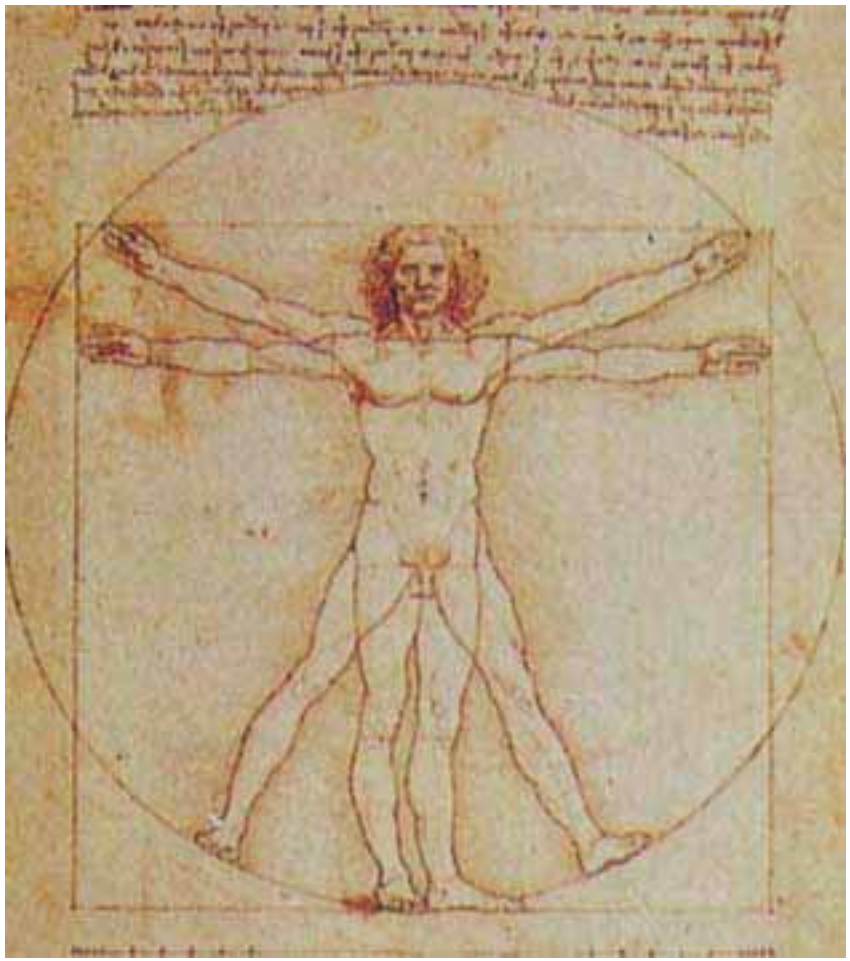
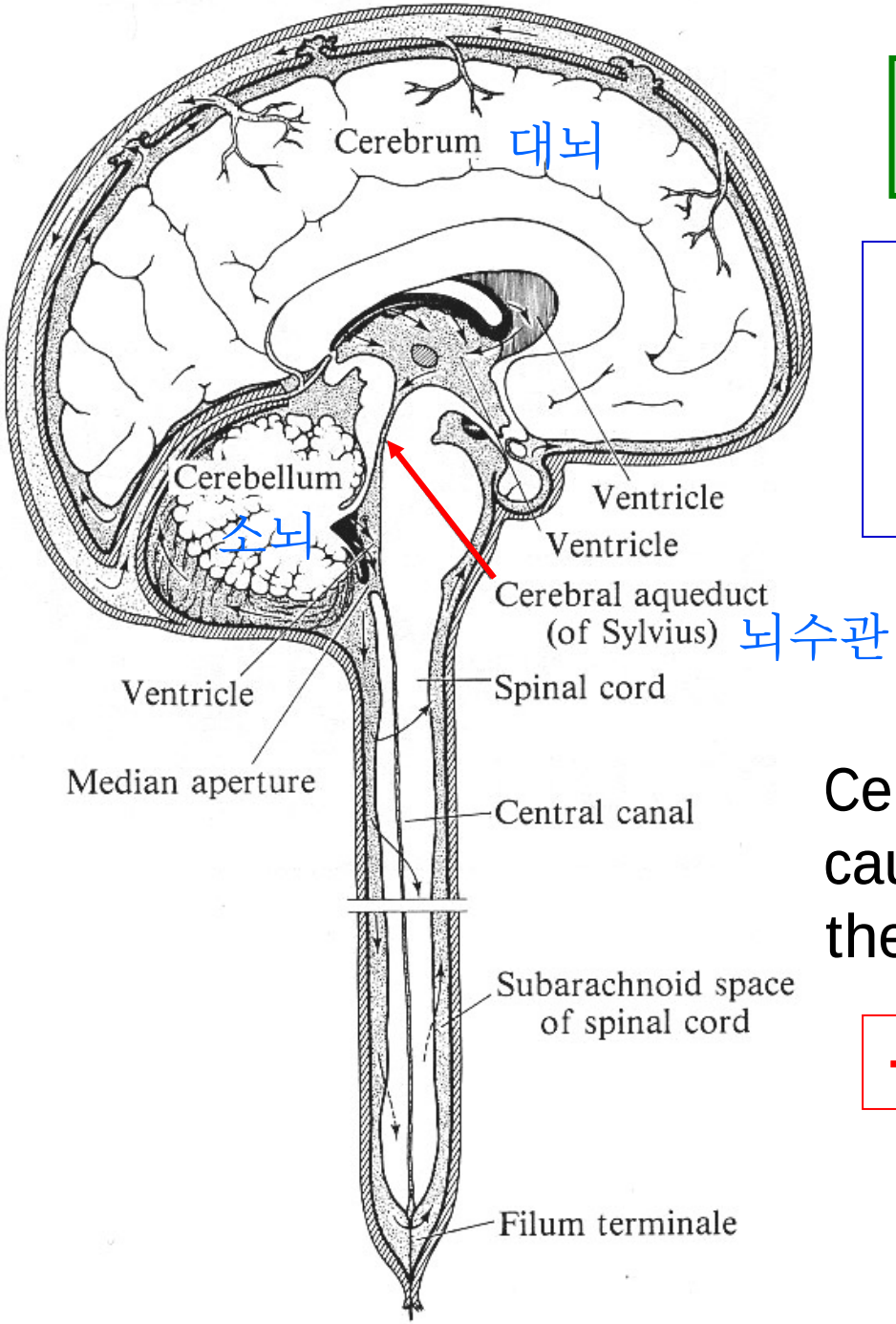
Ch07 Biological and Medical Applications of Pressures and Fluids



Pressures in Humans

TABLE 7.1 / TYPICAL FLUID PRESSURES (in mm Hg) IN HUMANS

Arterial blood pressures	
Maximum (systolic):	
adult	100–140
infant	60–70
Minimum (diastolic):	
adult	60–90
infant	30–40
Venous blood pressures	
Venules	8–15
Veins	4–8
Major veins (CVP)	4
Capillary blood pressure	
Arteriole end	35
Venule end	15
Bladder	
Average	0–25
During micturition	110
Brain, lying down (CSF)	5–12
Eye, aqueous humor	12–24
Gastrointestinal	10–20
Intrathoracic	−4 to −8
Middle ear	<1



Cerebrospinal Pressure

cerebrospinal fluid(CSF)

pressure: ~5-12 mm Hg

Protect brain (buoyant force)

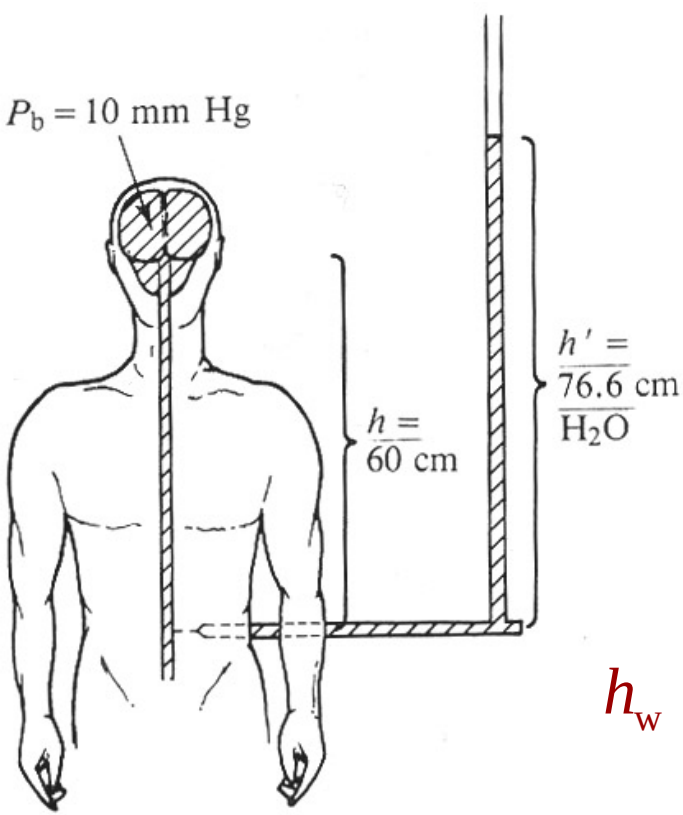
But...

Cerebral aqueduct can be blocked, causing pressure to build inside the skull

→ Hydrocephalus (수두증)

Example 7.1

If pressure in the CSF is measured in the figure below, a) what is the pressure due to the weight of the CSF? b) what is the pressure in centimeters if the patient lies down? (density of CSF=1.05g/cm^3)



$$P = \rho g h + P_{\text{brain}}$$
$$= (1.05\times10^3)(9.8)(0.60) + (13.6\times10^3)(9.8)(0.01)$$
$$= 7.51\times10^3 \text{ N/m}^2$$

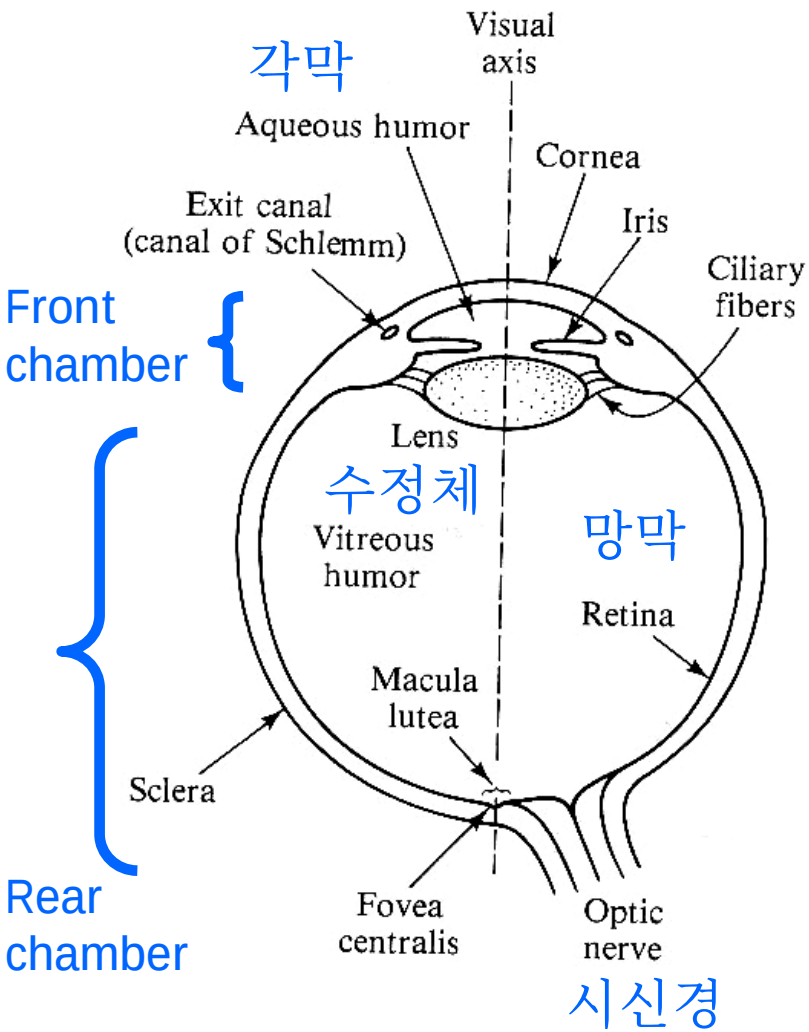
Density of Mercury

$$h_w = \frac{P}{\rho_w g} = \frac{7.51\times10^3}{(10^3)(9.8)} = 76.6\,\text{cmH}_2\text{O}$$

No weight if the patient lies down

$$h_w = \frac{(10mm)\times13.6\times10^3 kg/m^3}{(1.0\times10^3 kg/m^3)} = 13.6\,\text{cmH}_2\text{O}$$

Pressure in the Eye



The shape of the eye is maintained by intraocular pressure (안압): 12-24 mmHg

Front chamber has aqueous humor (수양액)

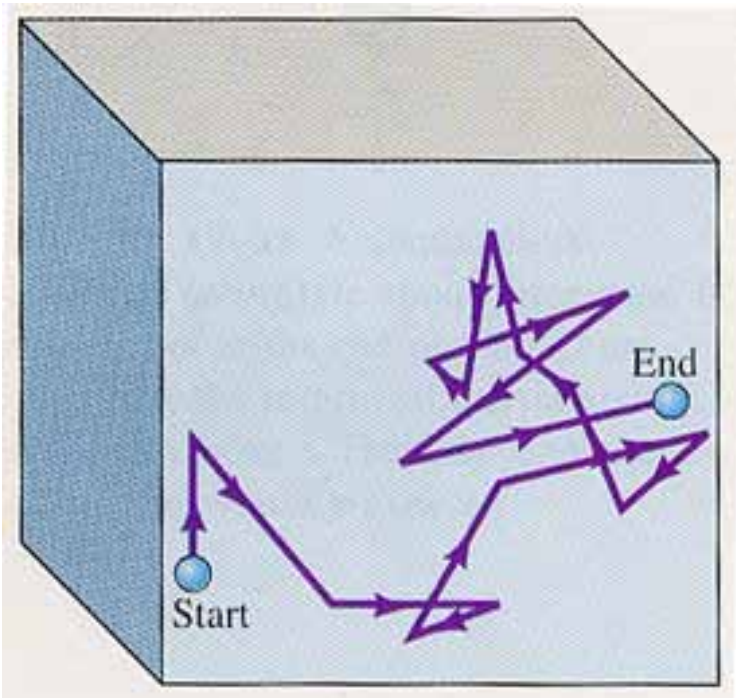
5 cm^3 is generated per day

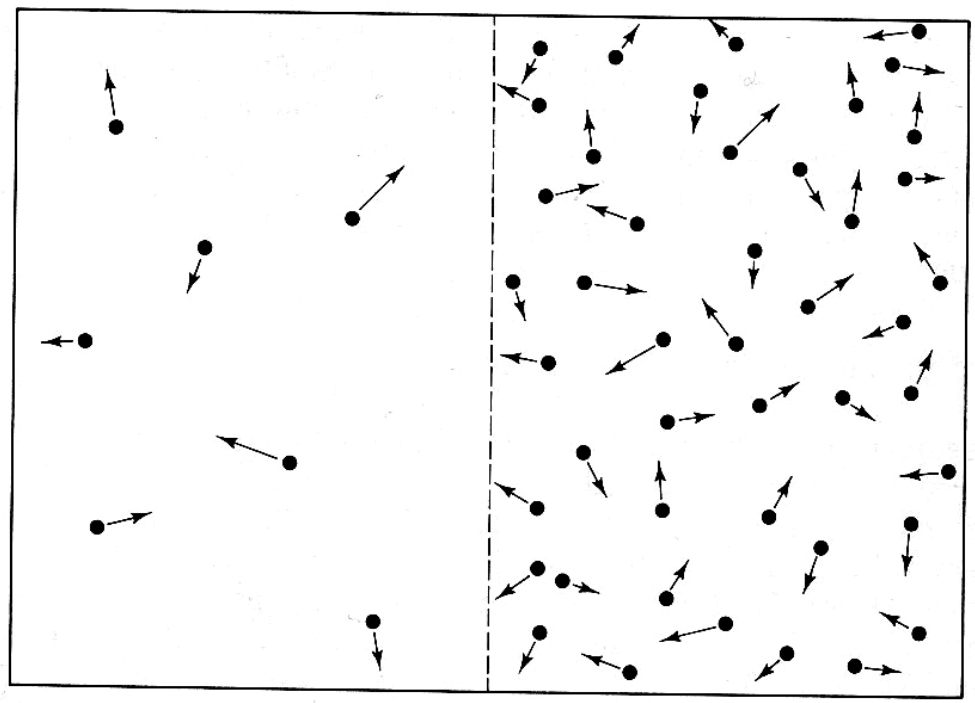
Rear chamber has vitreous humor (초자체액, jelly-like)

: holds the retina

Diffusion

:the movement of substances due to random thermal molecular motion



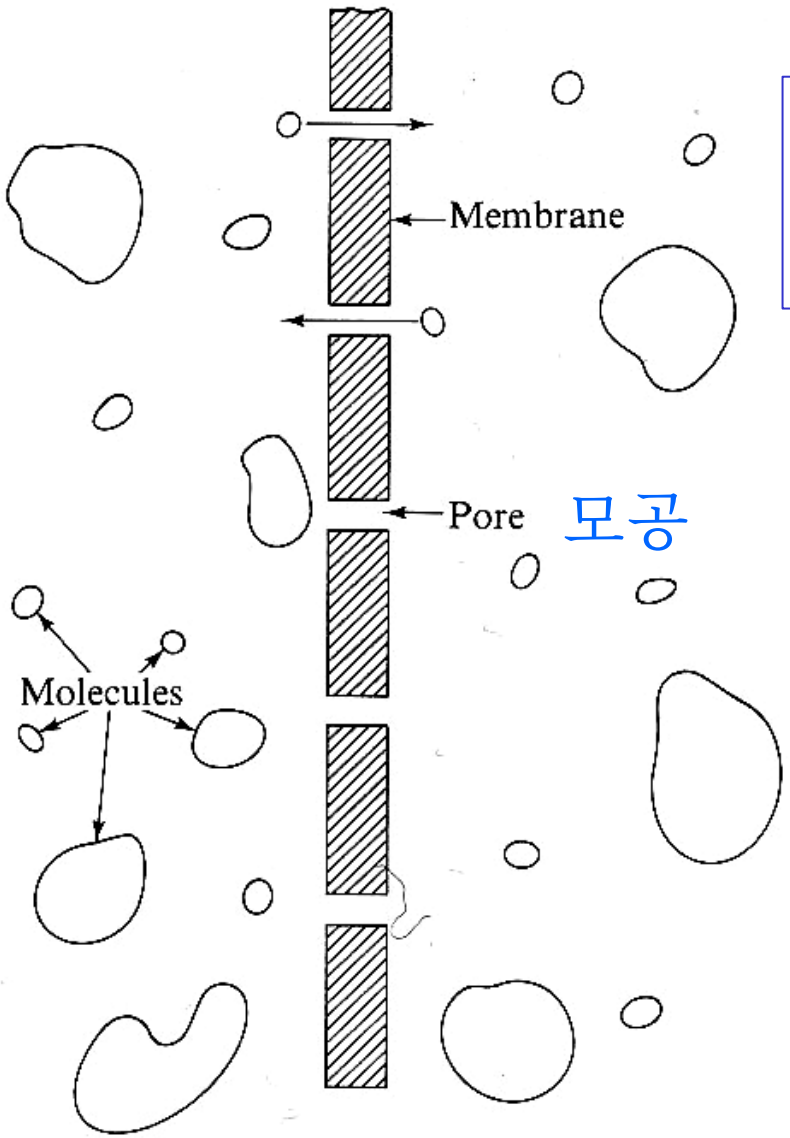


Fick's law :

1) Direction of diffusion is from higher to lower concentration
2) The rate of diffusion is proportional to the difference in concentration

Diffusion Through Membranes

(세포막)



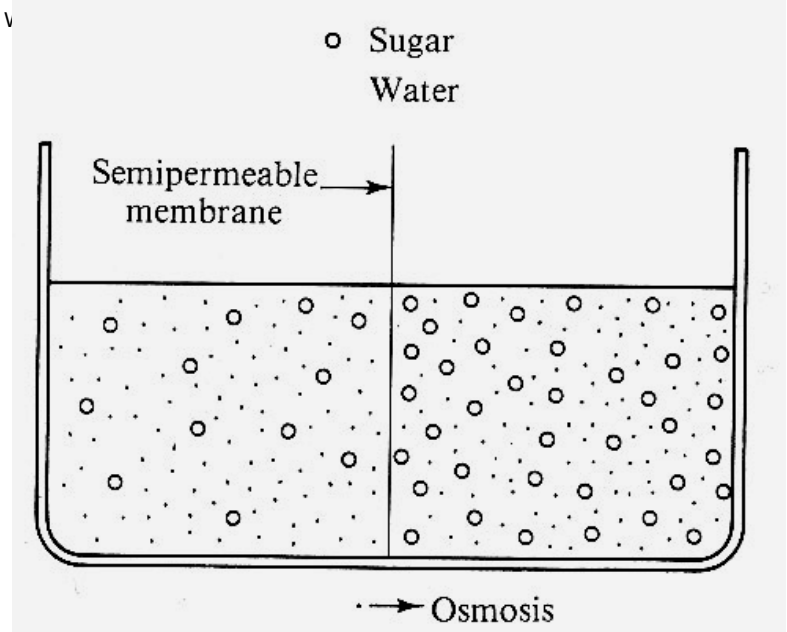
membrane width

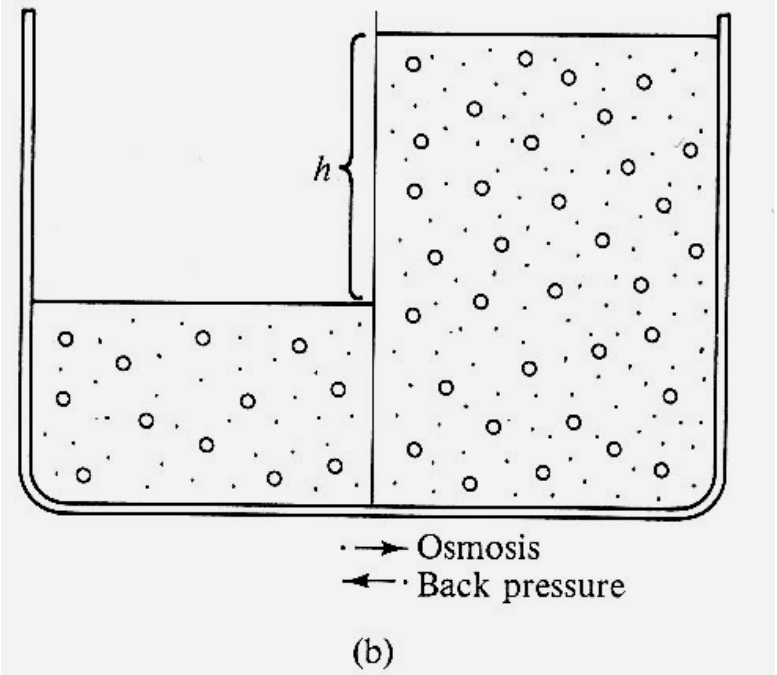
$(65 \sim 100) \times 10^{-10}\ \text{m} \Rightarrow 100\ \text{atoms}$

$\text{pores} \Rightarrow (7 \sim 10) \times 10^{-10}\ \text{m}$

Most membranes are selectively permeable

: they allow only certain substances to cross them





Osmosis(삼투압)

Number of sugar molecules are larger for the right

(water molecules can penetrate membrane but sugar molecules cannot)

: water flows to right

the height difference = osmosis