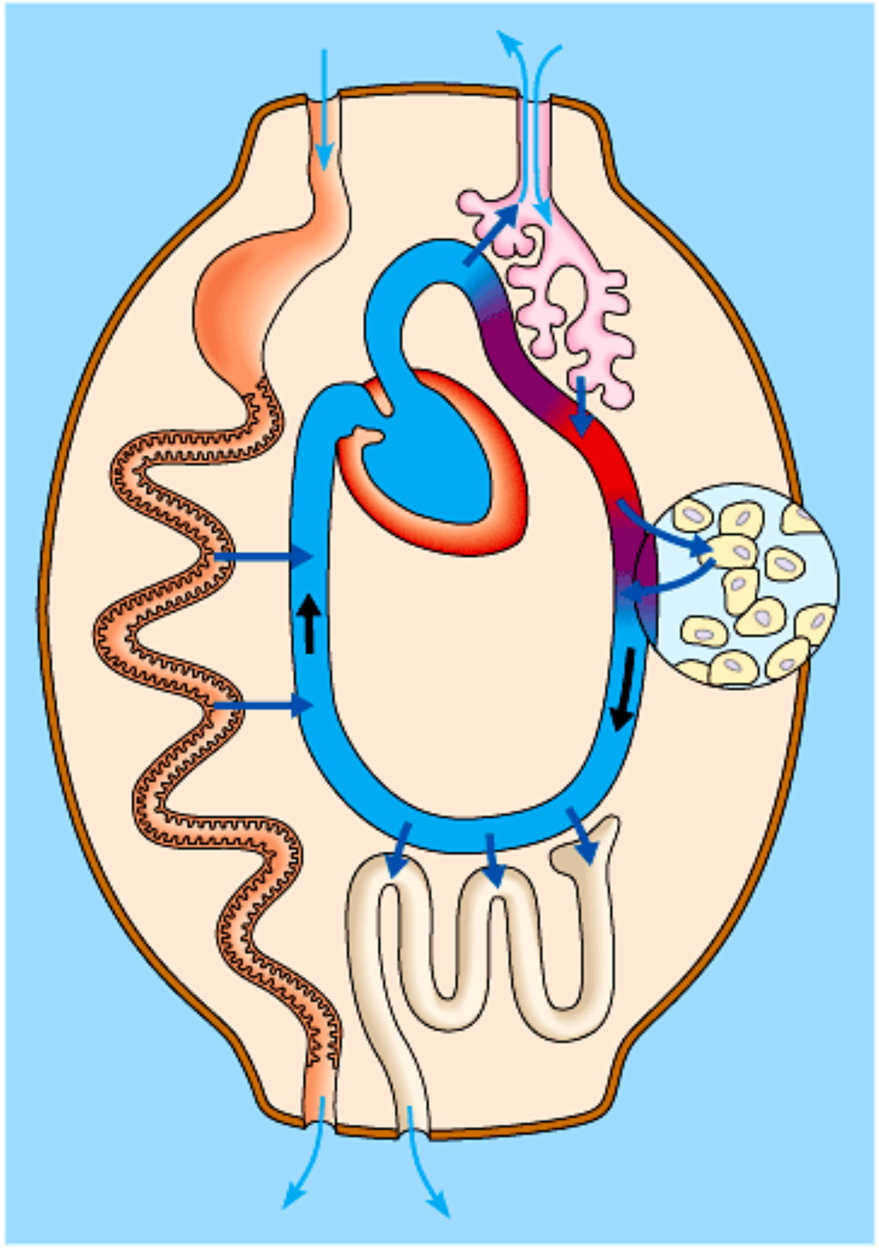


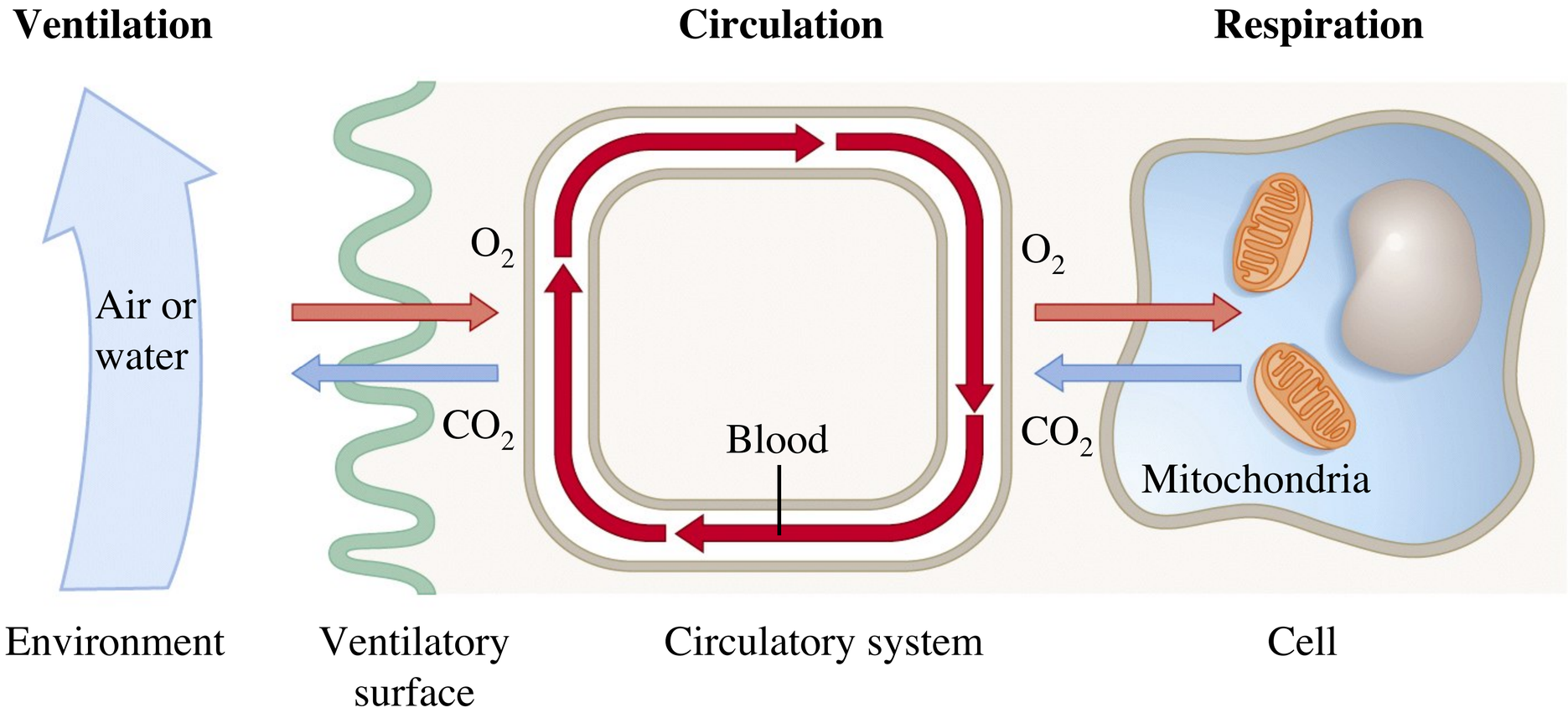


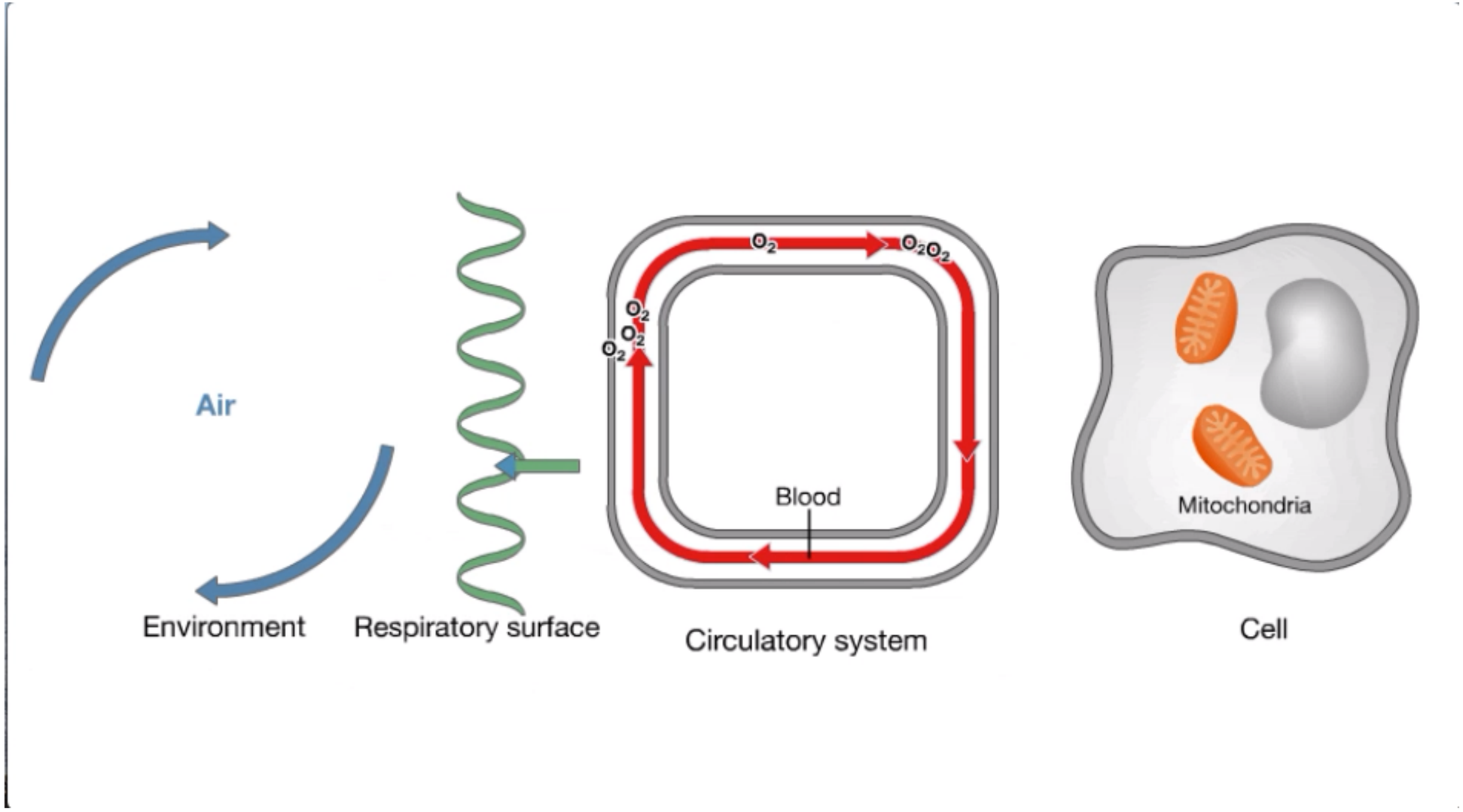

PRINCIPAL VEINS OF THE BODY
G
H
F2
F1
E2
E1
C2
D2
I2
A
J2
N
K2
L2
O
P
J1
M
K1
L1
Diaphragm
Q

page 75

The Basics




Ventilation
Circulation
Respiration
Air or water
O_2
CO_2
Blood
O_2
CO_2
Mitochondria
Environment
Ventilatory surface
Circulatory system
Cell

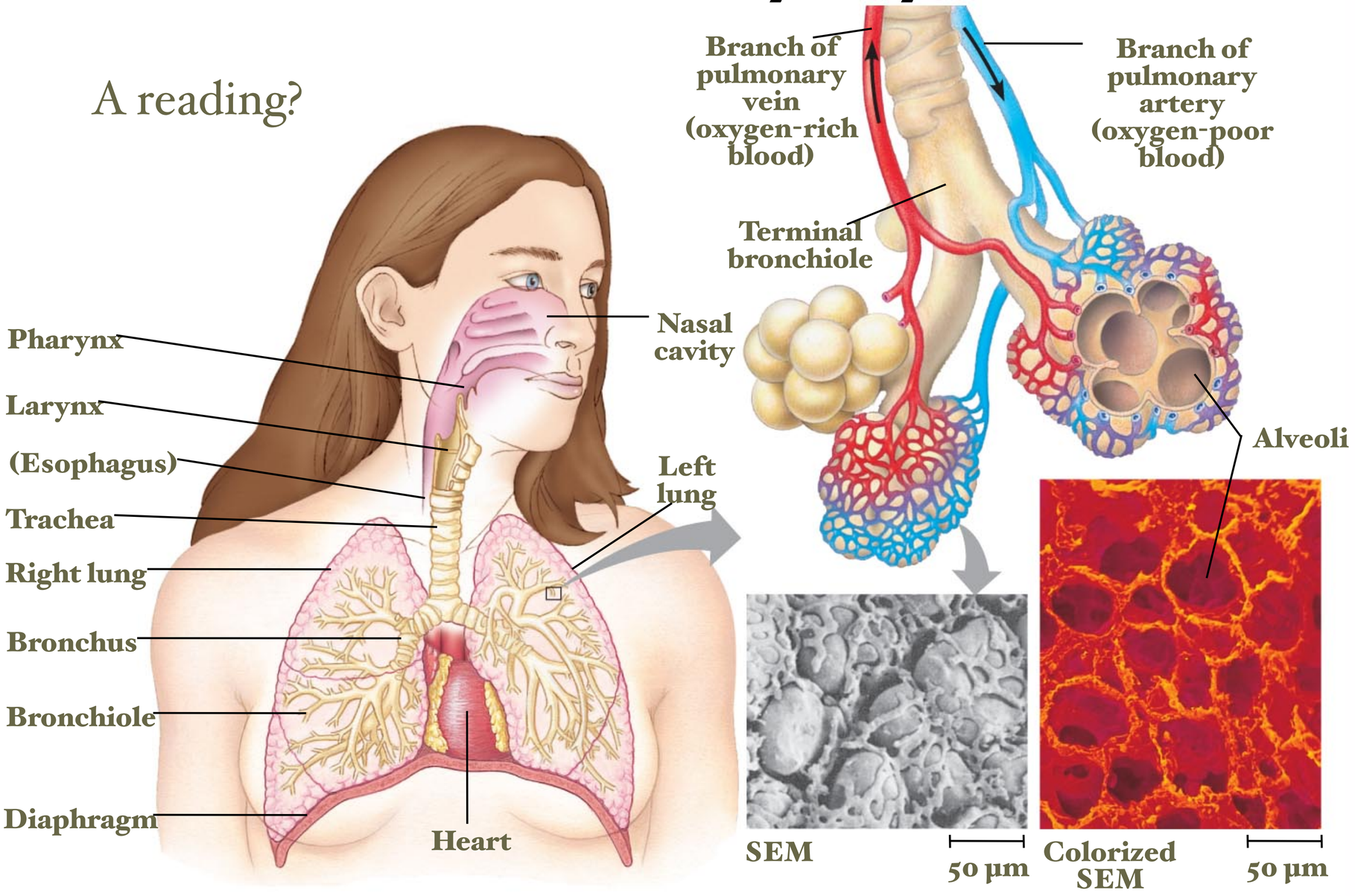

Air
Environment
Respiratory surface
O_2
O_2
O_2
O_2
O_2
Blood
Circulatory system
Mitochondria
Cell

What is unique about blood in pulmonary arteries compared with blood in other arteries?

a) Blood in pulmonary arteries is always blue; it is red in all other arteries.
b) It is moving away from the heart.
c) It is moving toward the heart.
d) It is the same as blood in other arteries.
e) It is loaded with carbon dioxide.

The Pulmonary System

A reading?



A reading . . .

Air enters through the nostrils and is then filtered by hairs, warmed, humidified, and sampled for odors as it flows through a maze of spaces in the nasal cavity. The nasal cavity leads to the pharynx, an intersection where the paths for air and food cross. When food is swallowed, the **larynx** (the upper part of the respiratory tract) moves upward and tips the

In negative pressure breathing, inhalation results from

a) forcing air from the throat down into the lungs.

b) contracting the diaphragm.

c) relaxing the muscles of the rib cage.

d) using muscles of the lungs to expand the alveoli.

e) contracting the abdominal muscles.

When you hold your breath, which of the following blood gas changes first leads to the urge to breathe?

a) rising O2

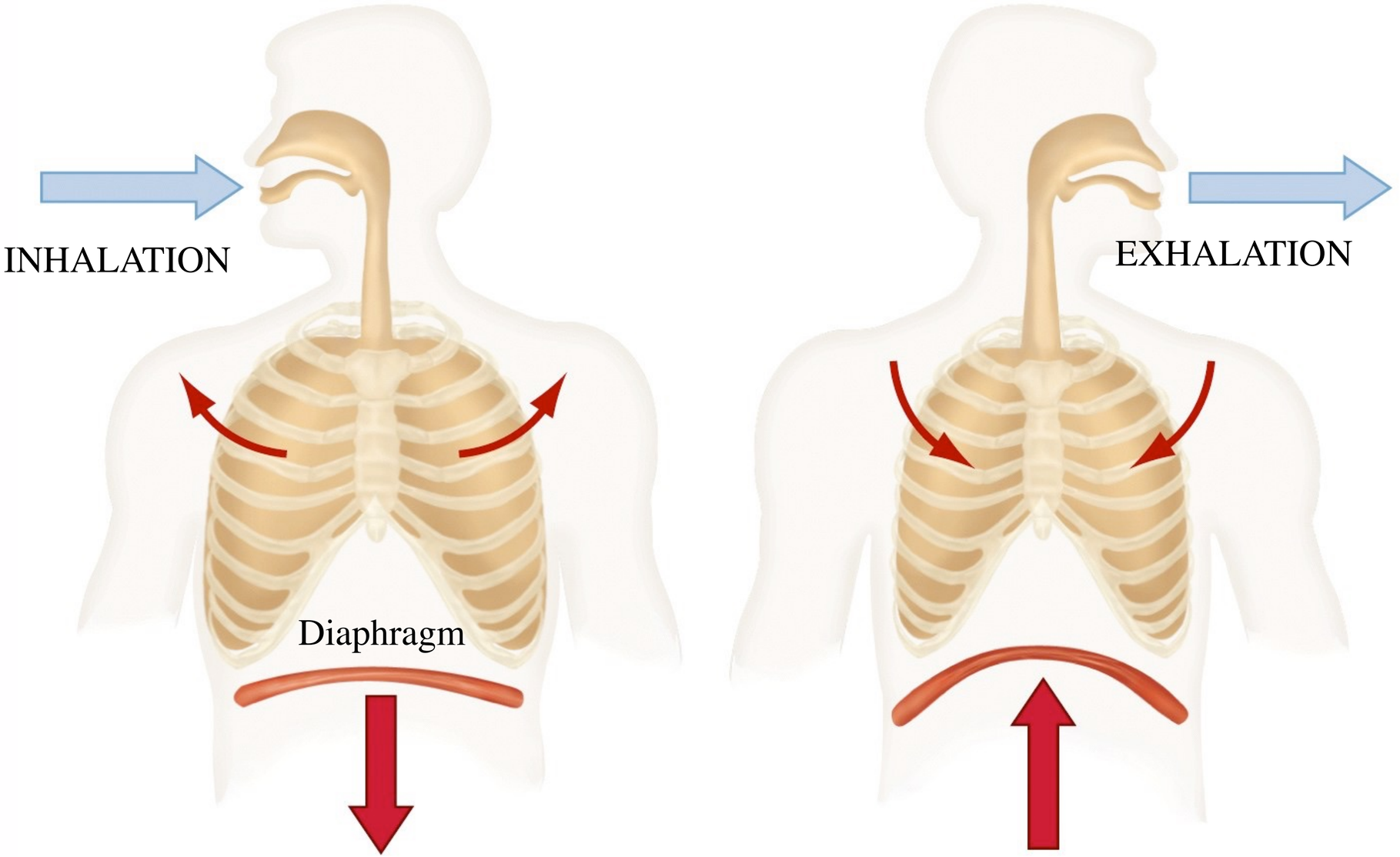
b) falling O2

c) rising CO2

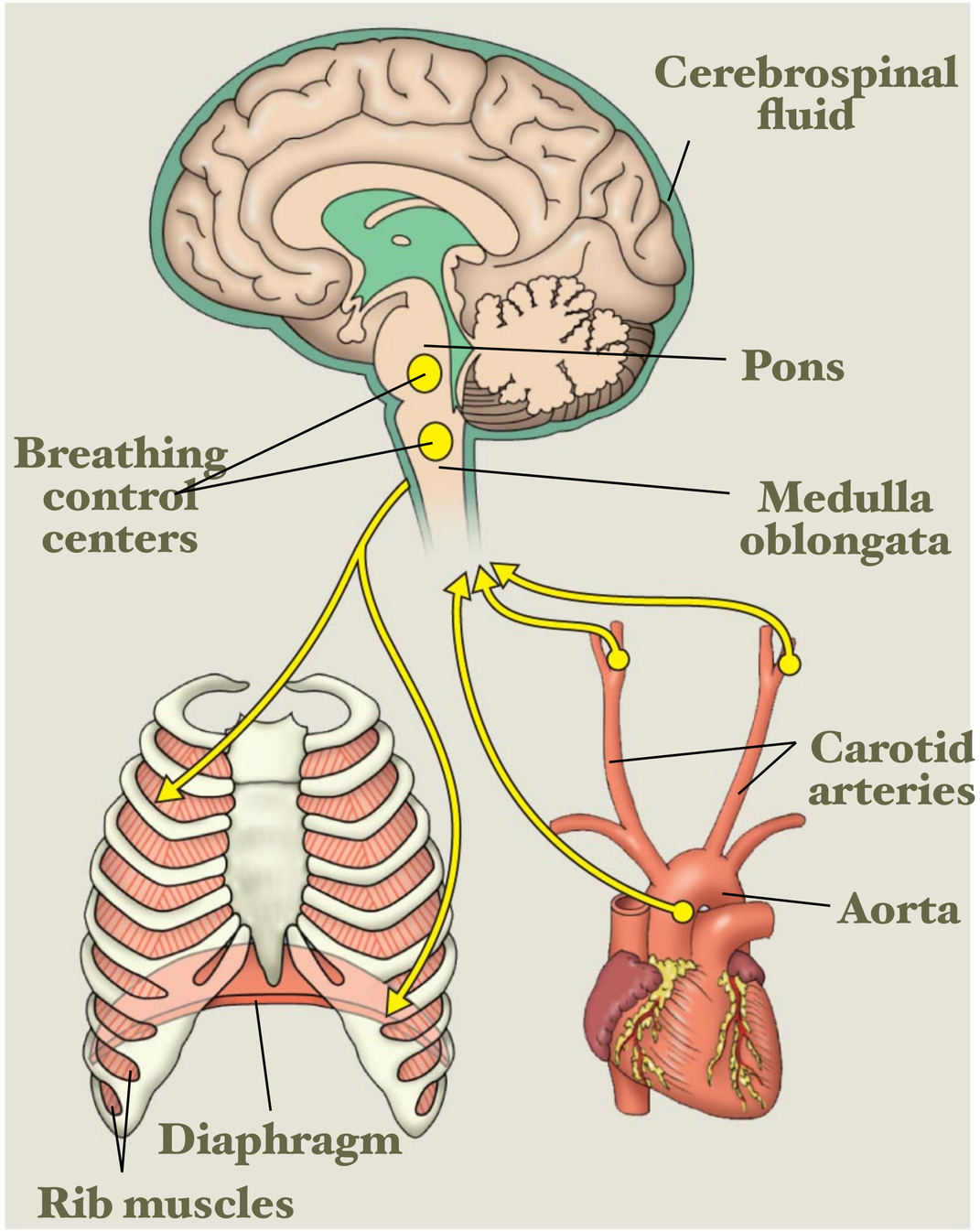
d) falling CO2

e) rising CO2 and falling O2

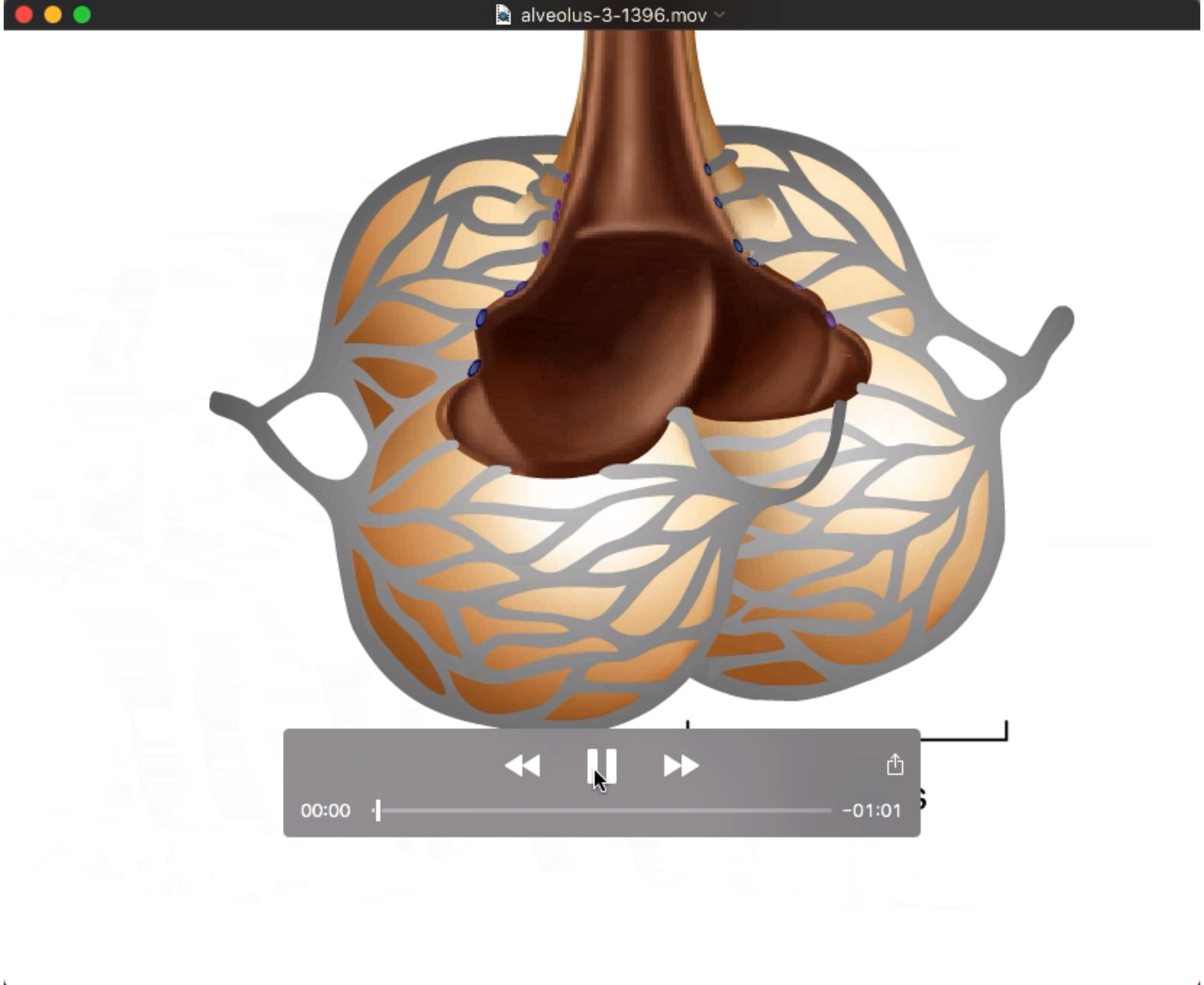
Lungs expand and contract in response to changes in pressure inside the chest cavity.



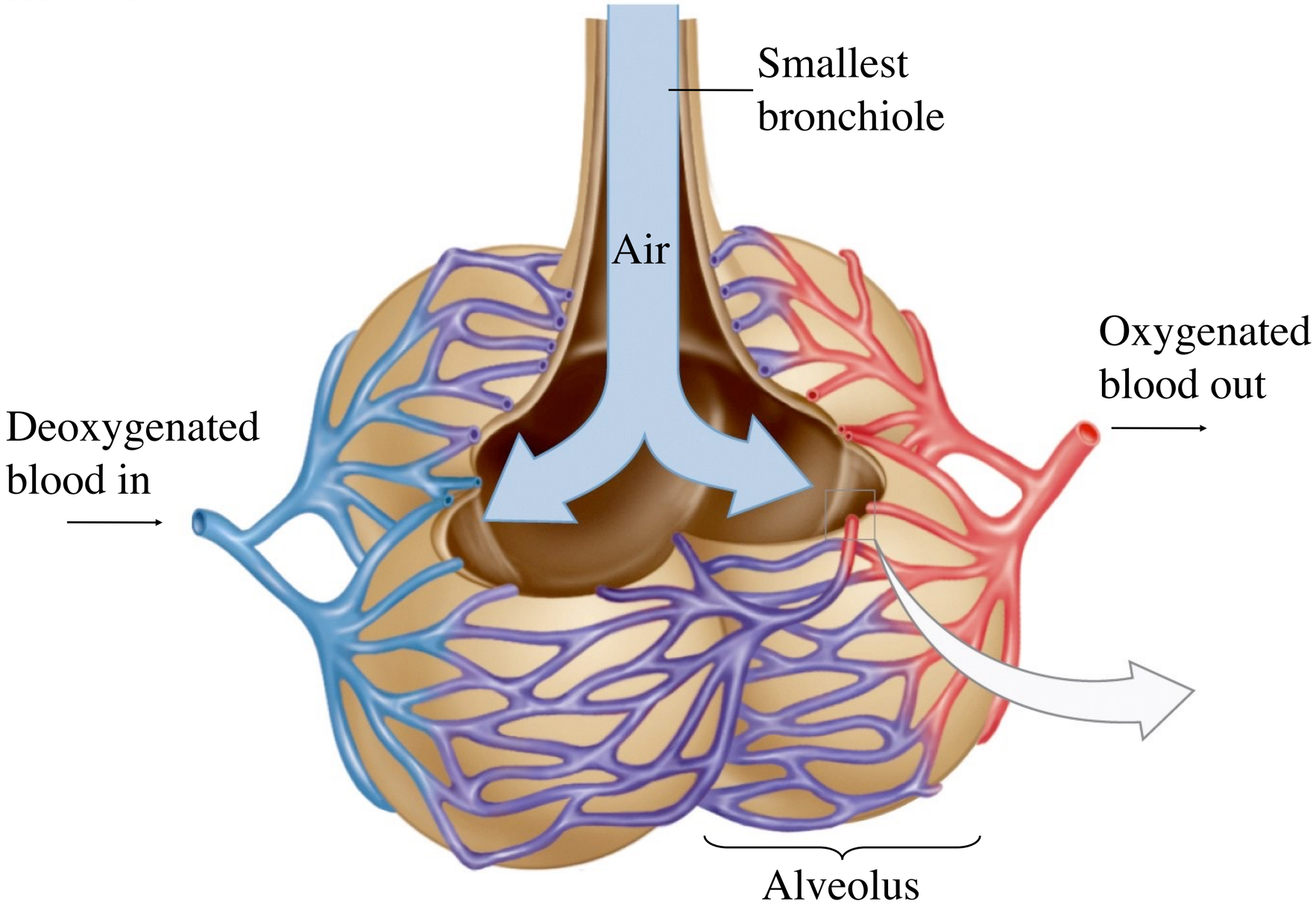
[CO2]



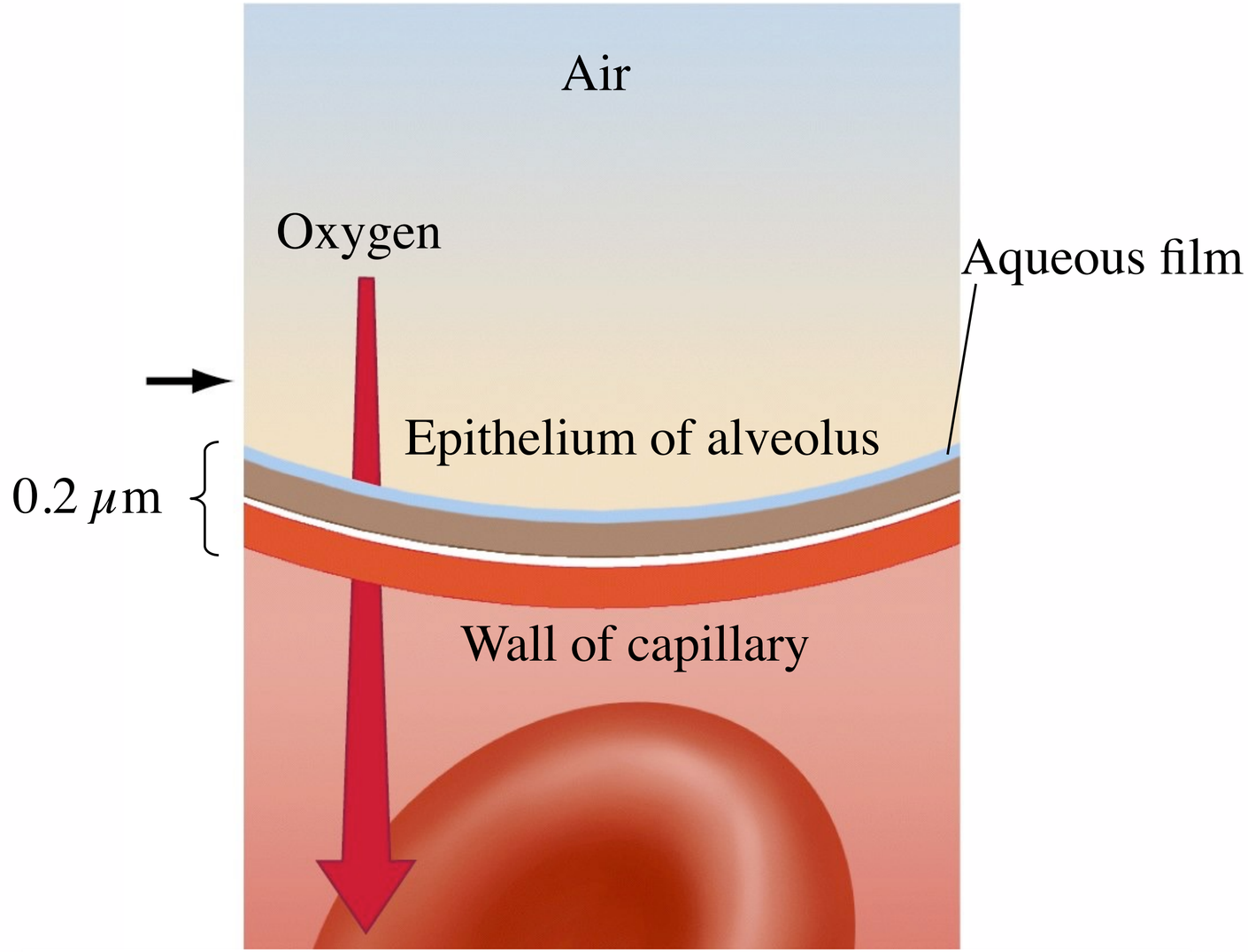
pH


alveolus-3-1396.mov
00:00
-01:01

Alveoli

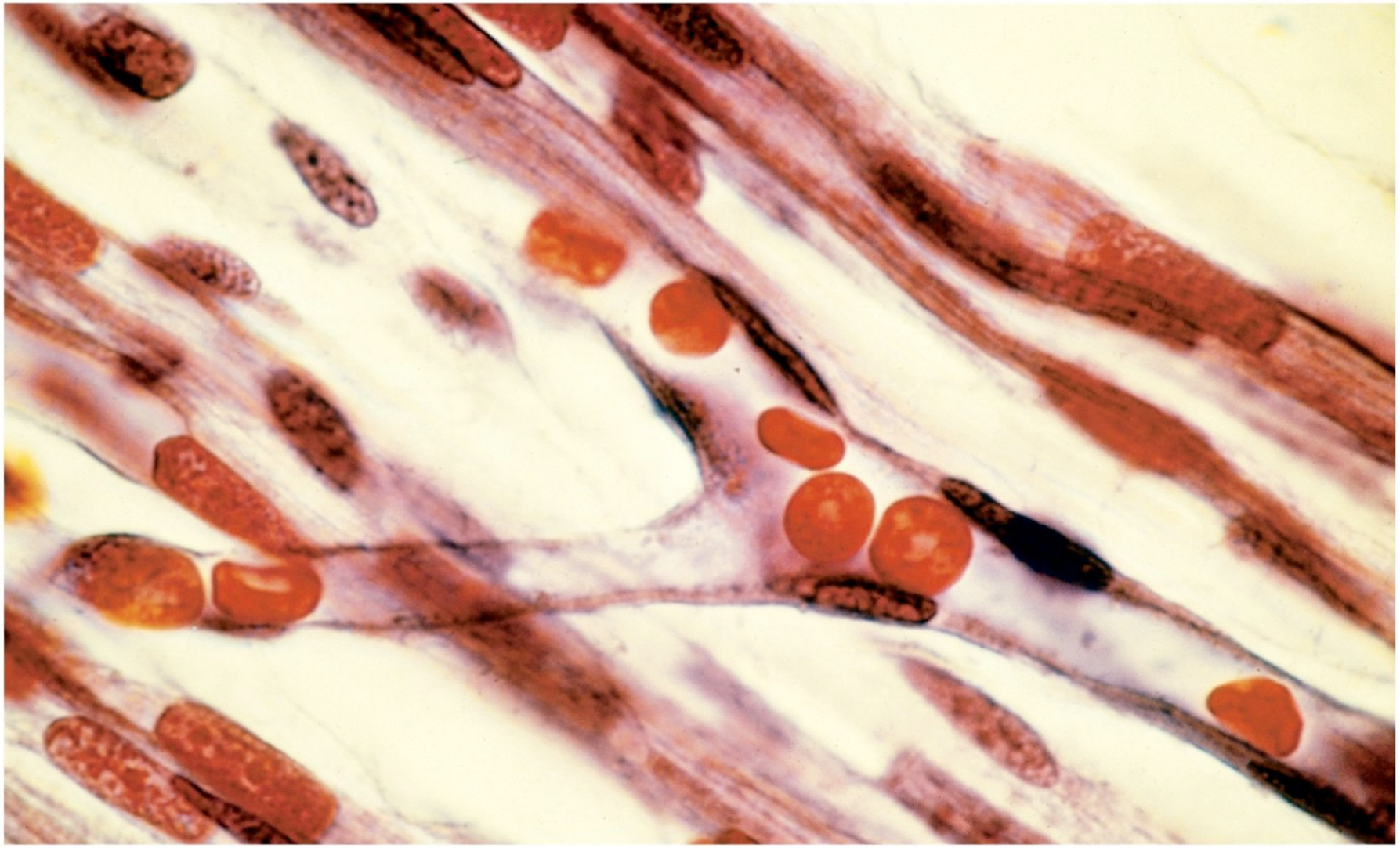

Smallest bronchiole
Air
Oxygenated blood out
Deoxygenated blood in
Alveolus

Fick's Law at the lungs (the alveolar ventilatory surface)

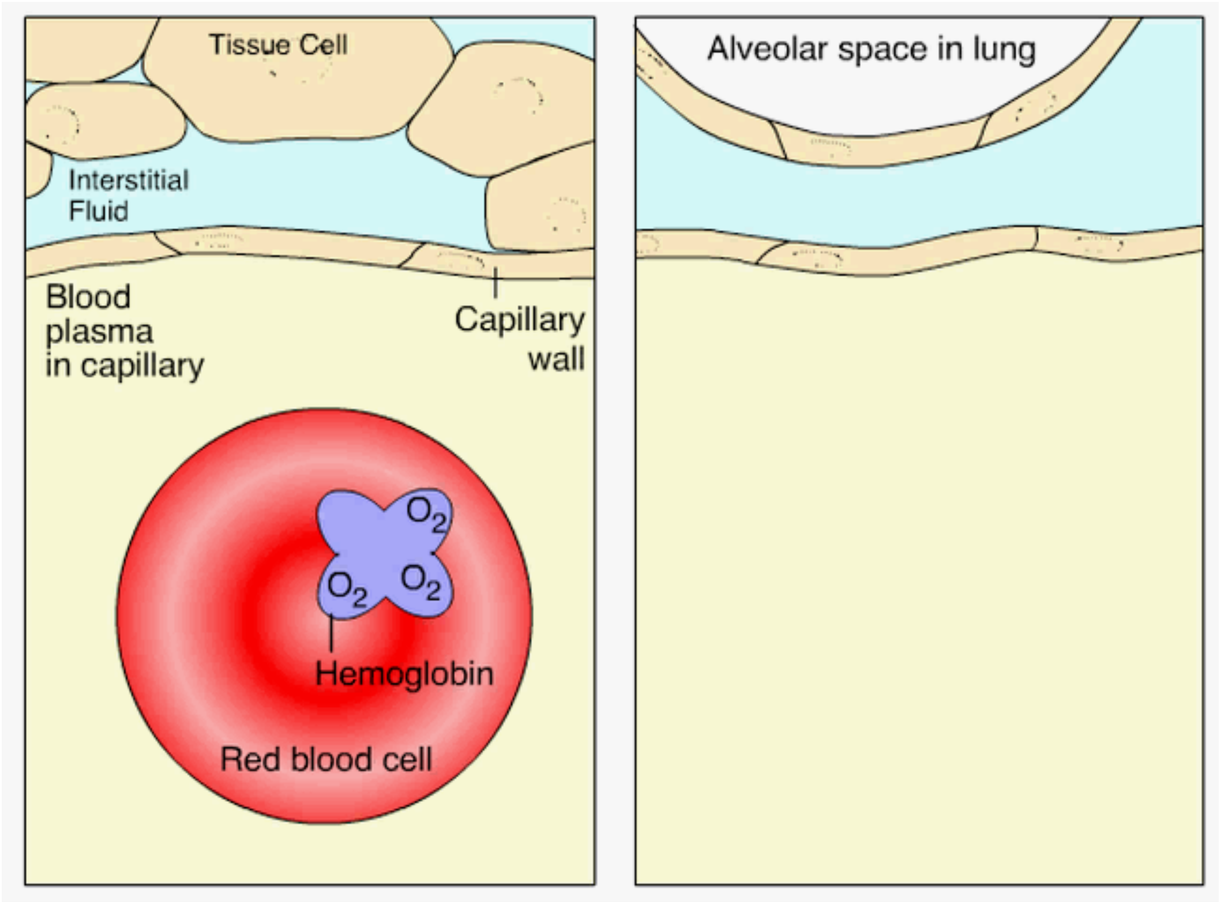


$$\text{Rate of diffusion} = k \times A \times \frac{(P_2 - P_1)}{D}$$

Capillaries are small and extremely thin walled.

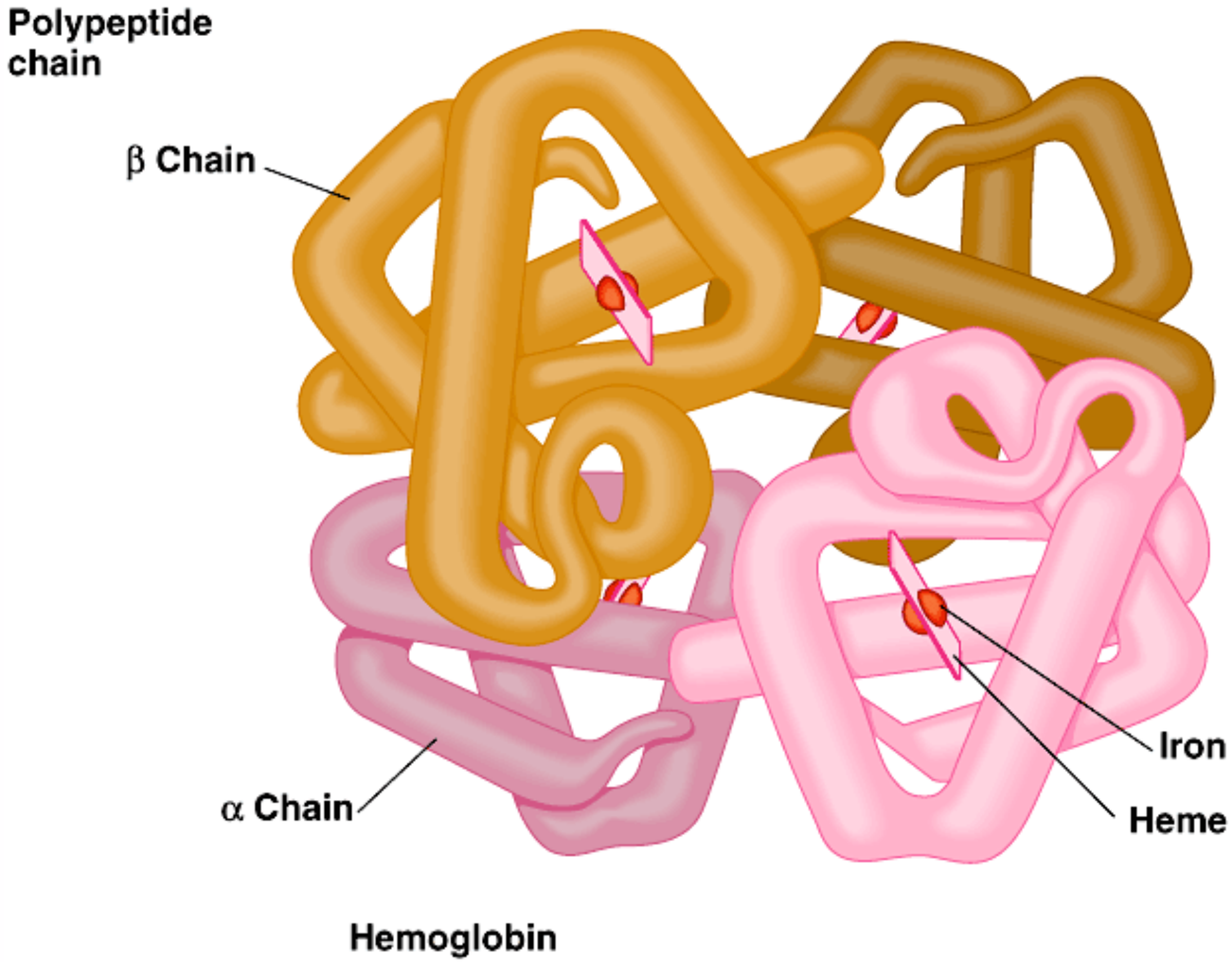


Gas Exchange

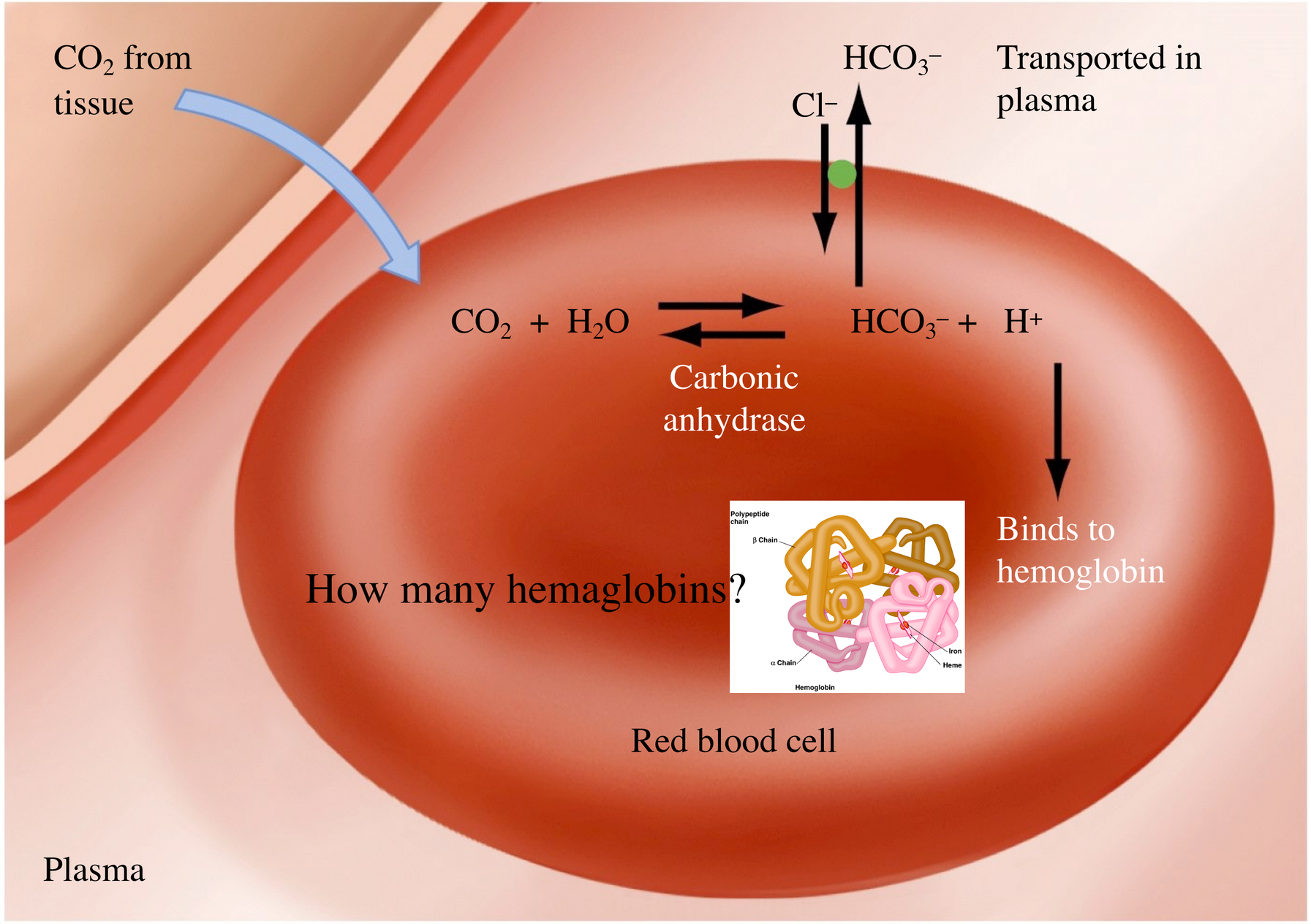


Hemoglobin

The Body's Oxygen Shuttle (and more)



At the tissue (the capillary bed by active muscle)

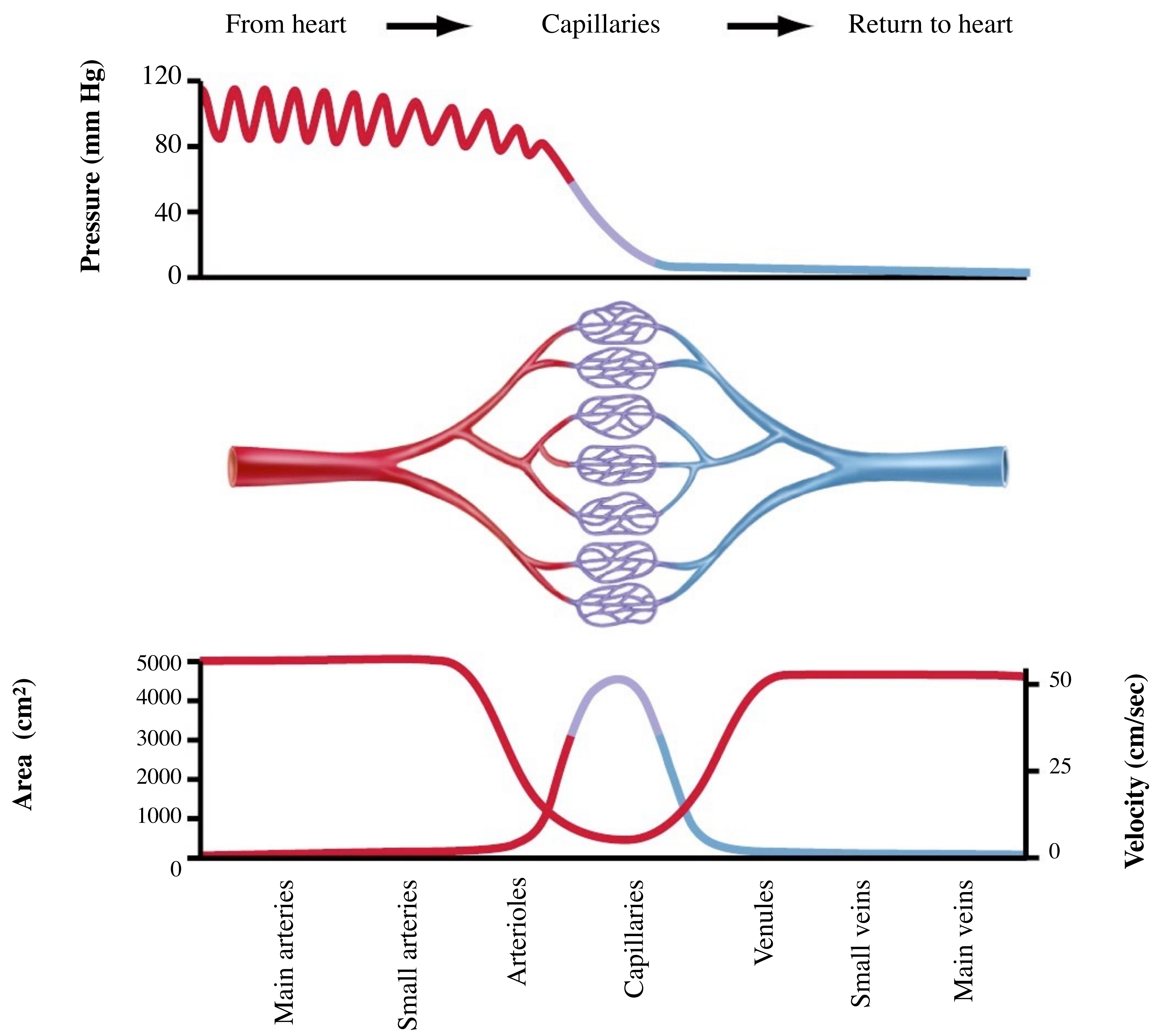


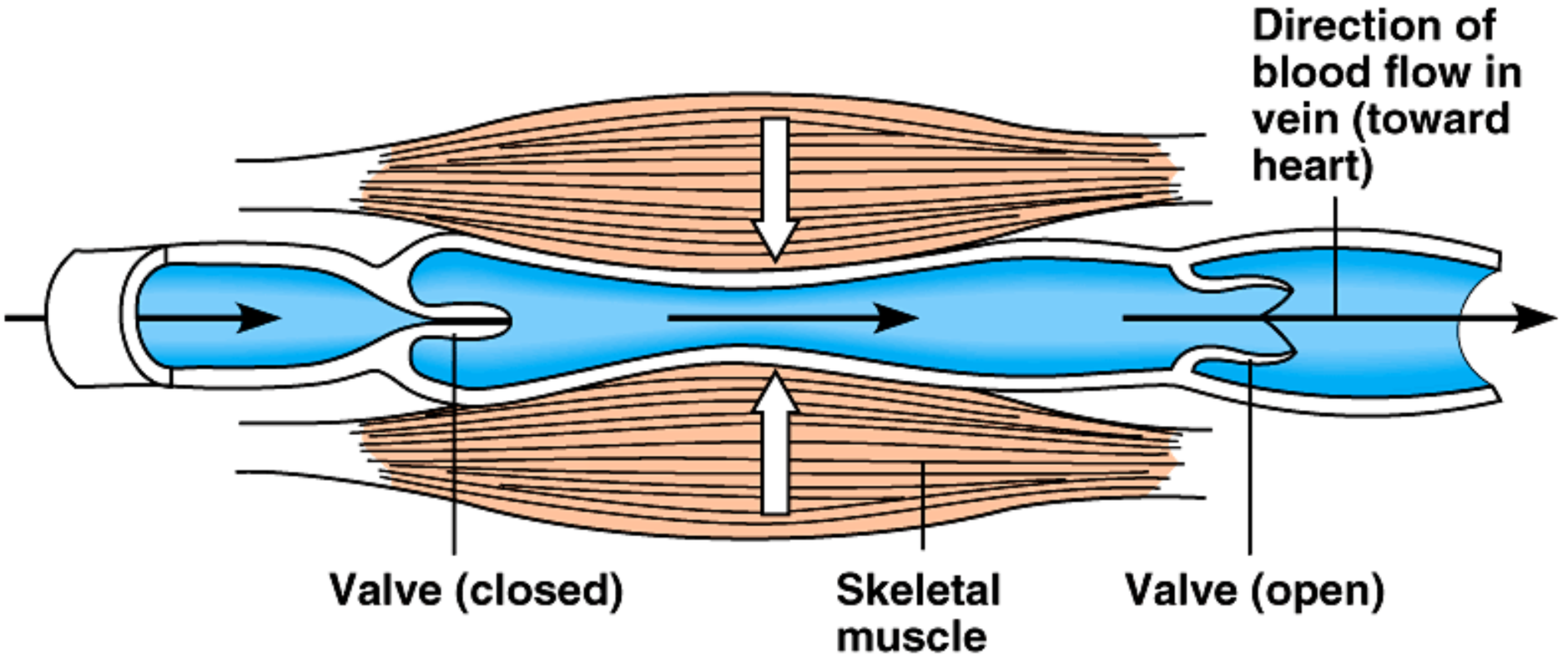
Compared to the interstitial fluid that bathes active muscle cells, blood in arteries just arriving at muscle cells has a?

a) higher concentration of O2
b) higher concentration of CO2
c) greater bicarbonate concentration.
d) lower pH
e) lower osmotic pressure

Which reaction accurately represents what happens inside red blood cells traveling through alveolar capillaries? (Hb = hemaglobin)

a) $Hb + 4\ O_2 \rightarrow Hb(O_2)_4$
b) $Hb(O_2)_4 \rightarrow Hb + 4O_2$
c) $CO_2 + H_2O \rightarrow H_2CO_3$
d) $H_2CO_3 \rightarrow H^+ + HCO_3^-$
e) $Hb + 4\ CO_2 \rightarrow Hb(CO_2)_4$


From heart
Capillaries
Return to heart
Pressure (mm Hg)
120
80
40
0
Area (cm²)
5000
4000
3000
2000
1000
0
Velocity (cm/sec)
50
25
0
Main arteries
Small arteries
Arterioles
Capillaries
Venules
Small veins
Main veins



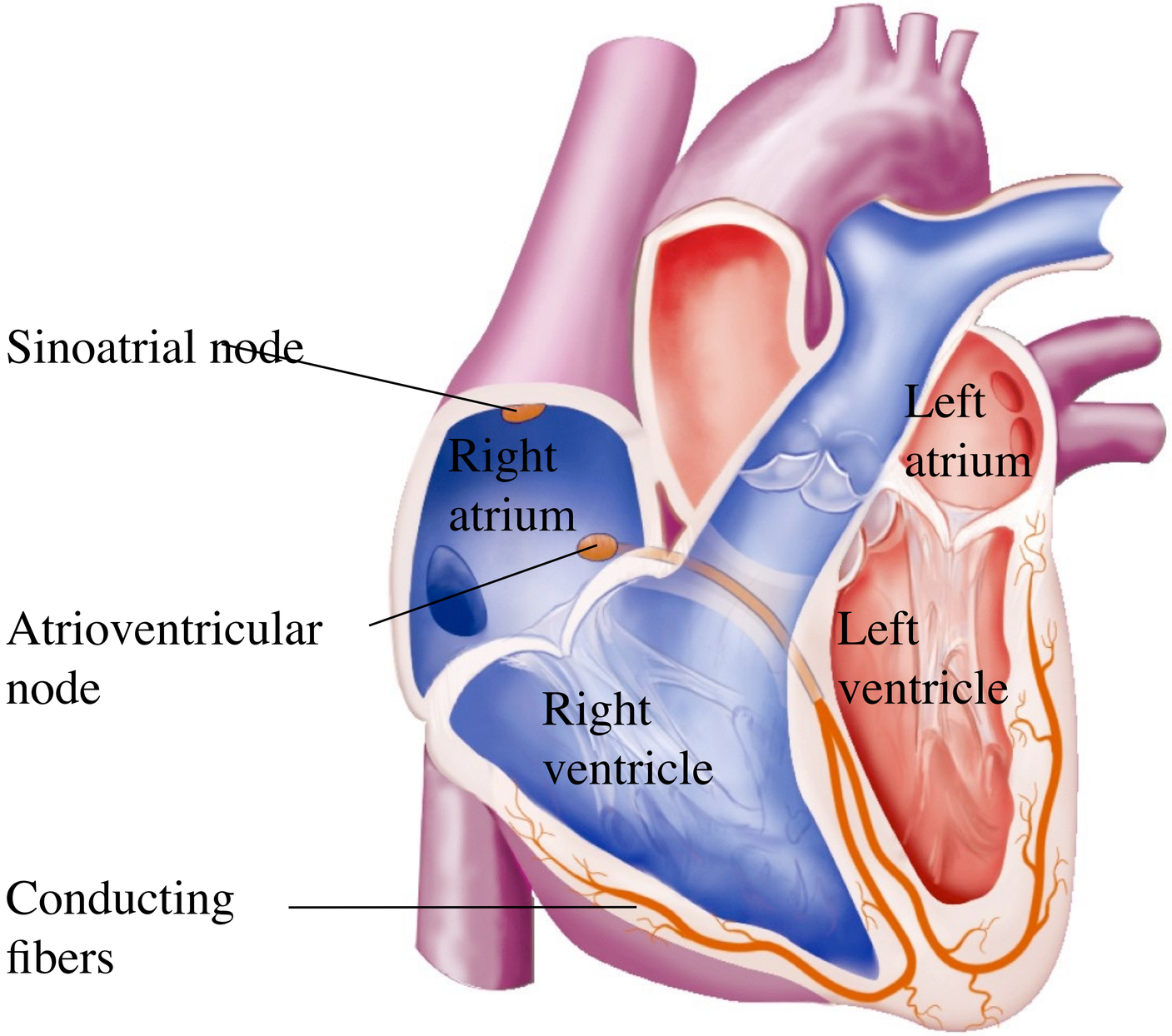


Figure 44-21 Biological Science 2/e

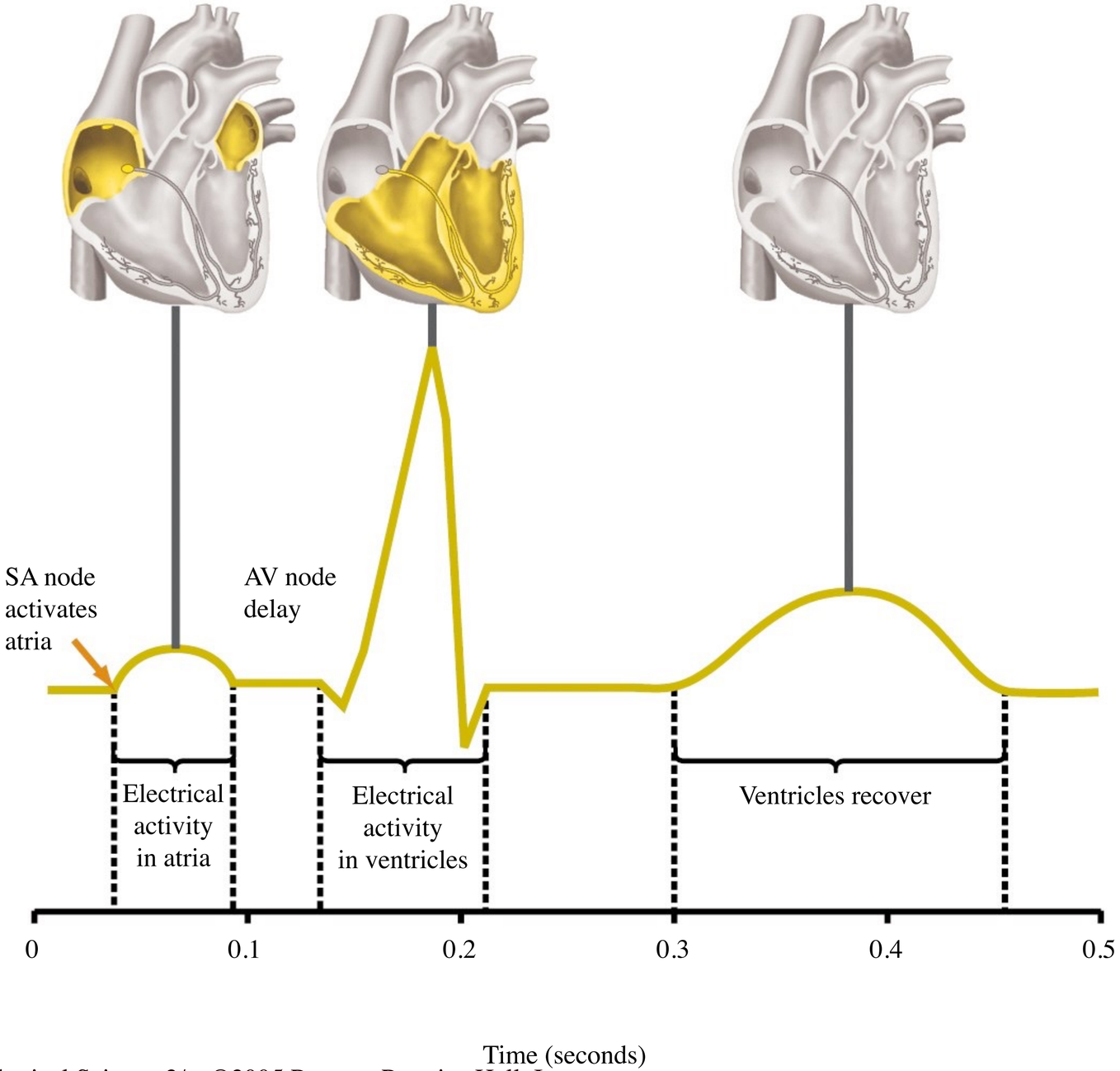
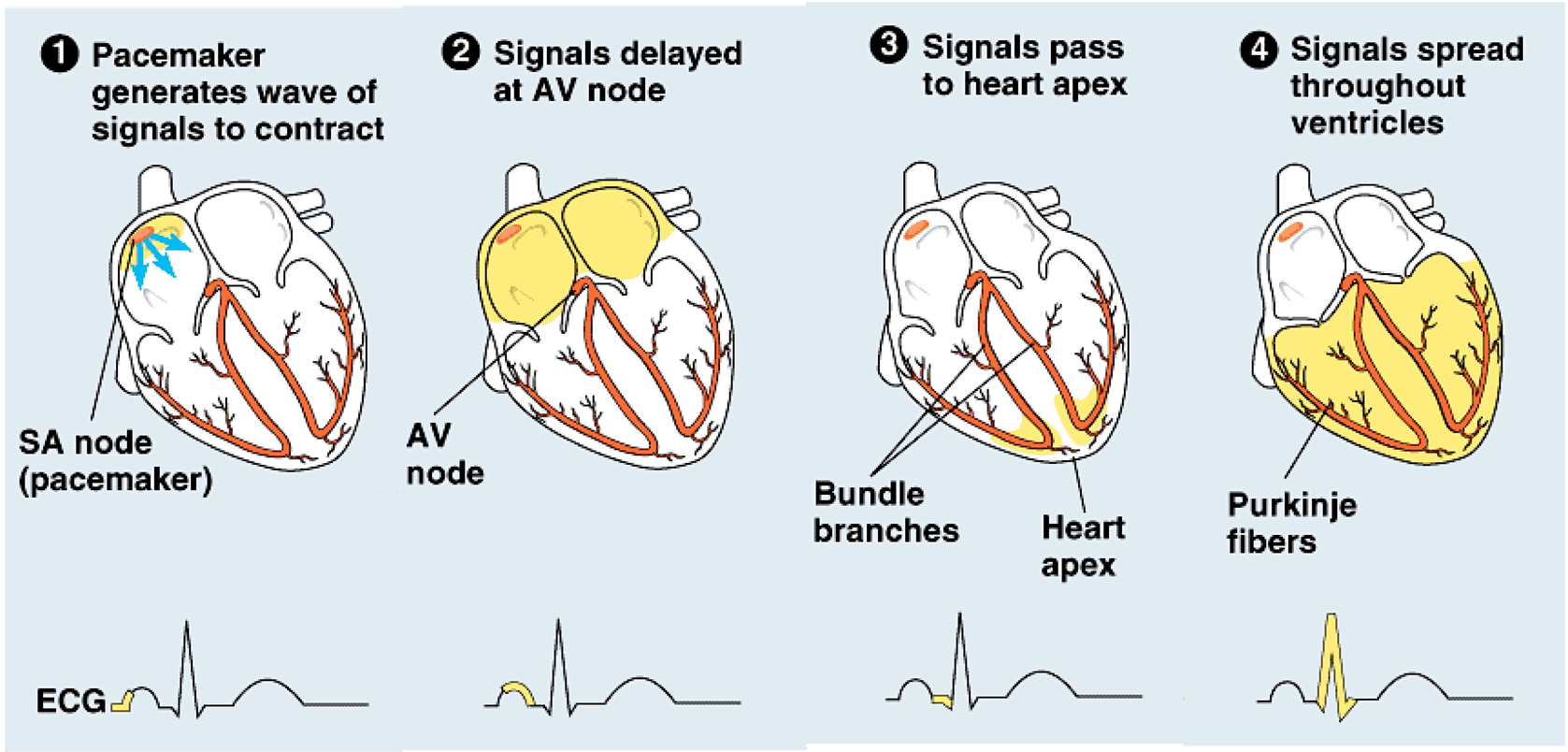
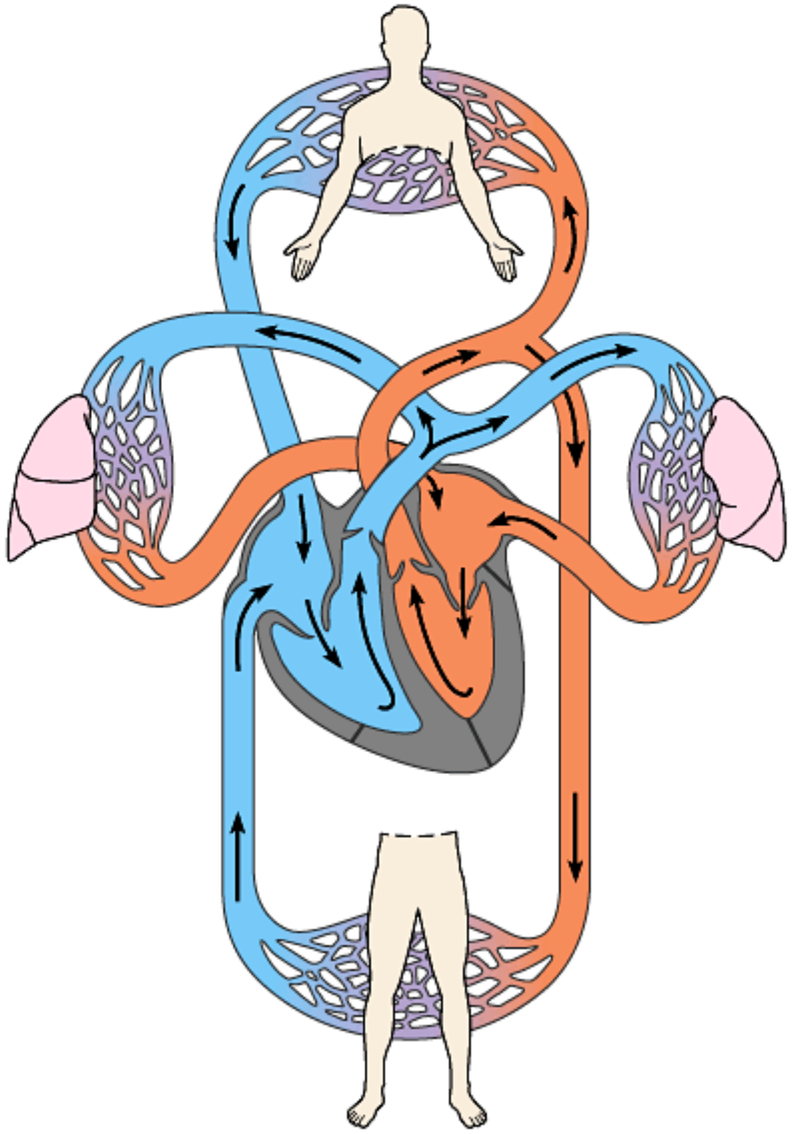


Figure 44-22 Biological Science 2/e



Be the HEART and **Depolarize**

The Basics of Circulation

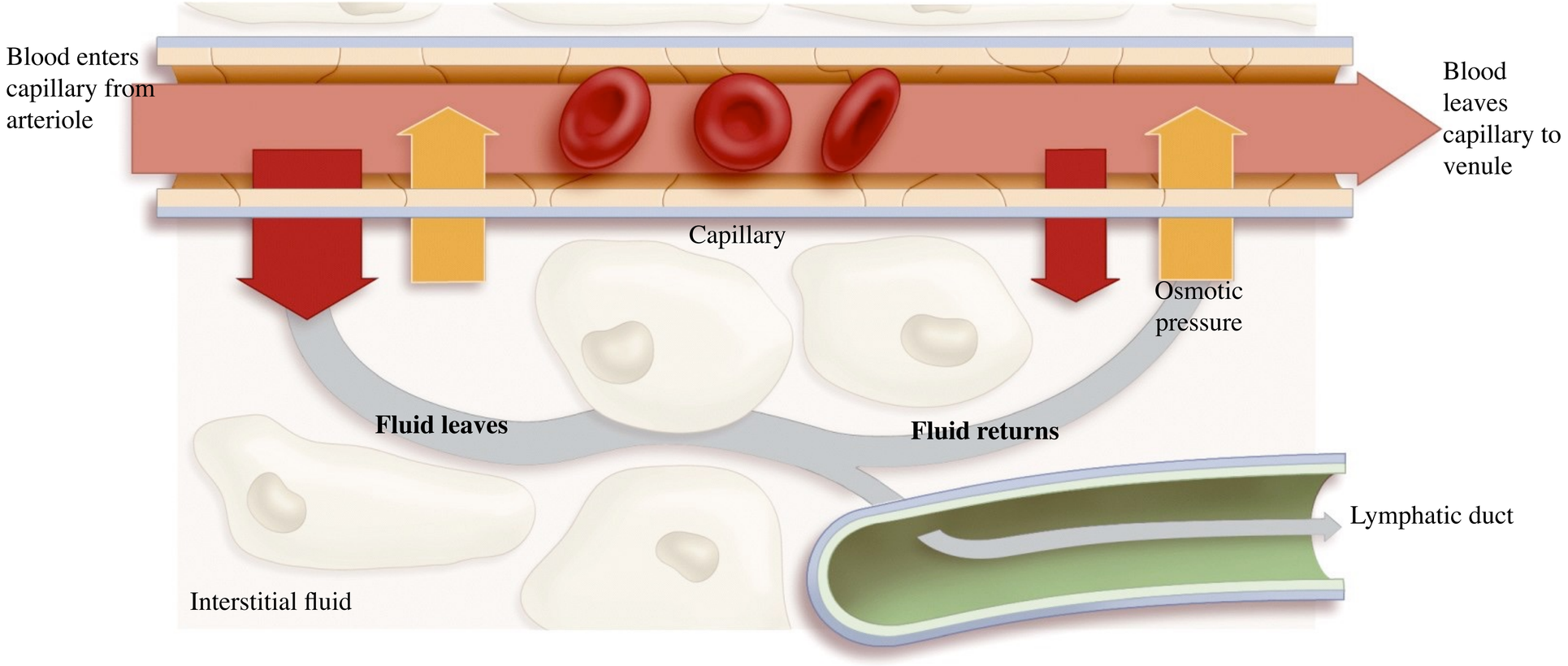


Blood returning to the mammalian heart in a pulmonary vein drains first into the

a) vena cava.
b) left atrium.
c) right atrium.
d) left ventricle.
e) right ventricle.

Glucose molecules absorbed by intestinal epithelia end up in a capillary and then travel to the liver through the

a) Inferior vena cava.
b) pancreatic vein.
c) splenic artery.
d) hepatic vein.
e) hepatic portal vein.
f) None of the above


Blood enters capillary from arteriole
Blood leaves capillary to venule
Capillary
Osmotic pressure
Fluid leaves
Fluid returns
Lymphatic duct
Interstitial fluid

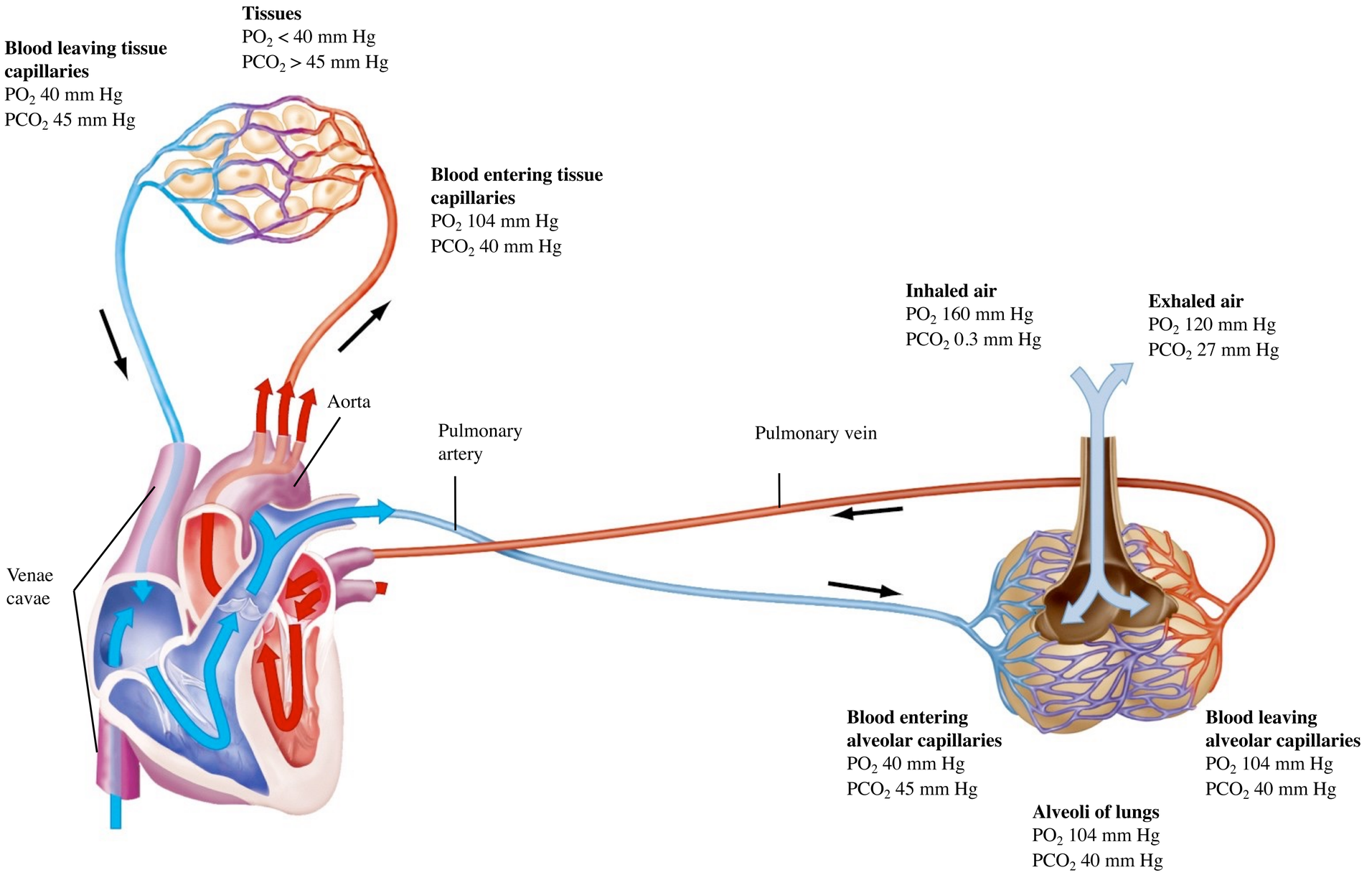


Figure 44-19 Biological Science 2/e