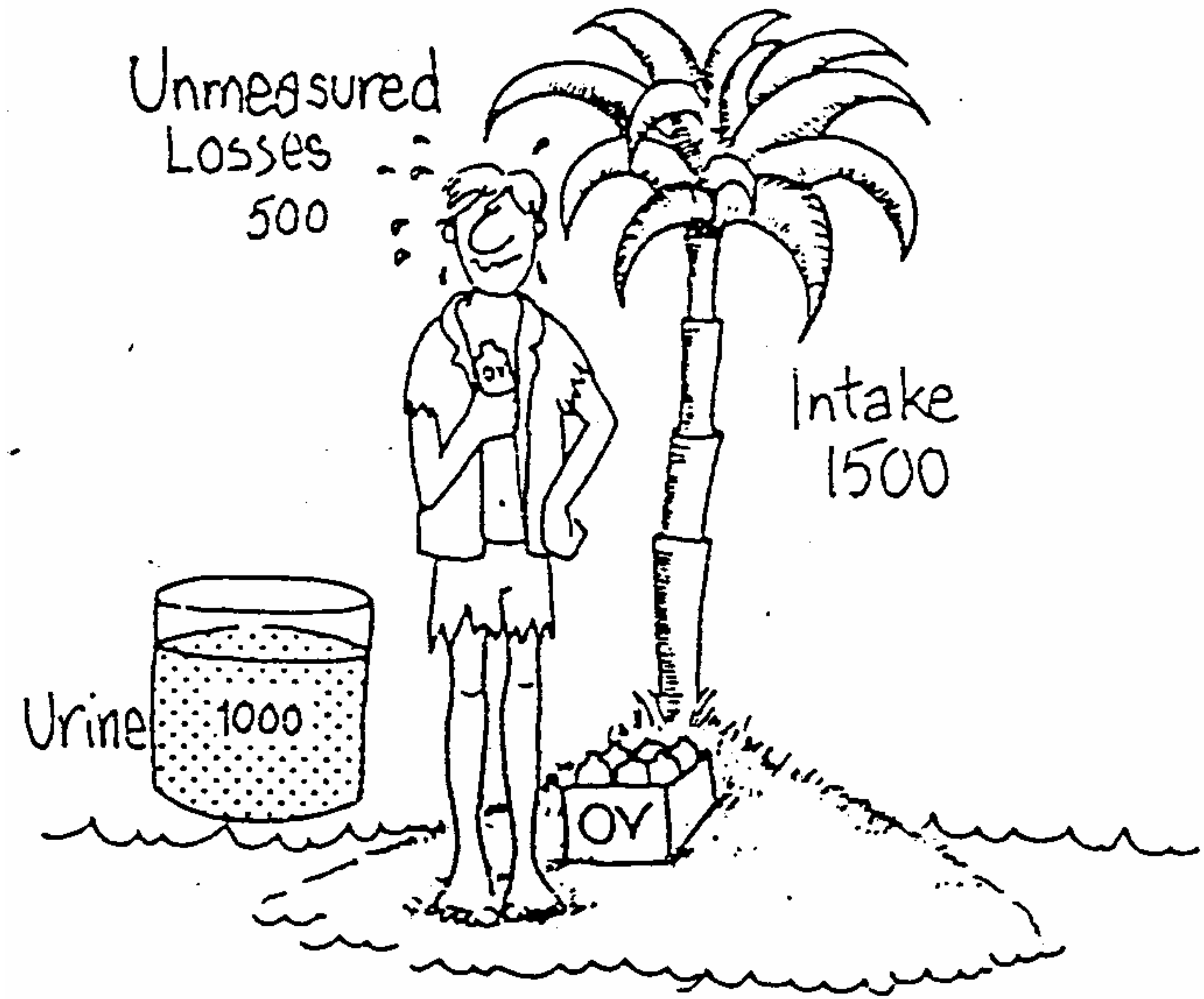
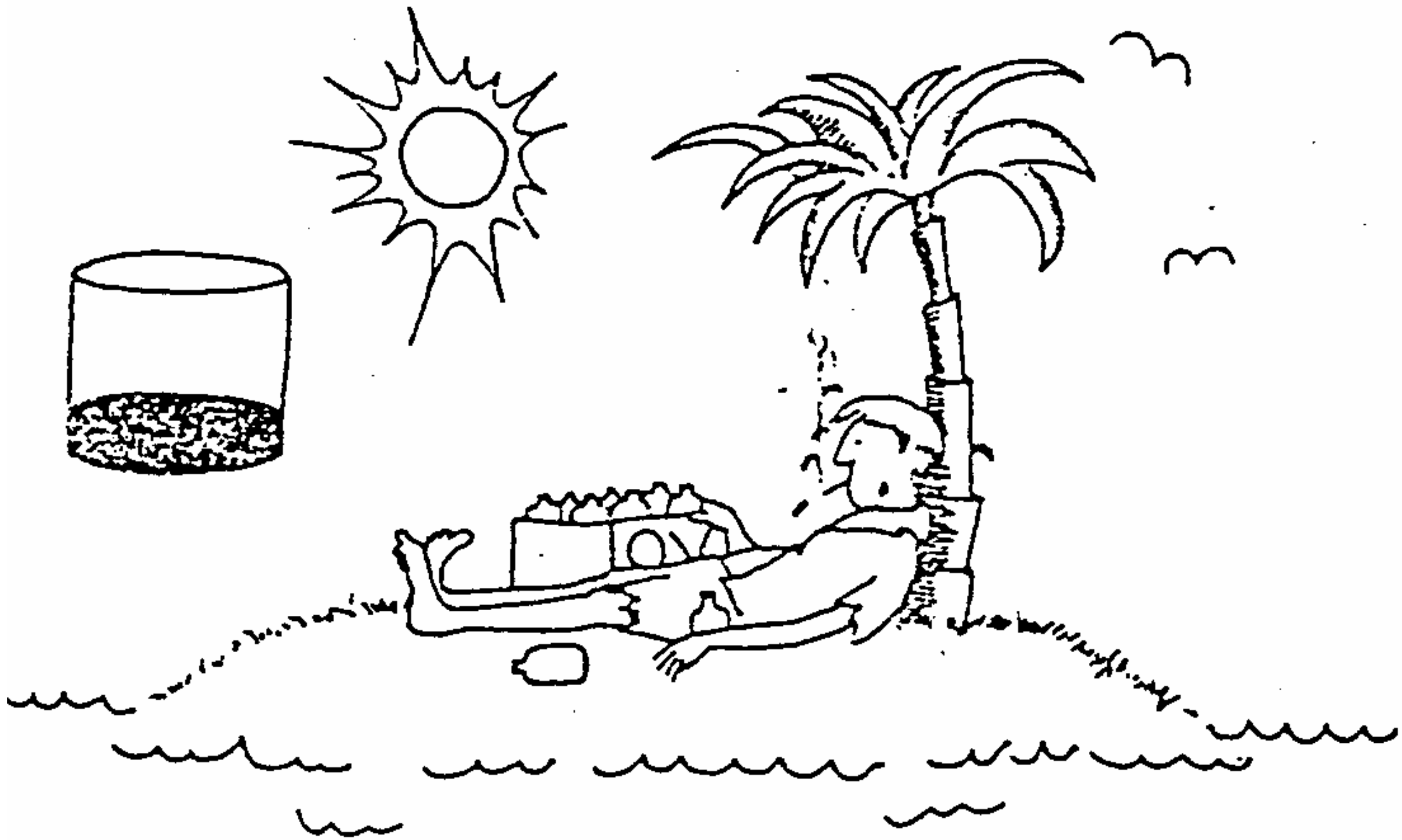
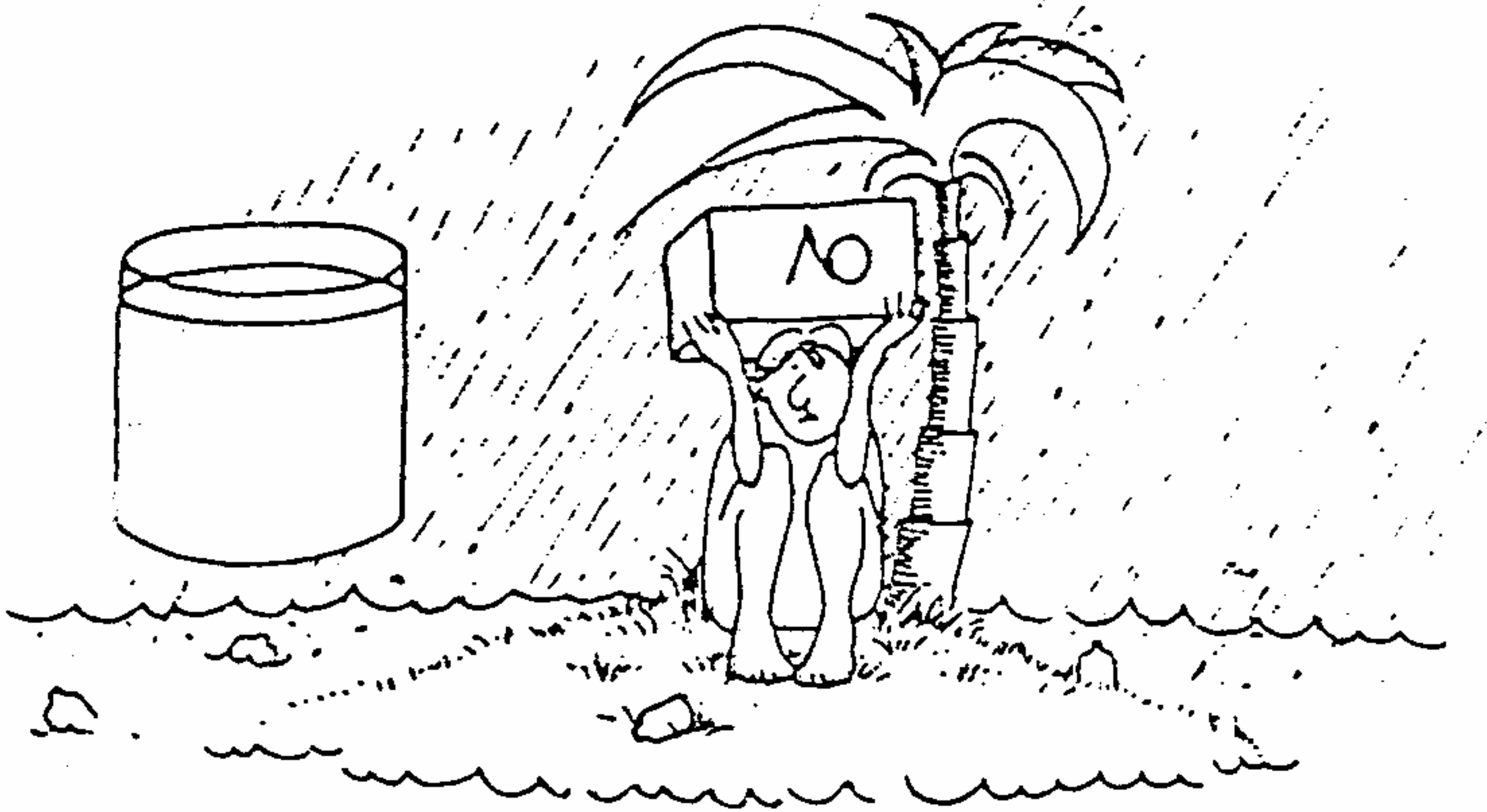
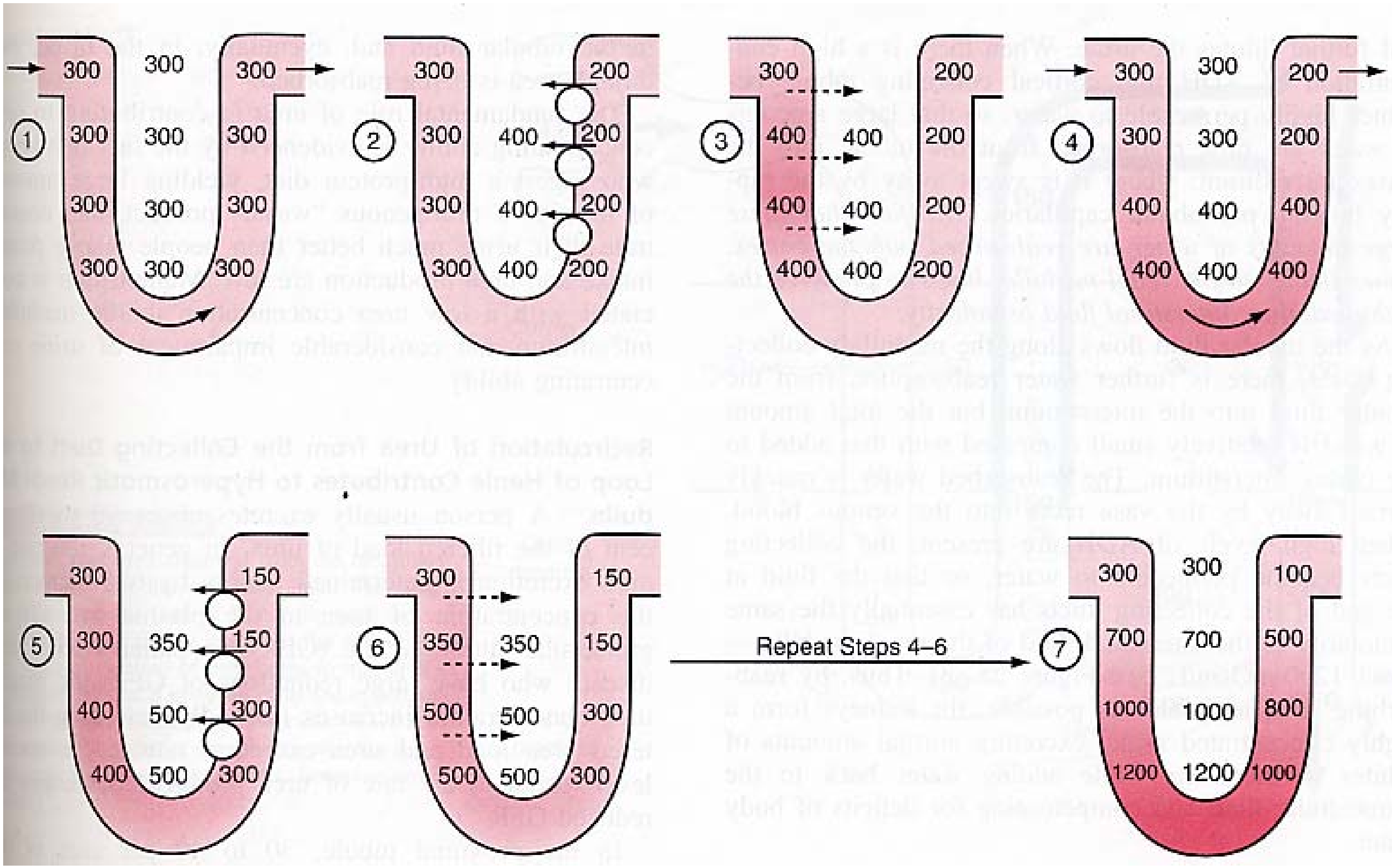

Unmeasured
Losses
500
Intake
1500
Urine
1000
OY

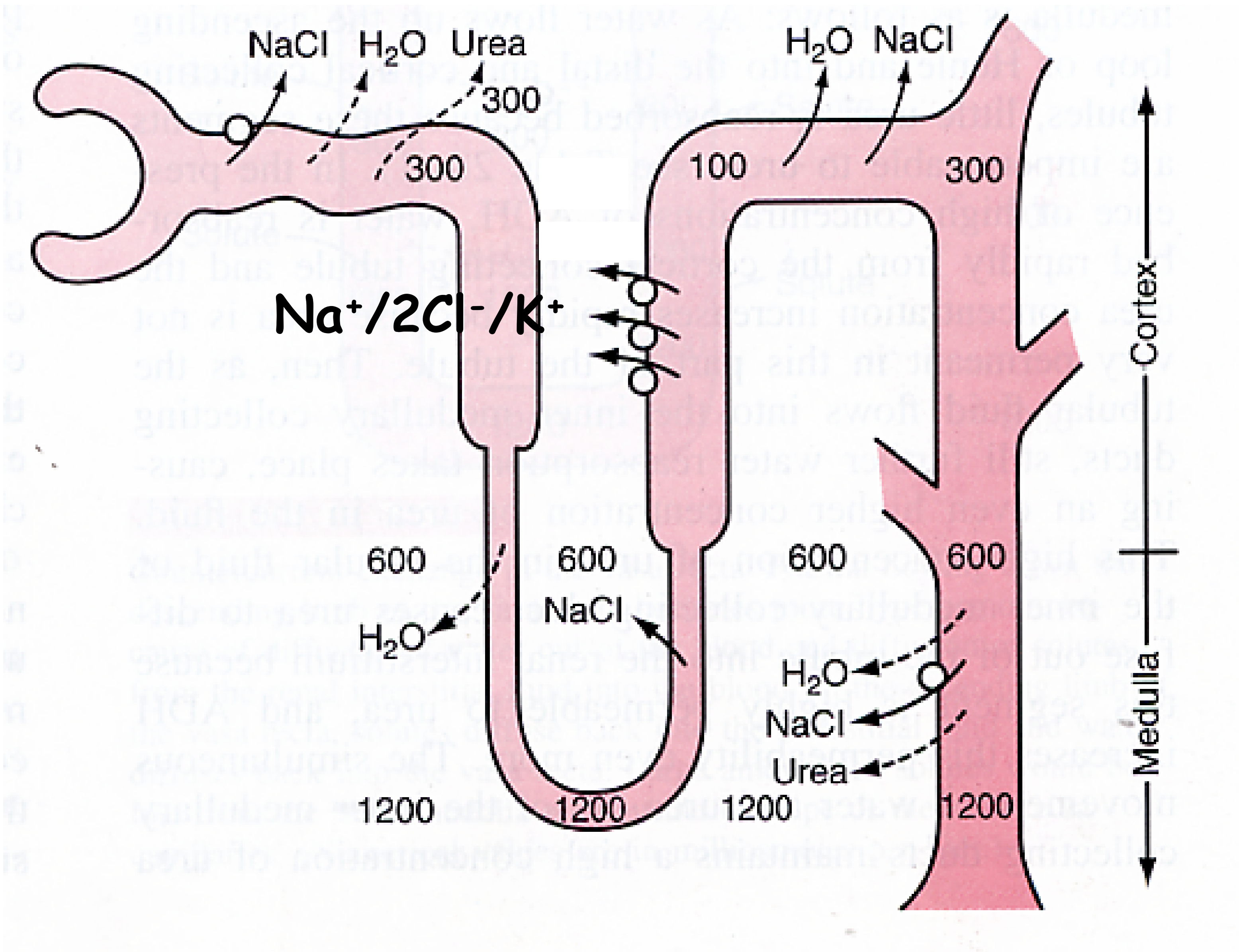




A counter current multiplier



Active transport of a $Na^+/2Cl^-/K^+$ complex in the ascending limb of the loop of Henle



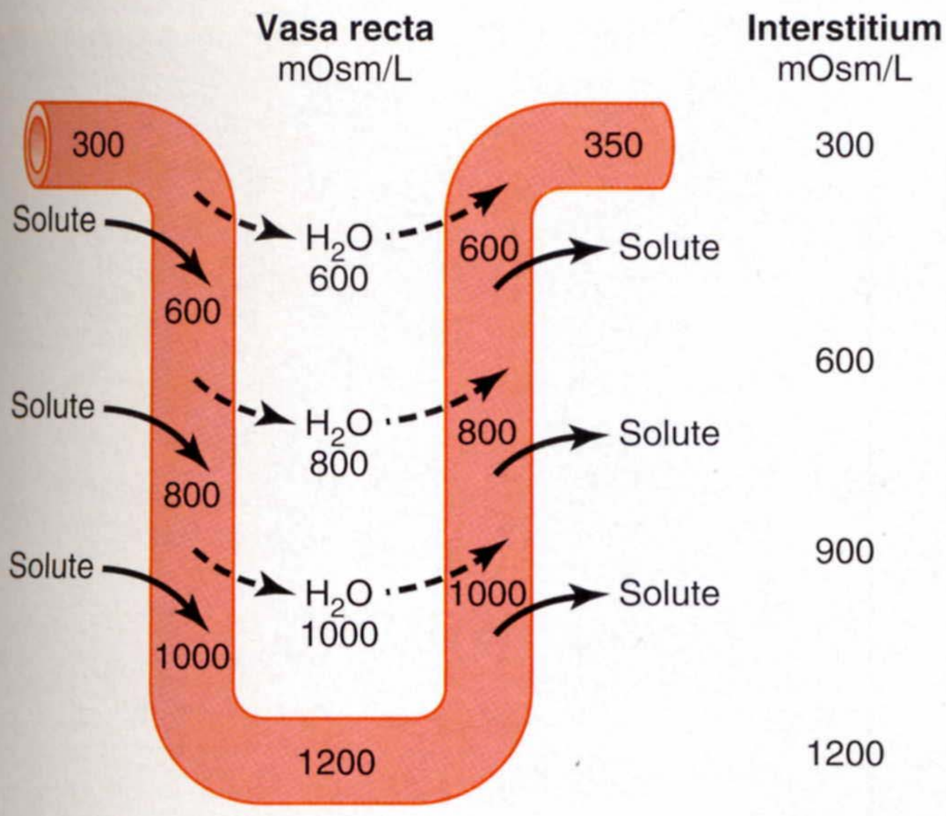


Figure 28–6

Countercurrent exchange in the vasa recta. Plasma flowing down the descending limb of the vasa recta becomes more hyperosmotic because of diffusion of water out of the blood and diffusion of solutes from the renal interstitial fluid into the blood. In the ascending limb of the vasa recta, solutes diffuse back into the interstitial fluid and water diffuses back into the vasa recta. Large amounts of solutes would be lost from the renal medulla without the U shape of the vasa recta capillaries. (Numerical values are in milliosmoles per liter.)

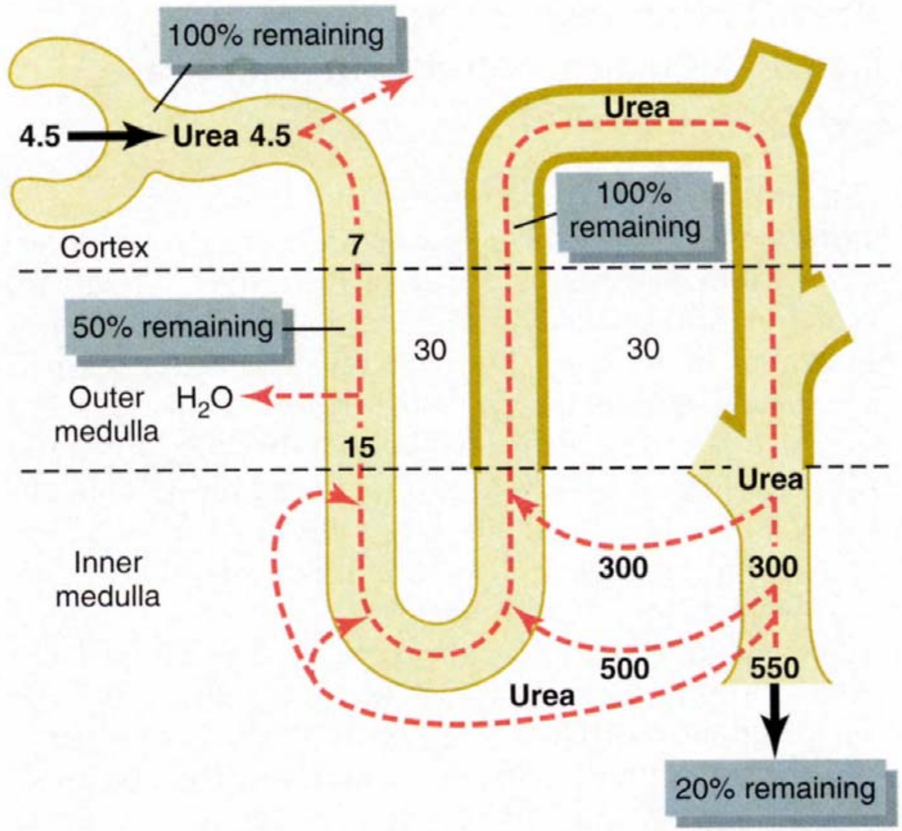


Figure 28–5

Recirculation of urea absorbed from the medullary collecting duct into the interstitial fluid. This urea diffuses into the thin loop of Henle, and then passes through the distal tubules, and finally passes back into the collecting duct. The recirculation of urea helps to trap urea in the renal medulla and contributes to the hyperosmolarity of the renal medulla. The heavy dark lines, from the thick ascending loop of Henle to the medullary collecting ducts, indicate that these segments are not very permeable to urea. (Numerical values are in milliosmoles per liter of urea during antidiuresis, when large amounts of antidiuretic hormone are present. Percentages of the filtered load of urea that remain in the tubules are indicated in the boxes.)

Recycling of NaCl and urea in the renal medulla

↓

A highly concentrated zone

↓

Water diffusion from the renal tubules to the urinary medulla

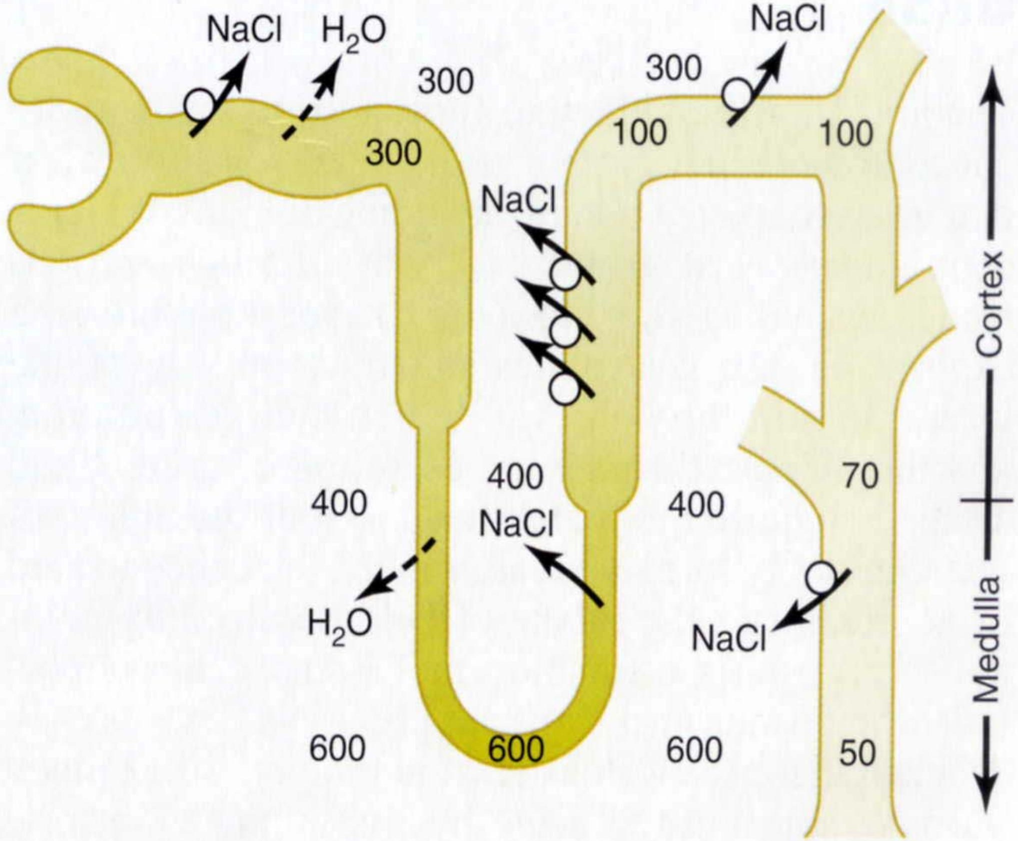


Figure 28–2

Formation of a dilute urine when antidiuretic hormone (ADH) levels are very low. Note that in the ascending loop of Henle, the tubular fluid becomes very dilute. In the distal tubules and collecting tubules, the tubular fluid is further diluted by the reabsorption of sodium chloride and the failure to reabsorb water when ADH levels are very low. The failure to reabsorb water and continued reabsorption of solutes lead to a large volume of dilute urine. (Numerical values are in milliosmoles per liter.)

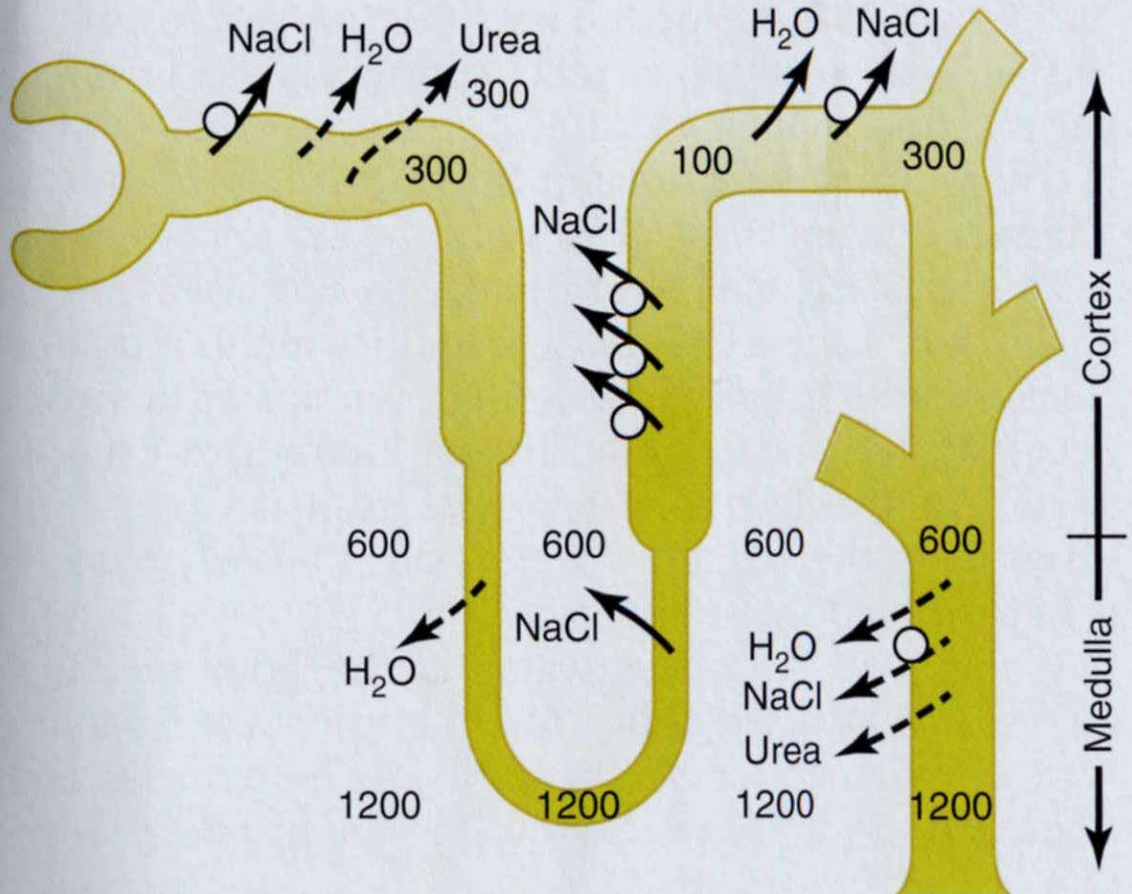


Figure 28–4

Formation of a concentrated urine when antidiuretic hormone (ADH) levels are high. Note that the fluid leaving the loop of Henle is dilute but becomes concentrated as water is absorbed from the distal tubules and collecting tubules. With high ADH levels, the osmolarity of the urine is about the same as the osmolarity of the renal medullary interstitial fluid in the papilla, which is about 1200 mOsm/L. (Numerical values are in milliosmoles per liter.)

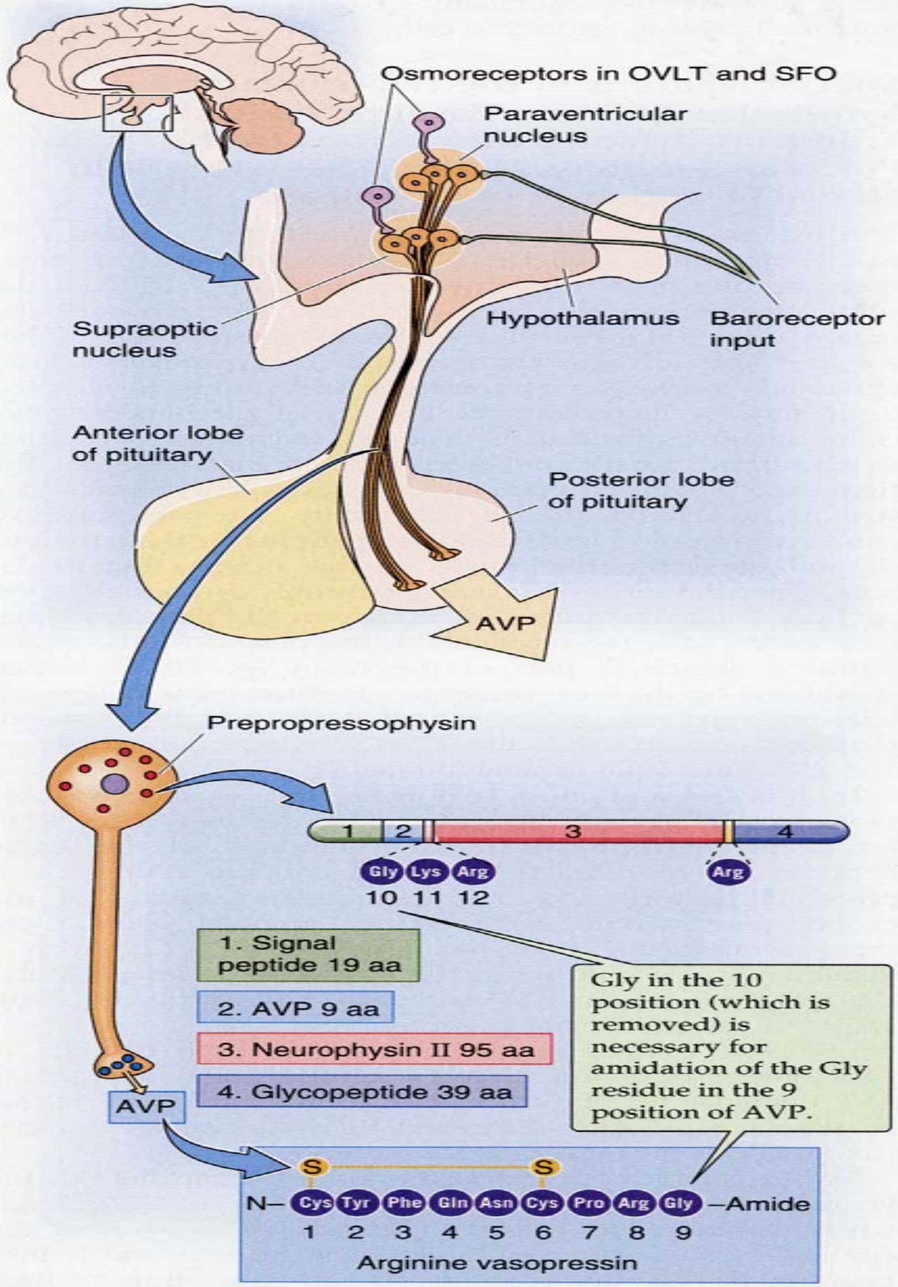
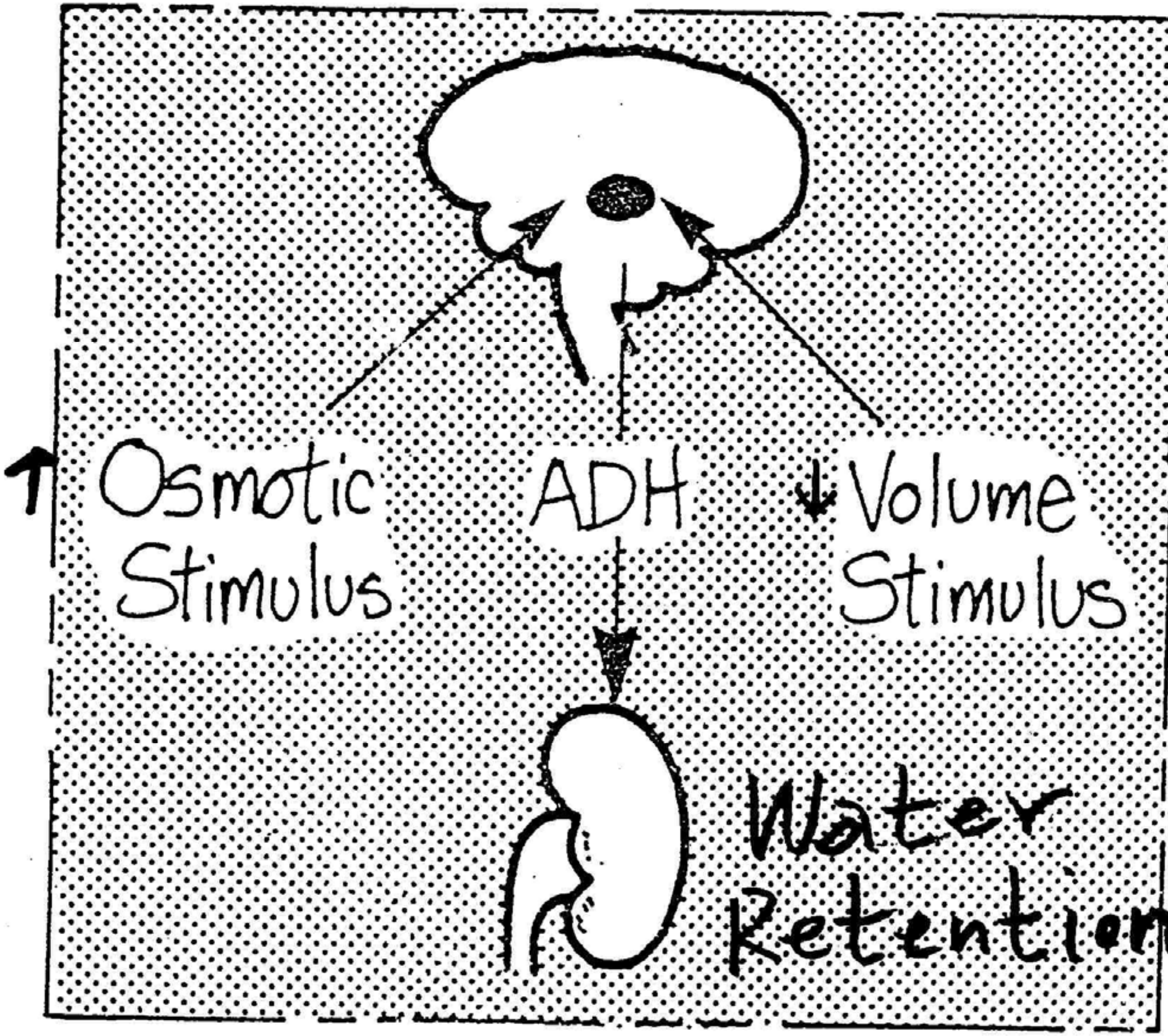


FIGURE 39–9. Control of arginine vasopressin (AVP) synthesis and release by osmoreceptors. Osmoreceptors are located in the organum vasculosum laminae terminalis (OVLT) and subfornical organ (SFO), two areas that breech the blood-brain barrier.


↑ Osmotic Stimulus
ADH
↓ Volume Stimulus
Water Retention

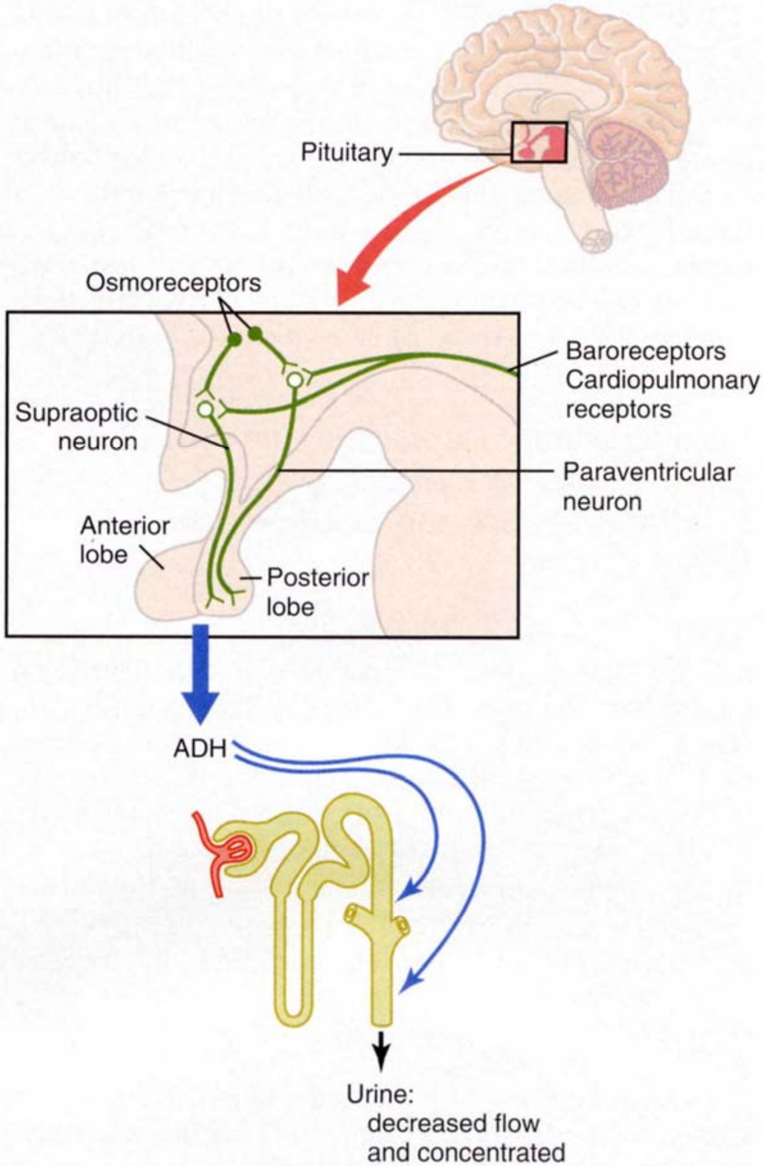
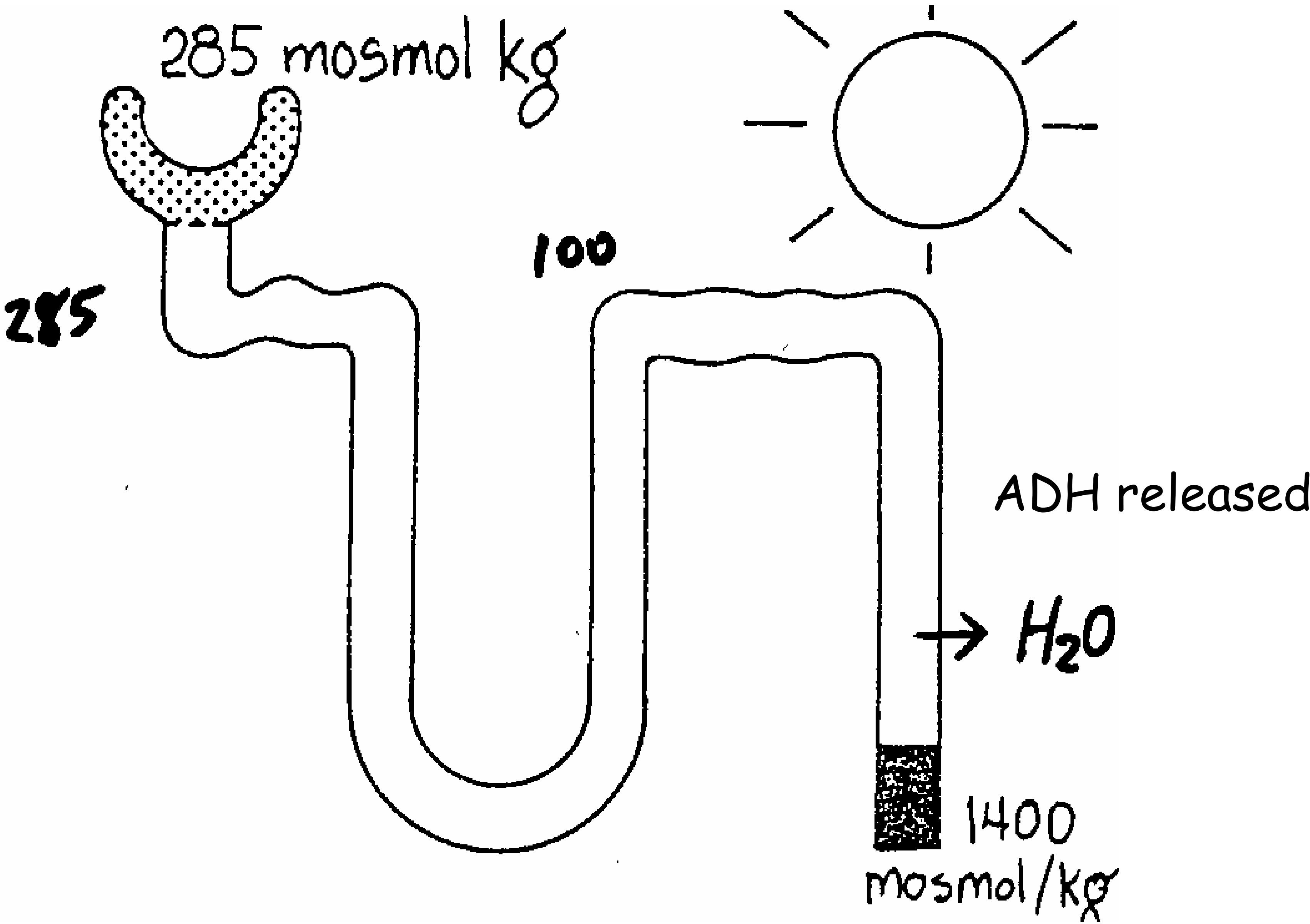
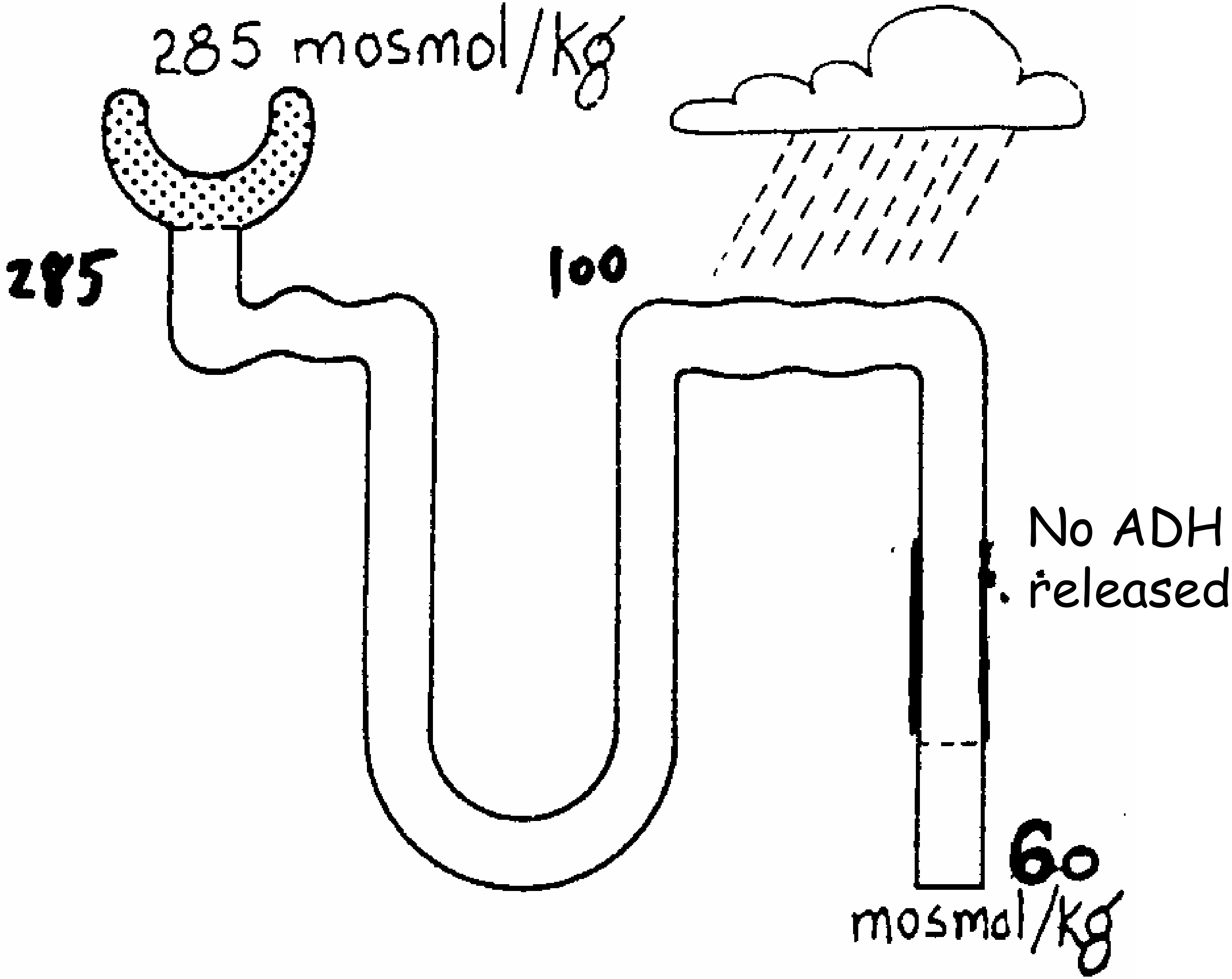


Figure 28–9

Neuroanatomy of the hypothalamus, where antidiuretic hormone (ADH) is synthesized, and the posterior pituitary gland, where ADH is released.


285 mosmol kg
285
100
ADH released
H_2O
1400
mosmol/kg



285 mosmol/Kg
285
100
No ADH
released
60
mosmol/Kg

References

1. Guyton and Hall
Textbook of Medical Physiology 10th Edition
2. Berne and Levy
Physiology 4th Edition

Sources of figures

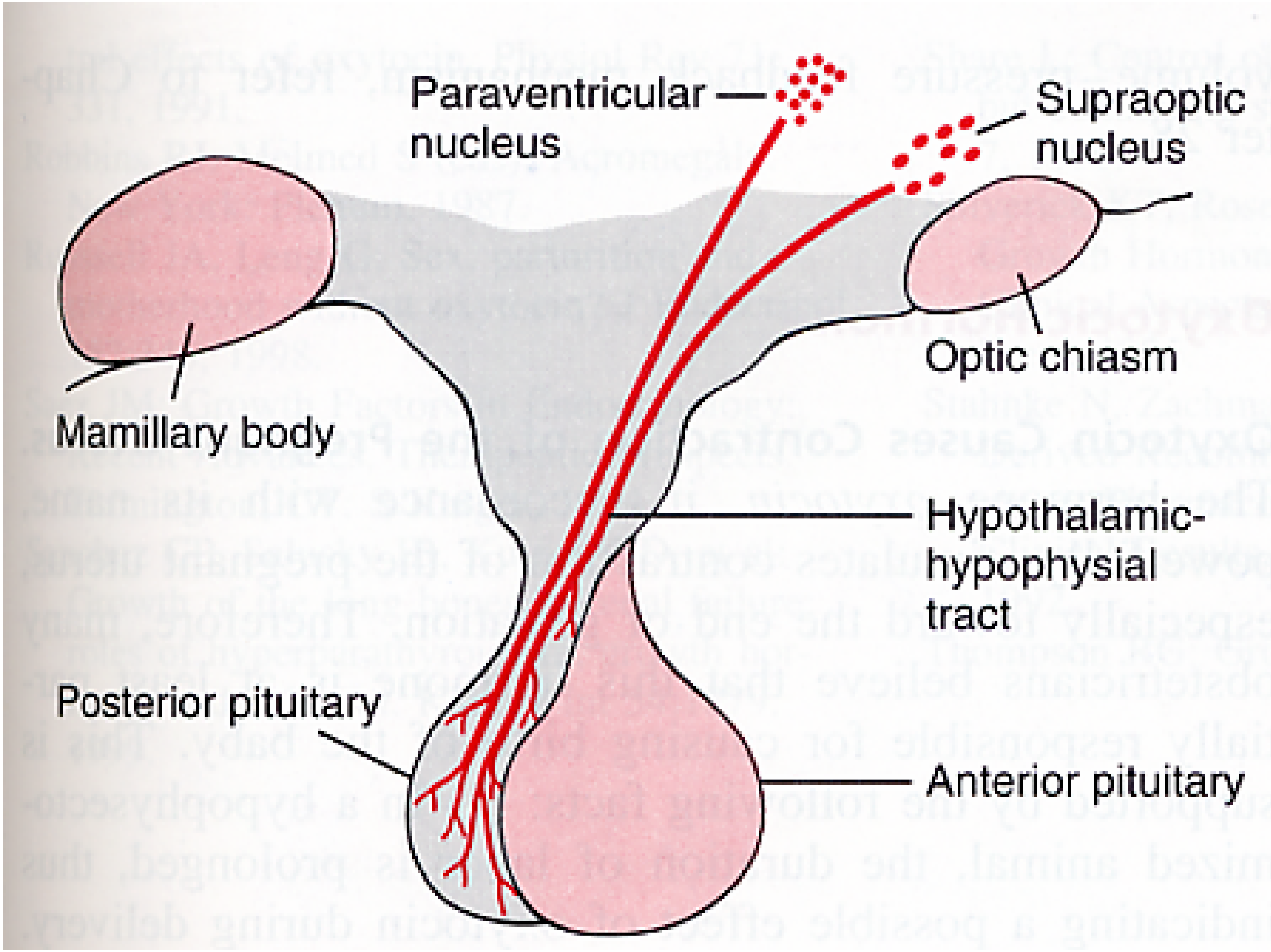
1. Guyton and Hall
Textbook of Medical Physiology 10th Edition
2. Berne and Levy
Physiology 4th Edition
3. Vaner, Sherman and Luciano
Human Physiology 8th Edition
4. Wilson and Waugh
Ross and Wilson Anatomy and Physiology in health and illness
8th Edition
5. Despopoulos and Silbernagl
Color atlas of Physiology

Table 28–2

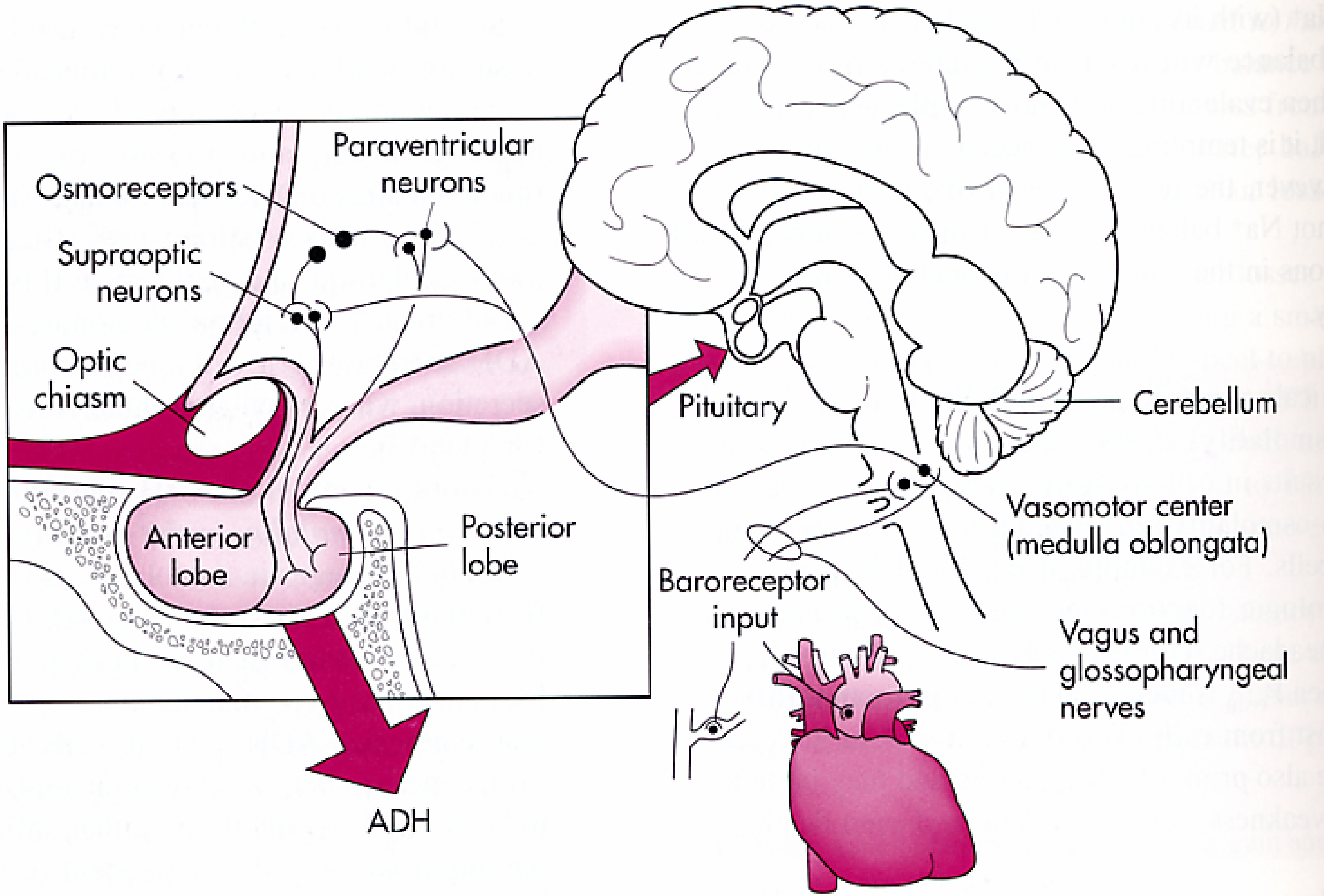
Regulation of ADH Secretion

Increase ADH	Decrease ADH
↑ Plasma osmolarity	↓ Plasma osmolarity
↓ Blood volume	↑ Blood volume
↓ Blood pressure	↑ Blood pressure
Nausea	
Hypoxia	
Drugs:	Drugs:
Morphine	Alcohol
Nicotine	Clonidine (antihypertensive drug)
Cyclophosphamide	Haloperidol (dopamine blocker)

greatly enhances the ADH response to increased osmolarity.



ADH is secreted from the posterior pituitary gland



ADH is secreted from the posterior pituitary gland in response to the signals from the osmoreceptor and volume receptors

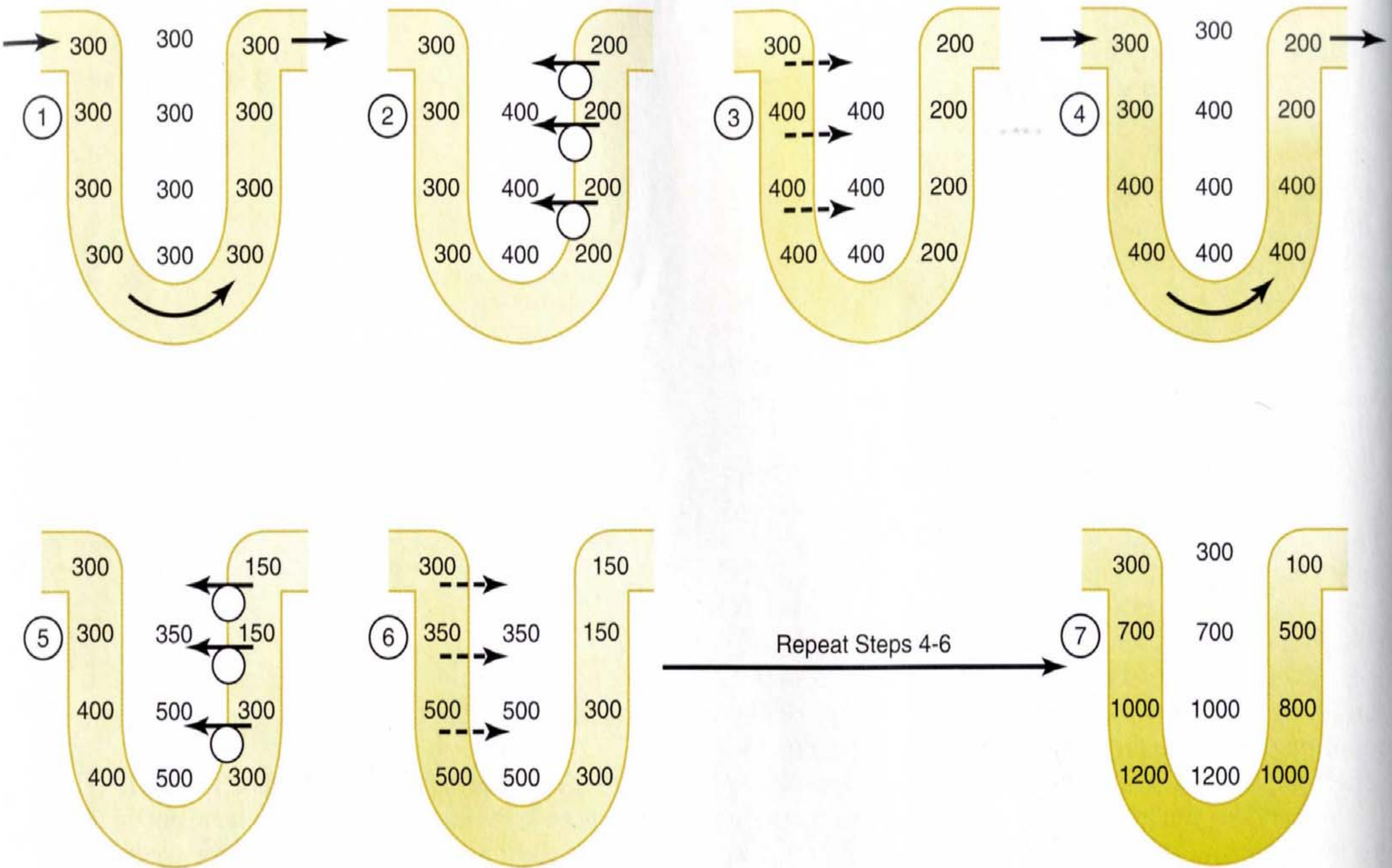
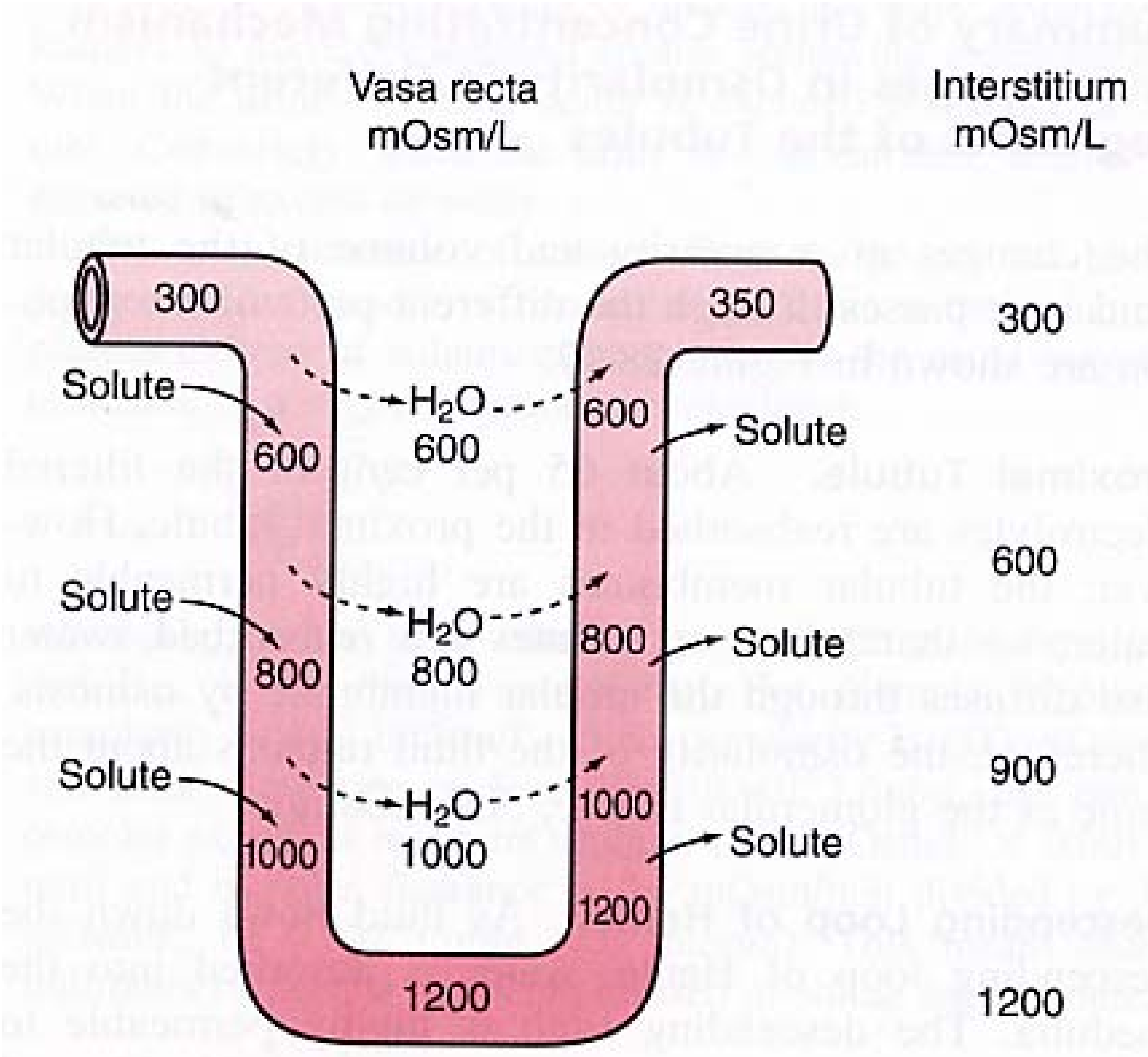
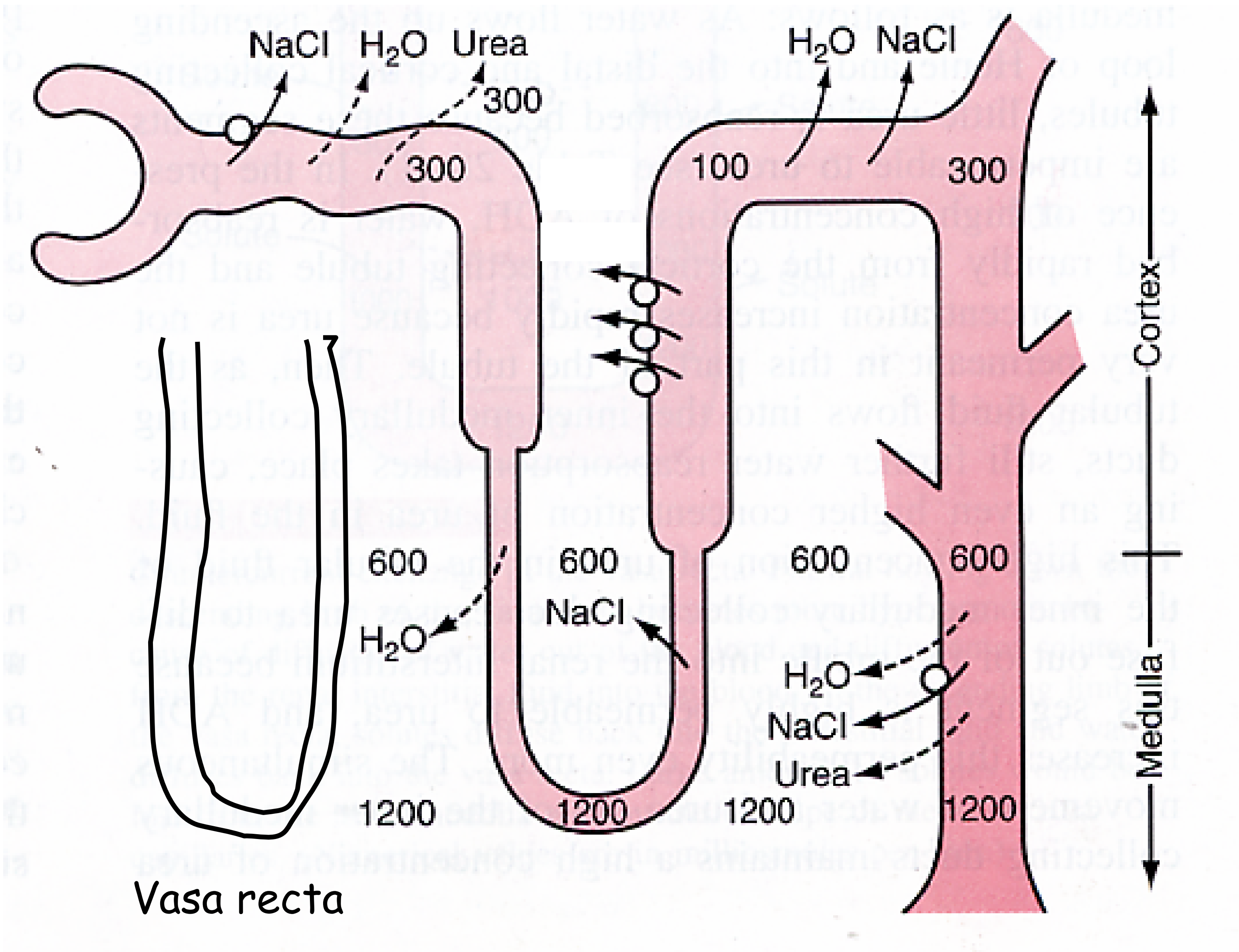


Figure 28–3

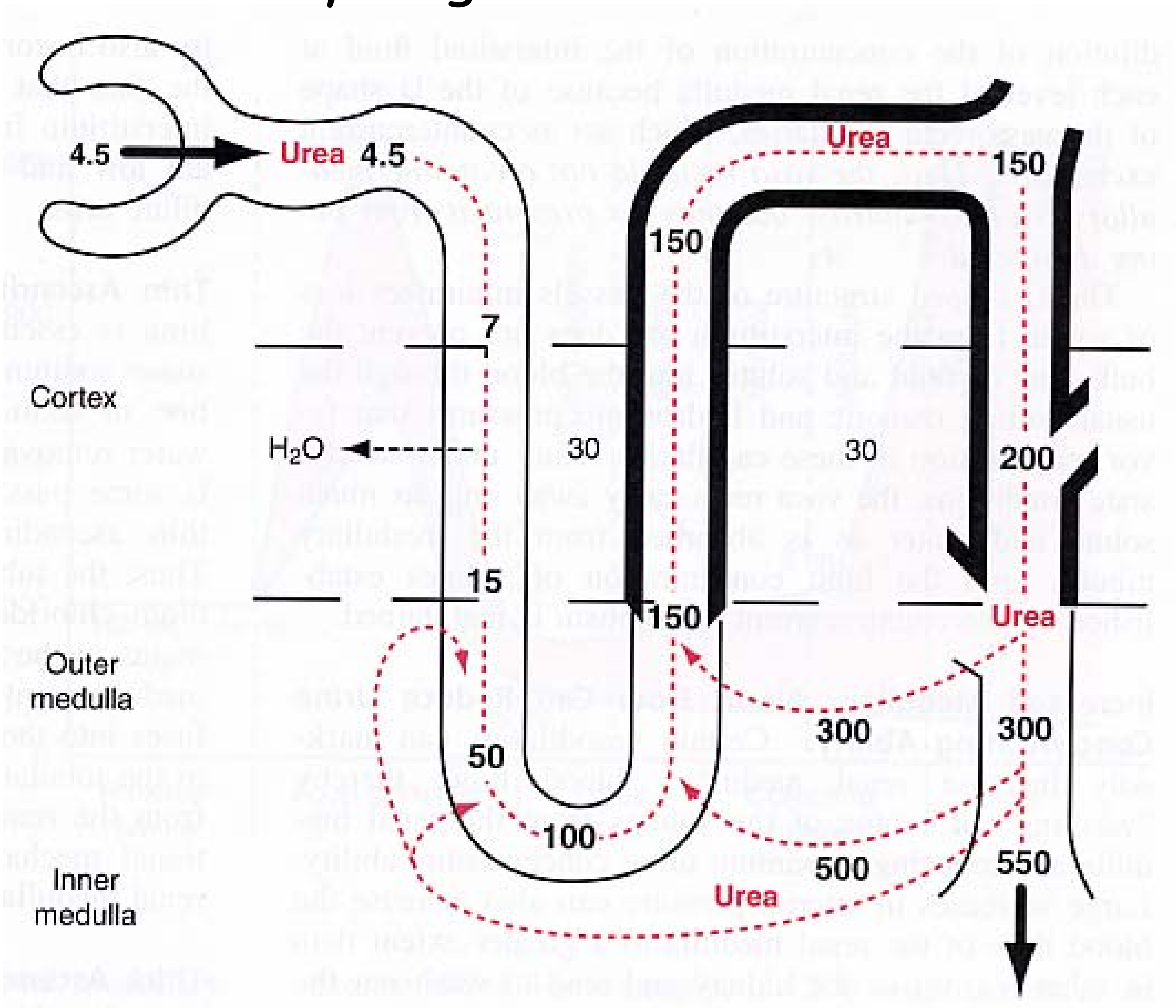
Countercurrent multiplier system in the loop of Henle for producing a hyperosmotic renal medulla. (Numerical values are in milliosmoles per liter.)

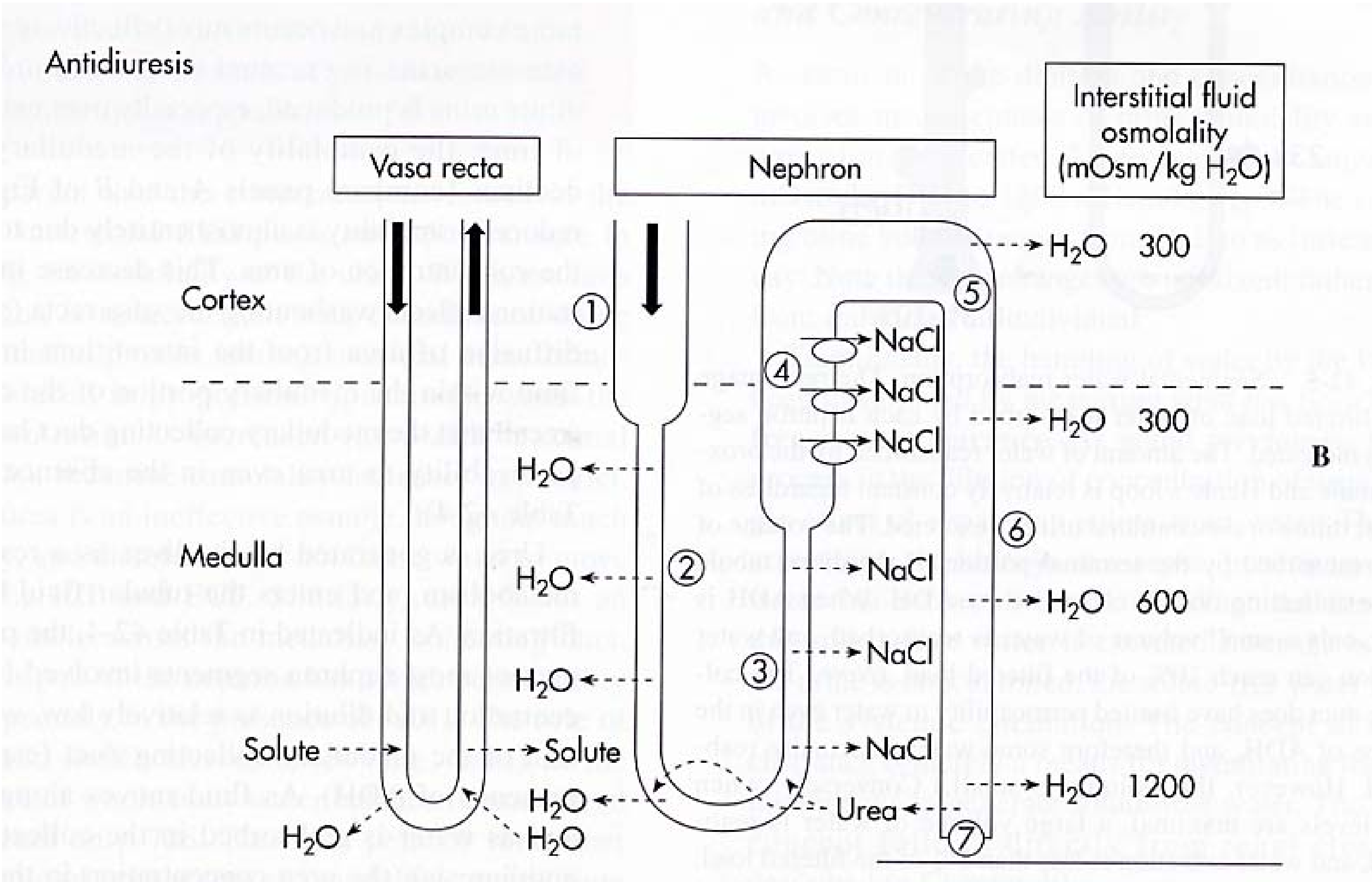


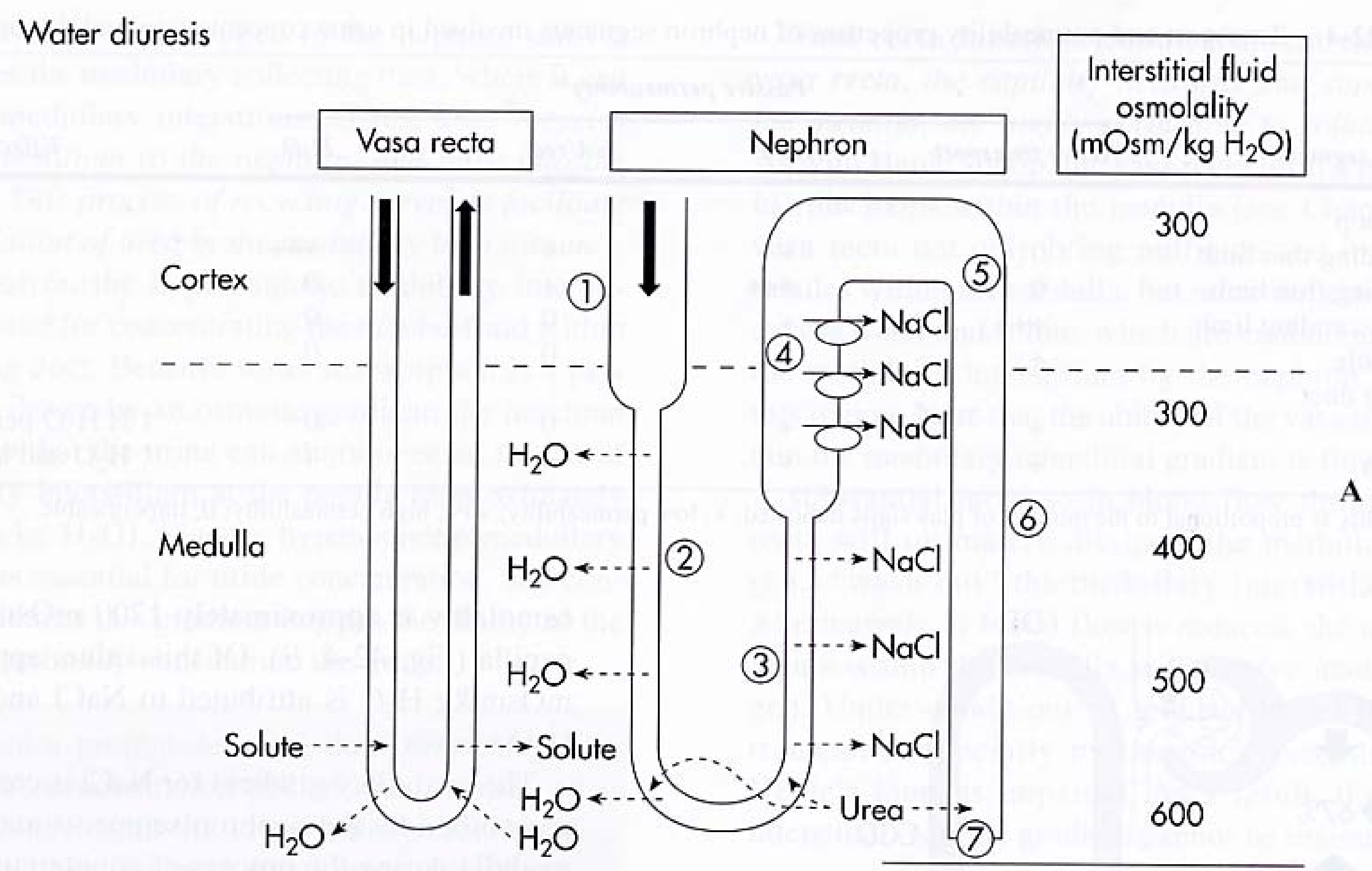
Vasa recta
mOsm/L
Interstitium
mOsm/L
300
350
300
Solute
H_2O
600
600
600
Solute
600
Solute
H_2O
800
800
800
Solute
900
Solute
H_2O
1000
1000
1000
Solute
1200
1200
1200


NaCl
H2O
Urea
300
300
H2O
NaCl
100
300
Cortex
600
600
600
600
NaCl
H2O
H2O
NaCl
Urea
Medulla
1200
1200
1200
1200
Vasa recta

Recycling of urea




Antidiuresis
Vasa recta
Nephron
Interstitial fluid osmolality (mOsm/kg H_2O)
Cortex
Medulla
1
2
3
4
5
6
7
H_2O 300
H_2O 300
H_2O 600
H_2O 1200
NaCl
NaCl
NaCl
NaCl
NaCl
NaCl
H_2O
H_2O
H_2O
H_2O
H_2O
H_2O
Solute
Solute
Urea
B



Water diuresis
Vasa recta
Nephron
Interstitial fluid osmolality (mOsm/kg H_2O)
Cortex
Medulla
300
300
400
500
600
A
1
2
3
4
5
6
7
NaCl
NaCl
NaCl
NaCl
NaCl
NaCl
H_2O
H_2O
H_2O
H_2O
H_2O
H_2O
Solute
Solute
Urea

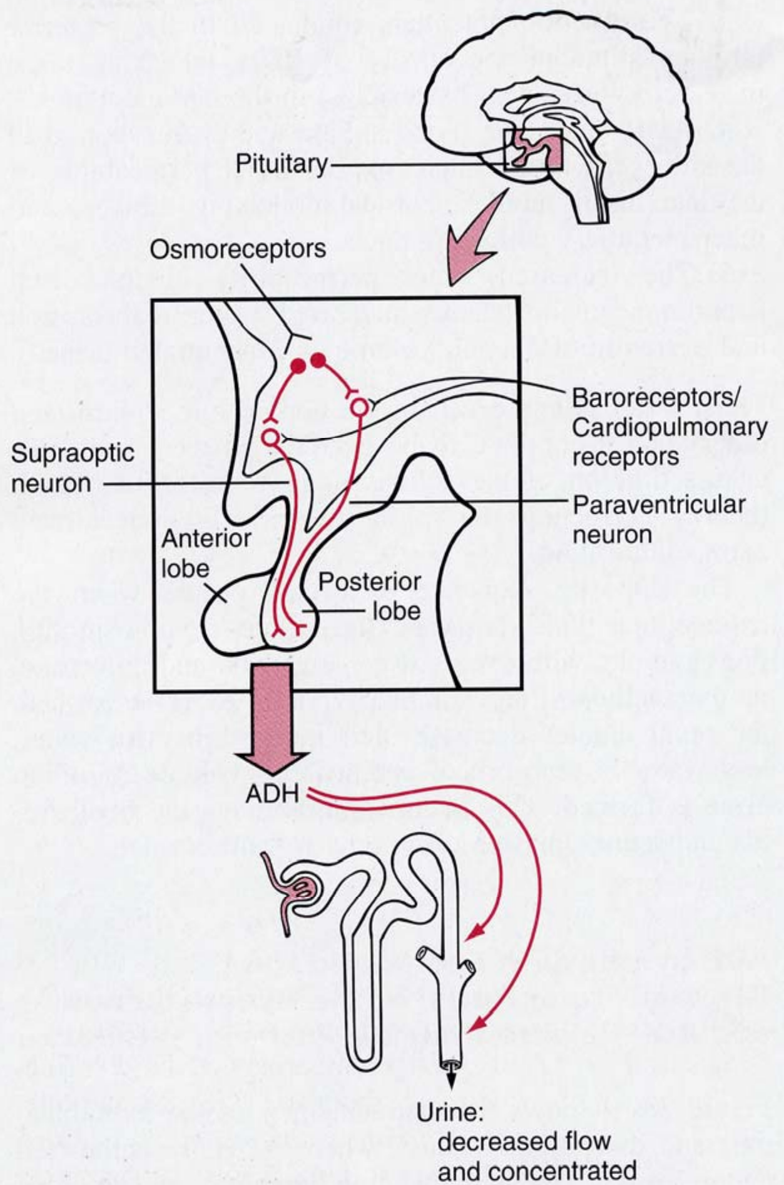


FIGURE 28–9

Neuroanatomy of the hypothalamus, where antidiuretic hormone (ADH) is synthesized, and the posterior pituitary gland, where ADH is released.