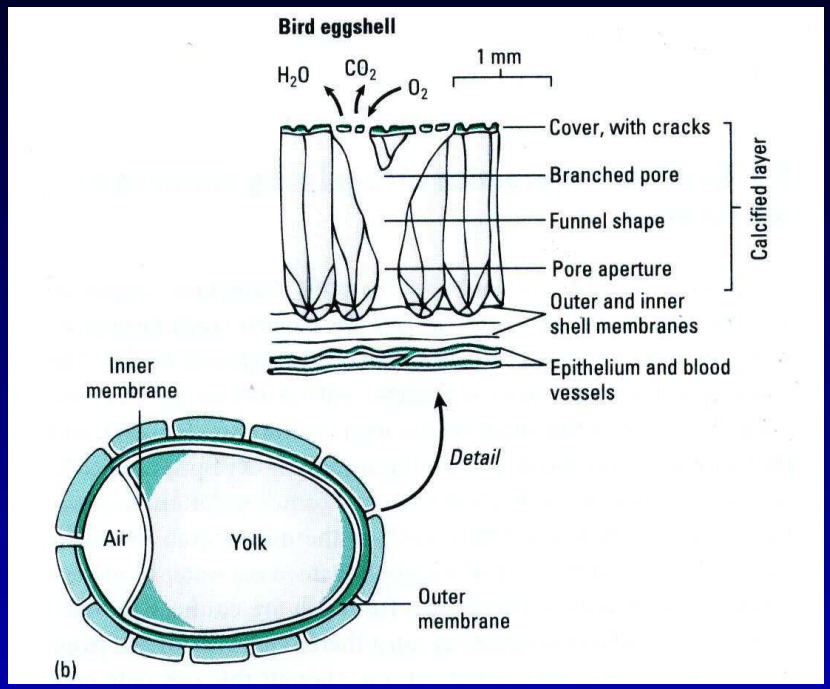
Water/Osmotic Relations of Terrestrial Birds and Mammals

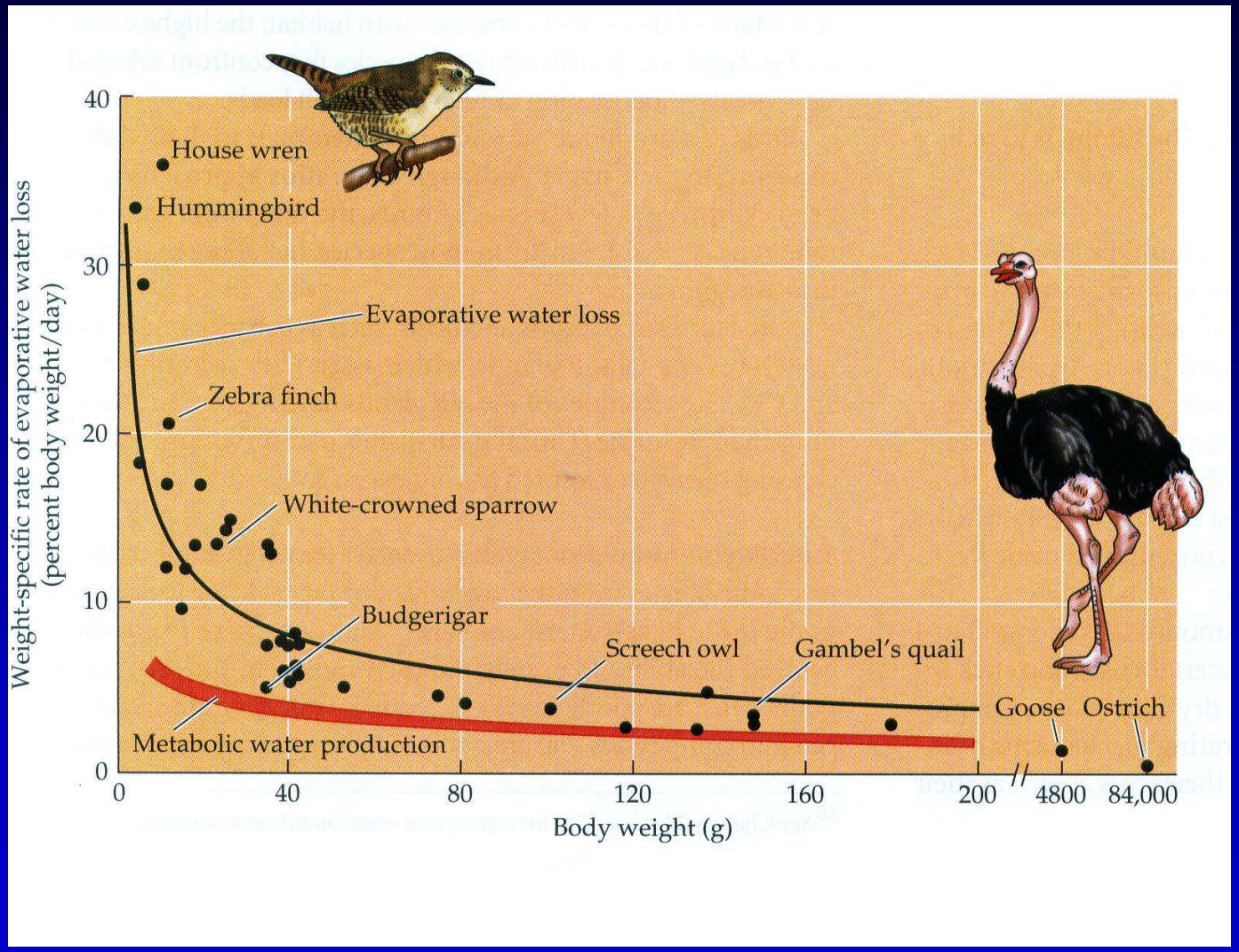
- Features in common:
  - High metabolic rates (endothermic)
    a) oxidation water
    b) respiratory water loss
  - Ability to produce hypertonic urine
  - Integument that features lipid barrier
- Some major differences (birds more like reptiles than mammals)

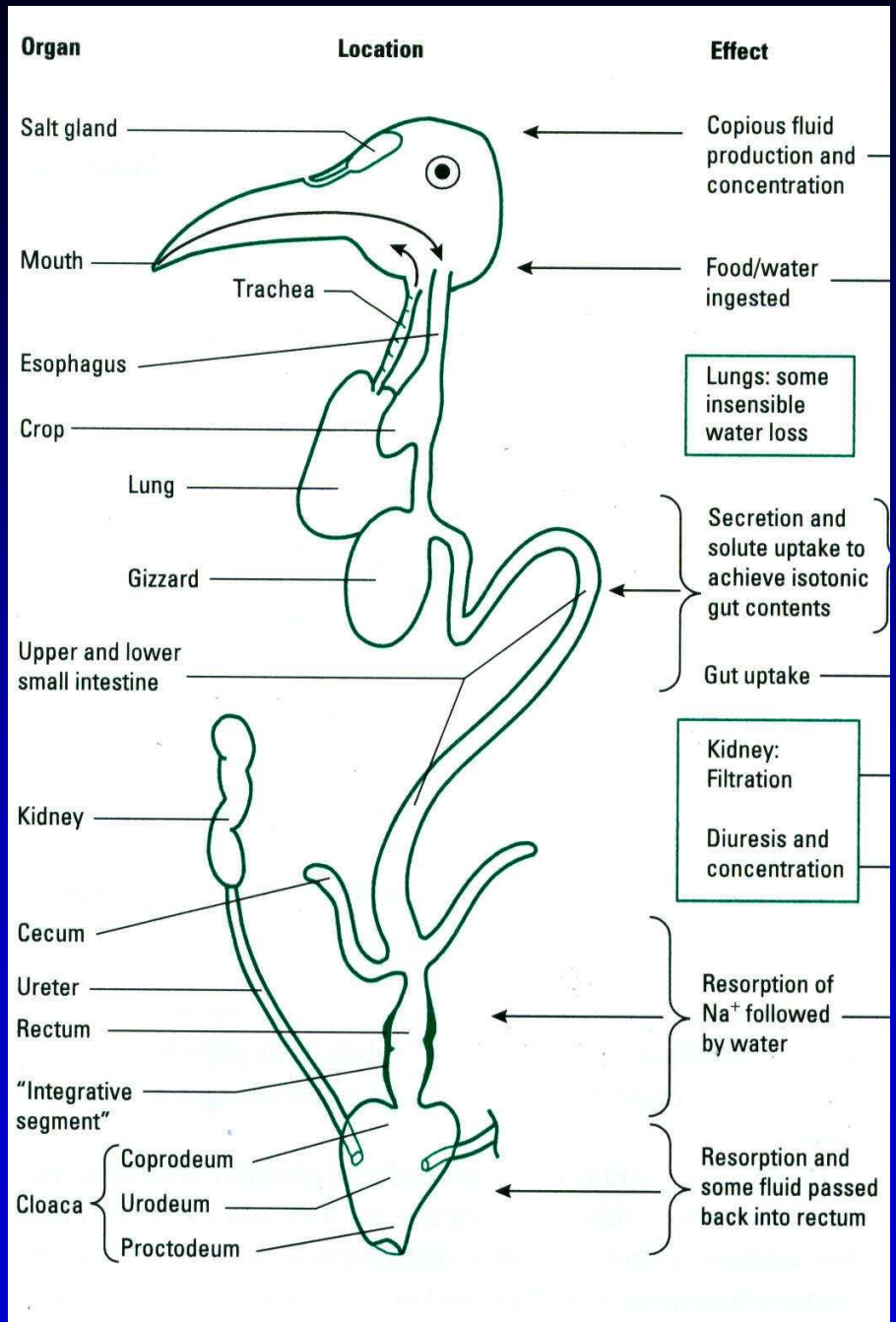
Avian Features

- Cleidoic egg

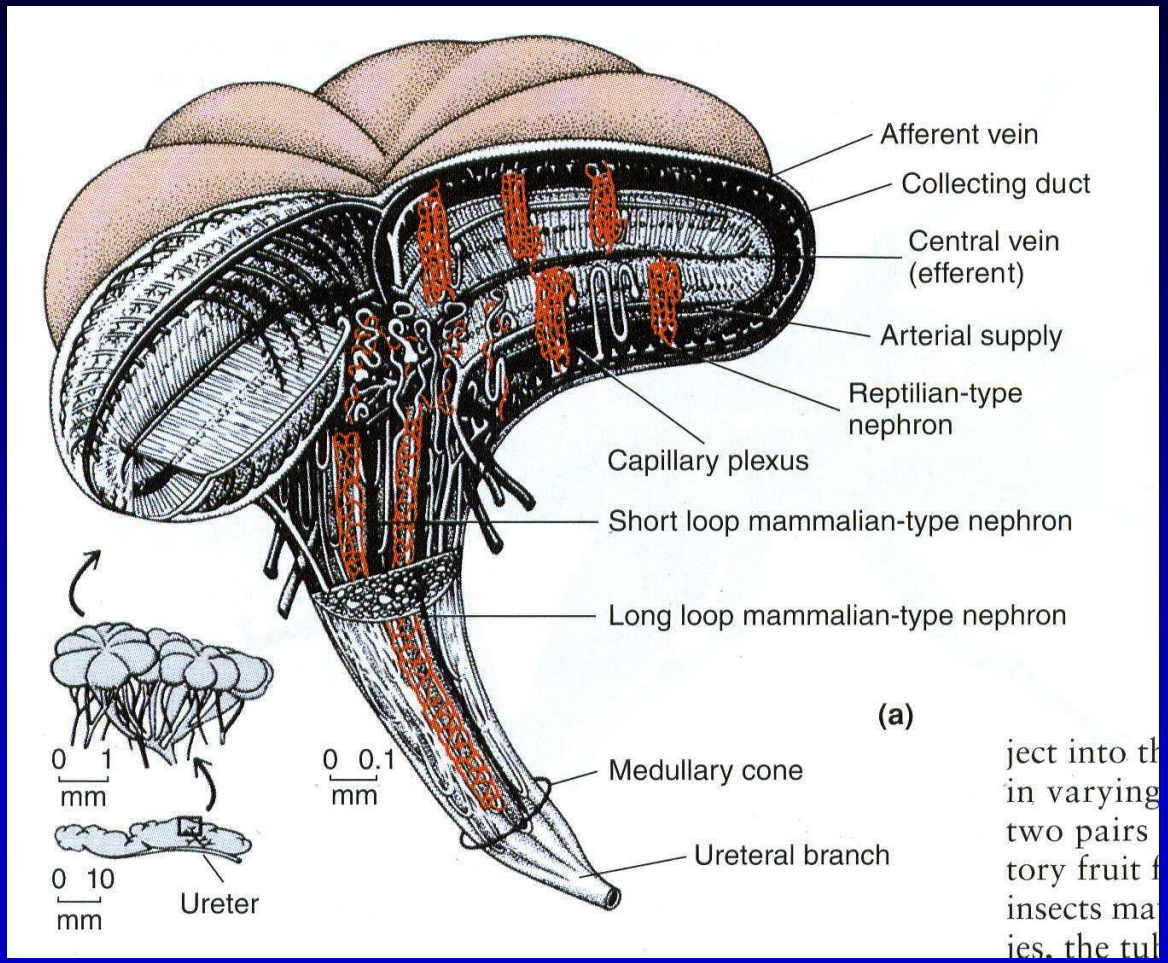


- Cloacal water reabsorption
- Uric acid excretion
- Extra-renal structures (salt glands)

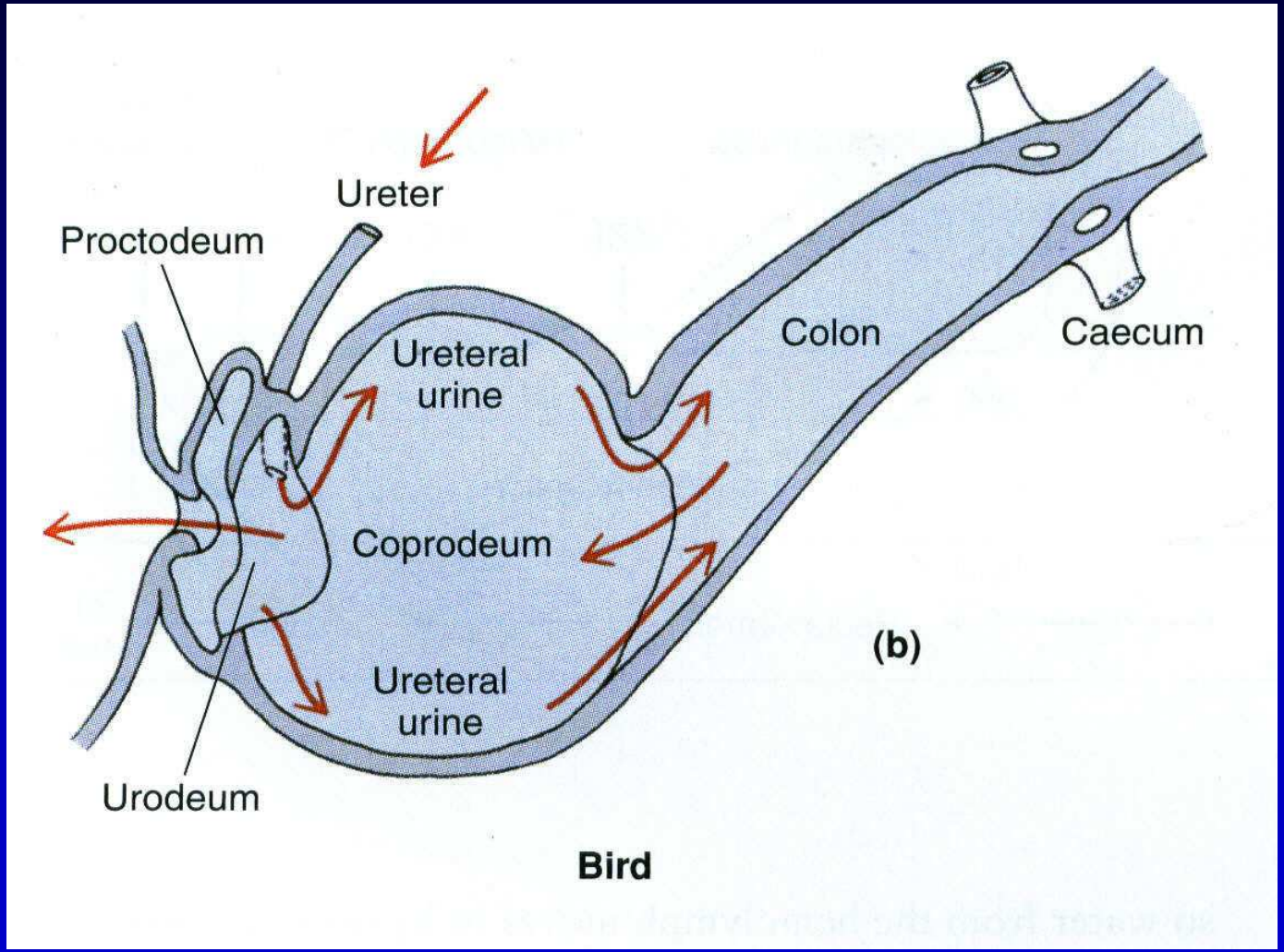

House wren
Hummingbird
Evaporative water loss
Zebra finch
White-crowned sparrow
Budgerigar
Screech owl
Gambel's quail
Goose
Ostrich
Metabolic water production
Weight-specific rate of evaporative water loss (percent body weight/day)
Body weight (g)
0
10
20
30
40
0
40
80
120
160
200
4800
84,000


Organ
Location
Effect
Salt gland
Copious fluid production and concentration
Mouth
Food/water ingested
Trachea
Esophagus
Lungs: some insensible water loss
Crop
Lung
Secretion and solute uptake to achieve isotonic gut contents
Gizzard
Upper and lower small intestine
Gut uptake
Kidney: Filtration
Kidney
Diuresis and concentration
Cecum
Ureter
Resorption of Na^+ followed by water
Rectum
"Integrative segment"
Coprodeum
Cloaca
Urodeum
Proctodeum
Resorption and some fluid passed back into rectum

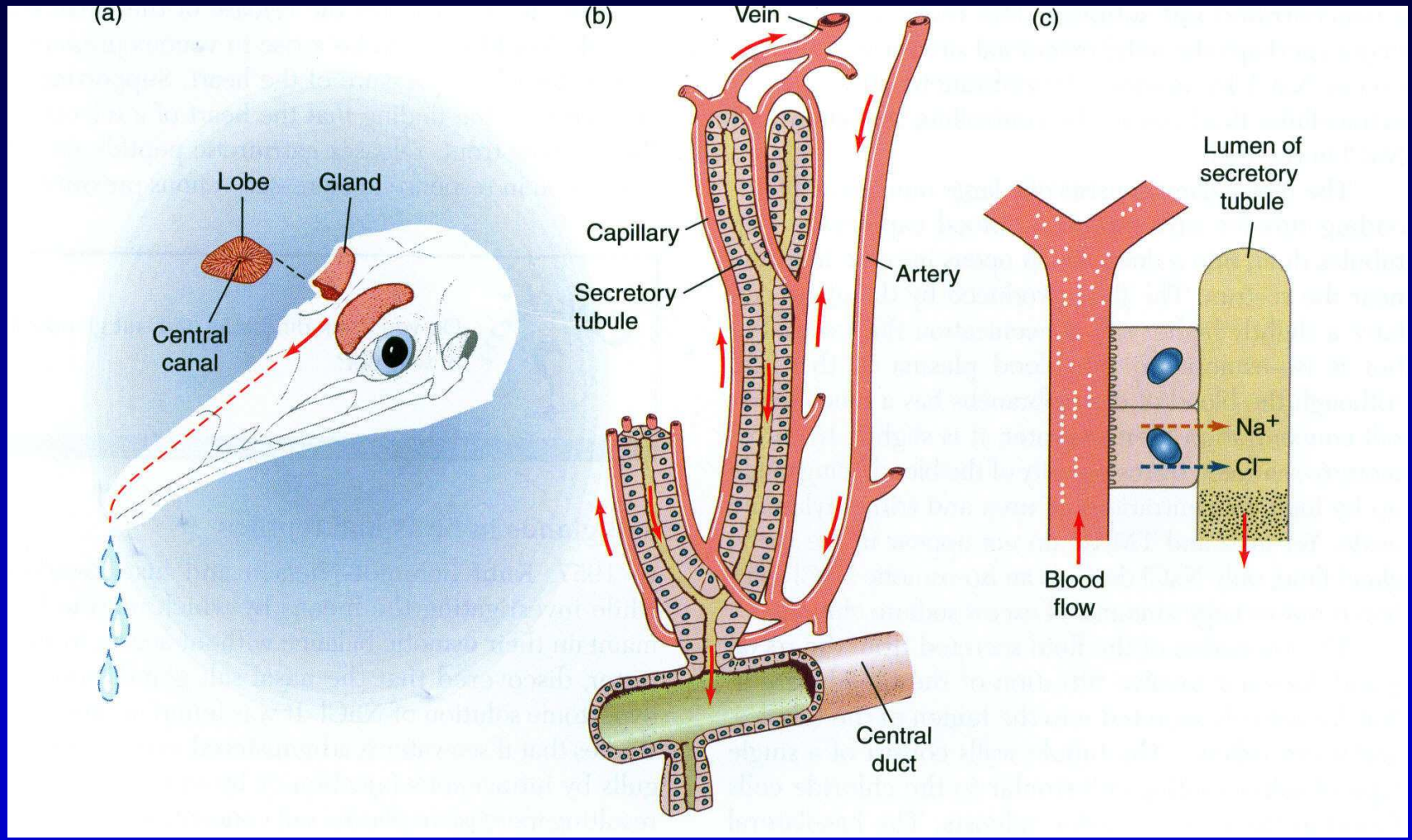
Avian Kidney



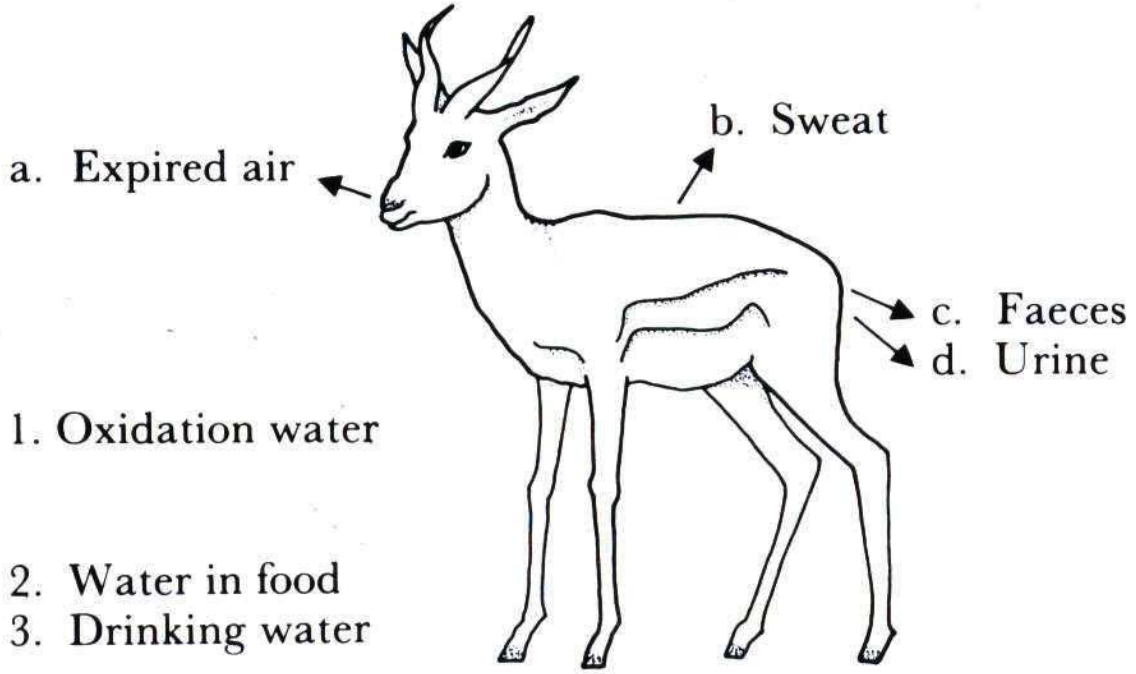
Avian Hindgut



Avian Salt Gland

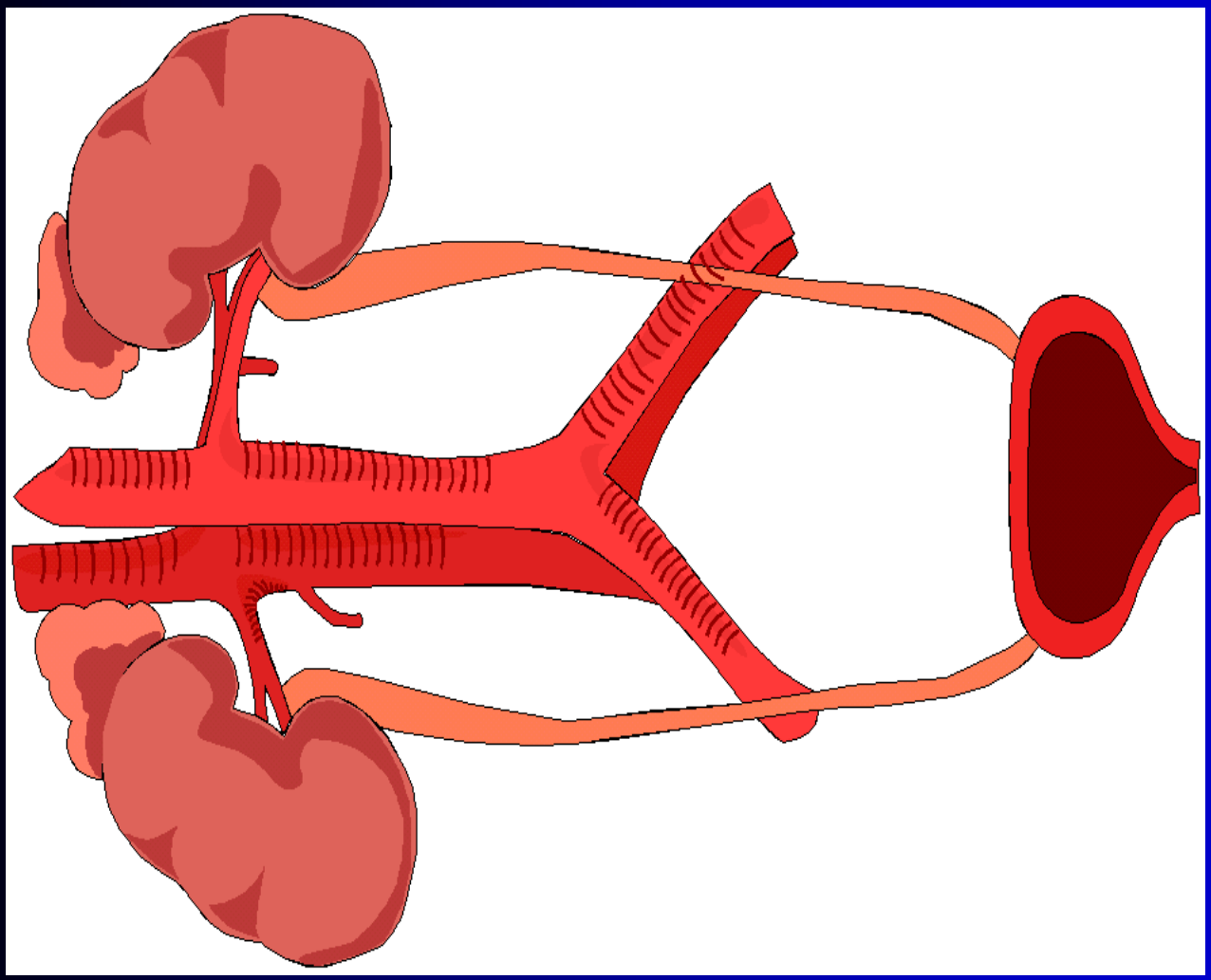


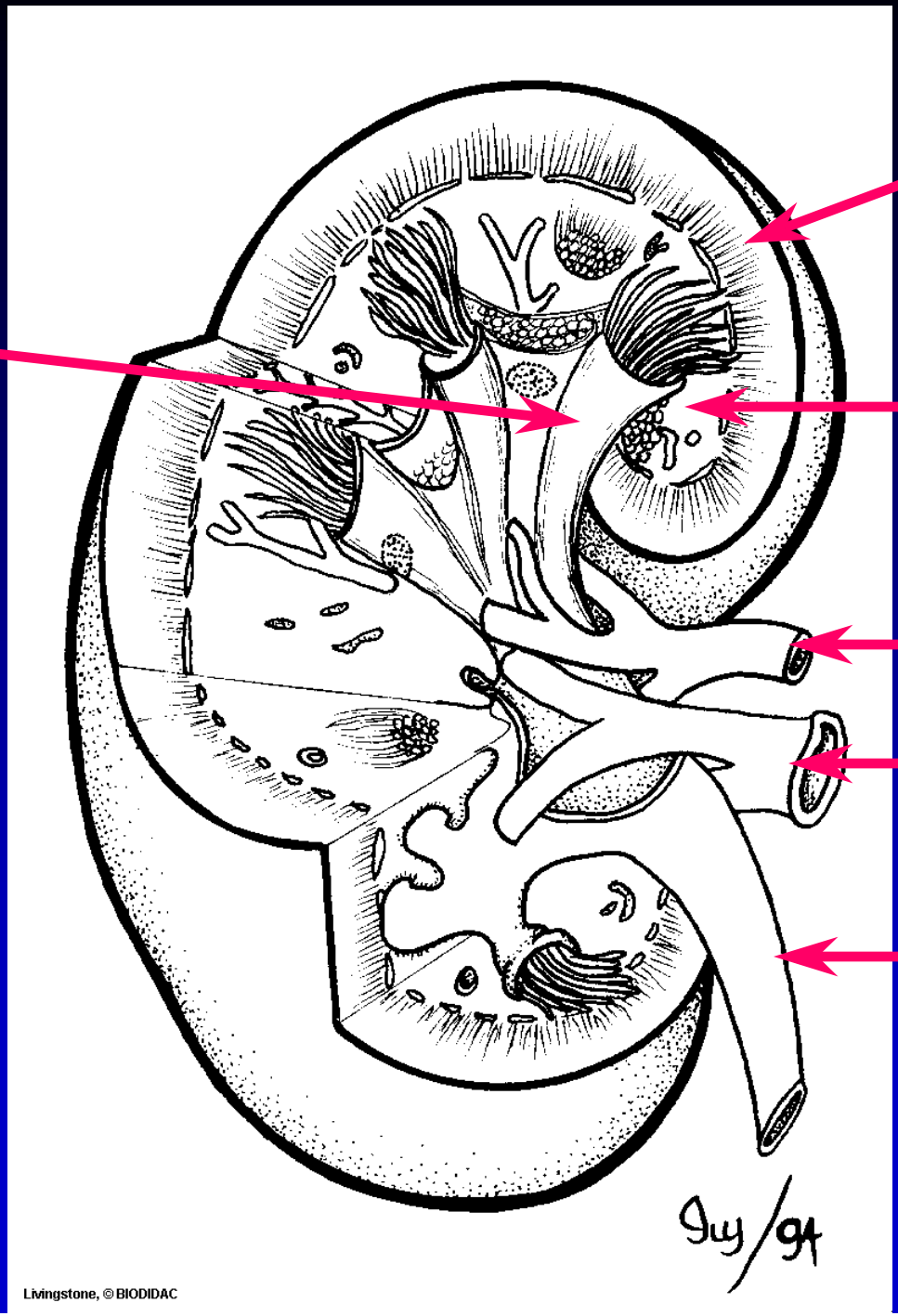
Mammals



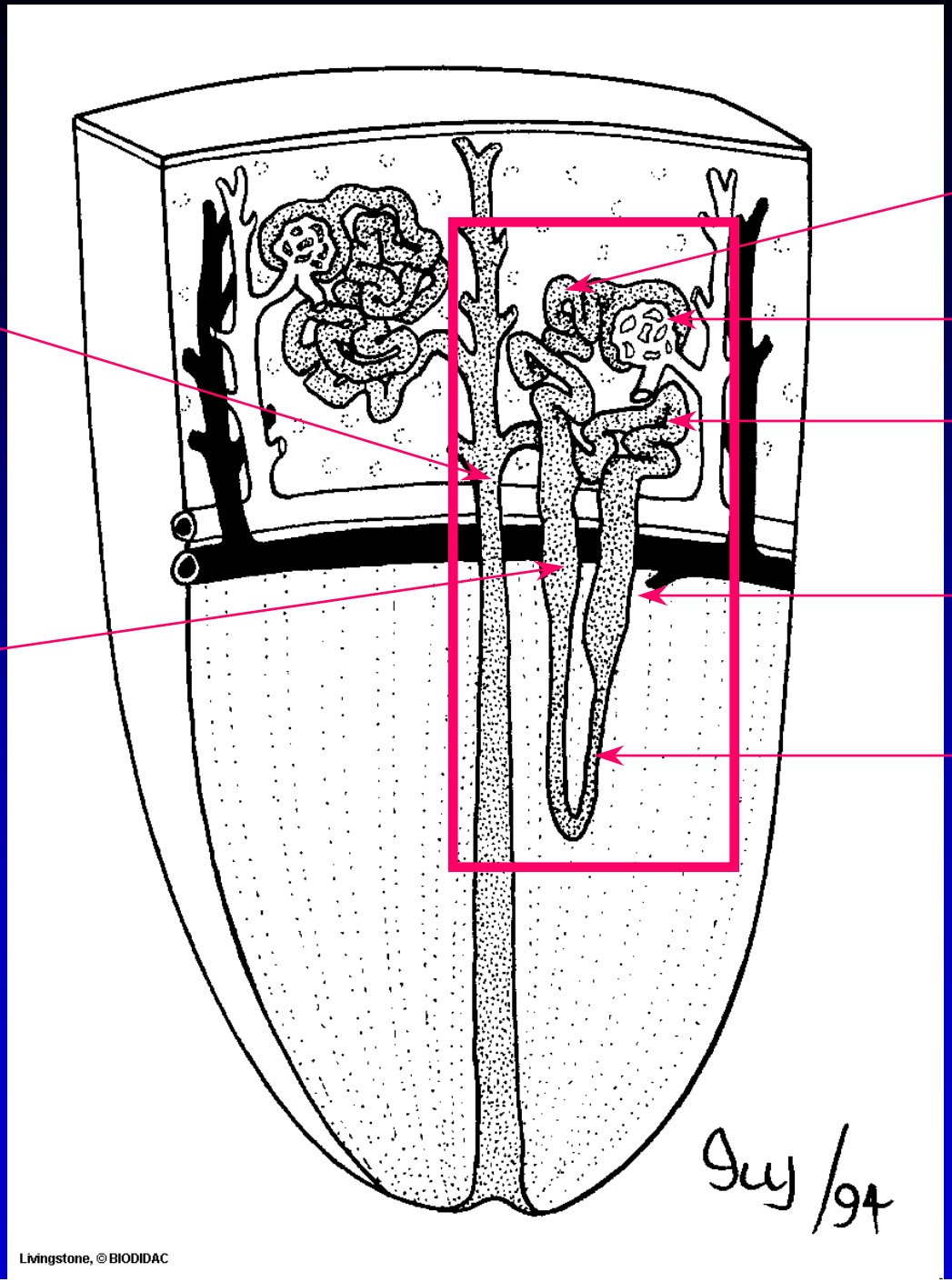
Gain		Loss
1. Oxidation water		a. Evaporation from lungs
2. Water in food	=	b. Evaporation from skin
3. Drinking water		c. Water in faeces
		d. Water in urine

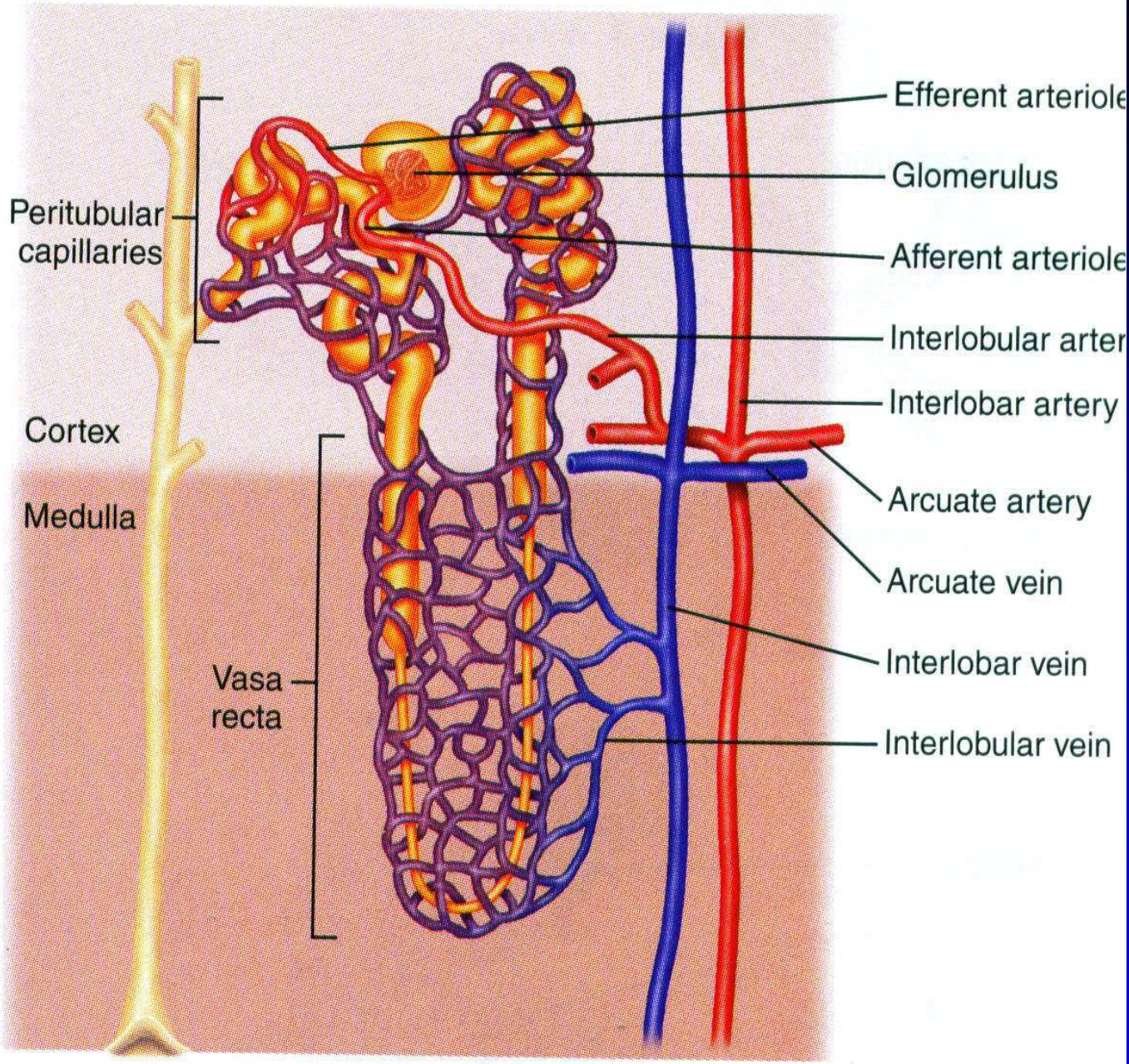
Figure 2.8 Water balance model for a typical mammal, the springbok.



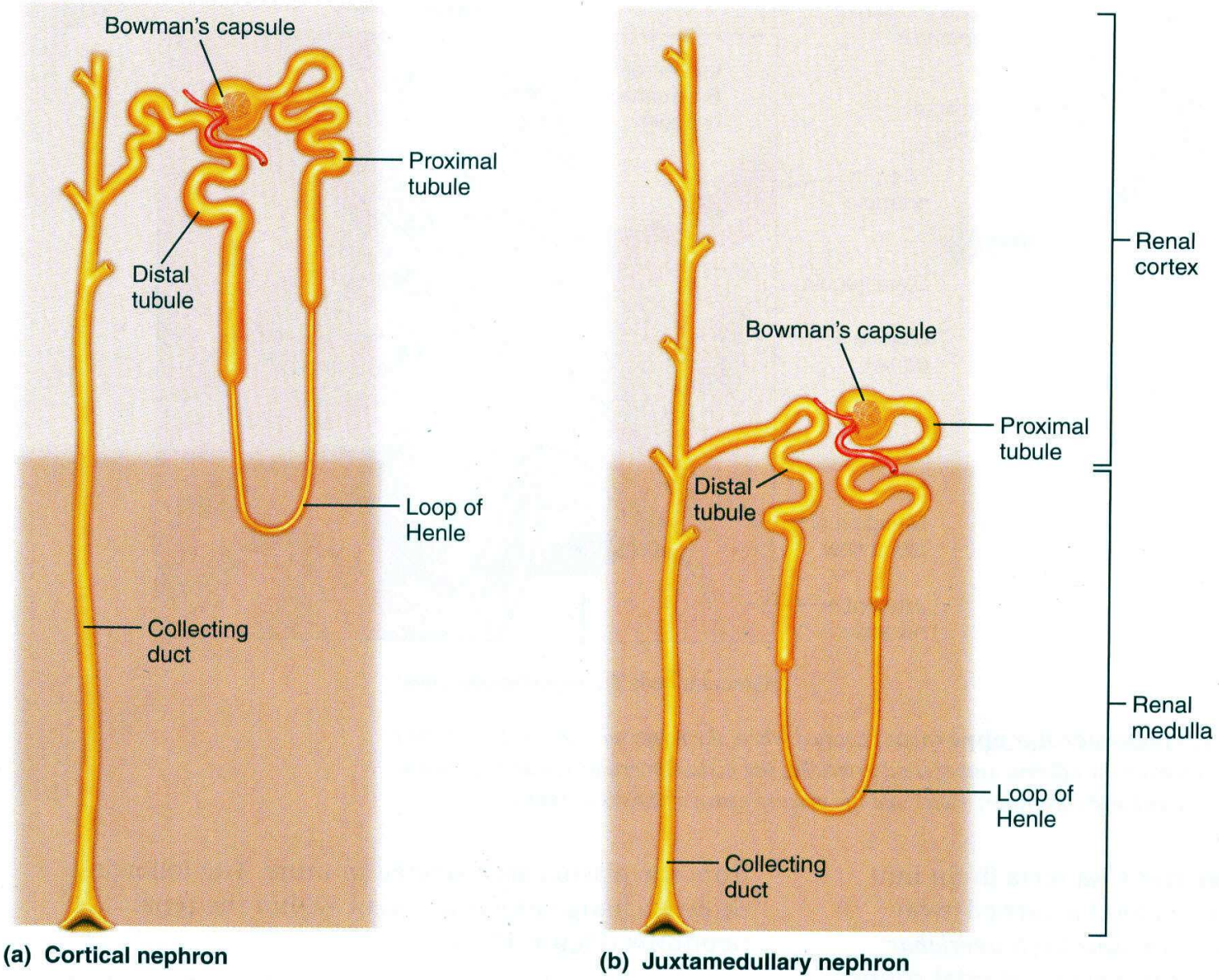

cortex
calyx
medulla
renal artery
renal vein
ureter
Livingstone, © BIODIDAC

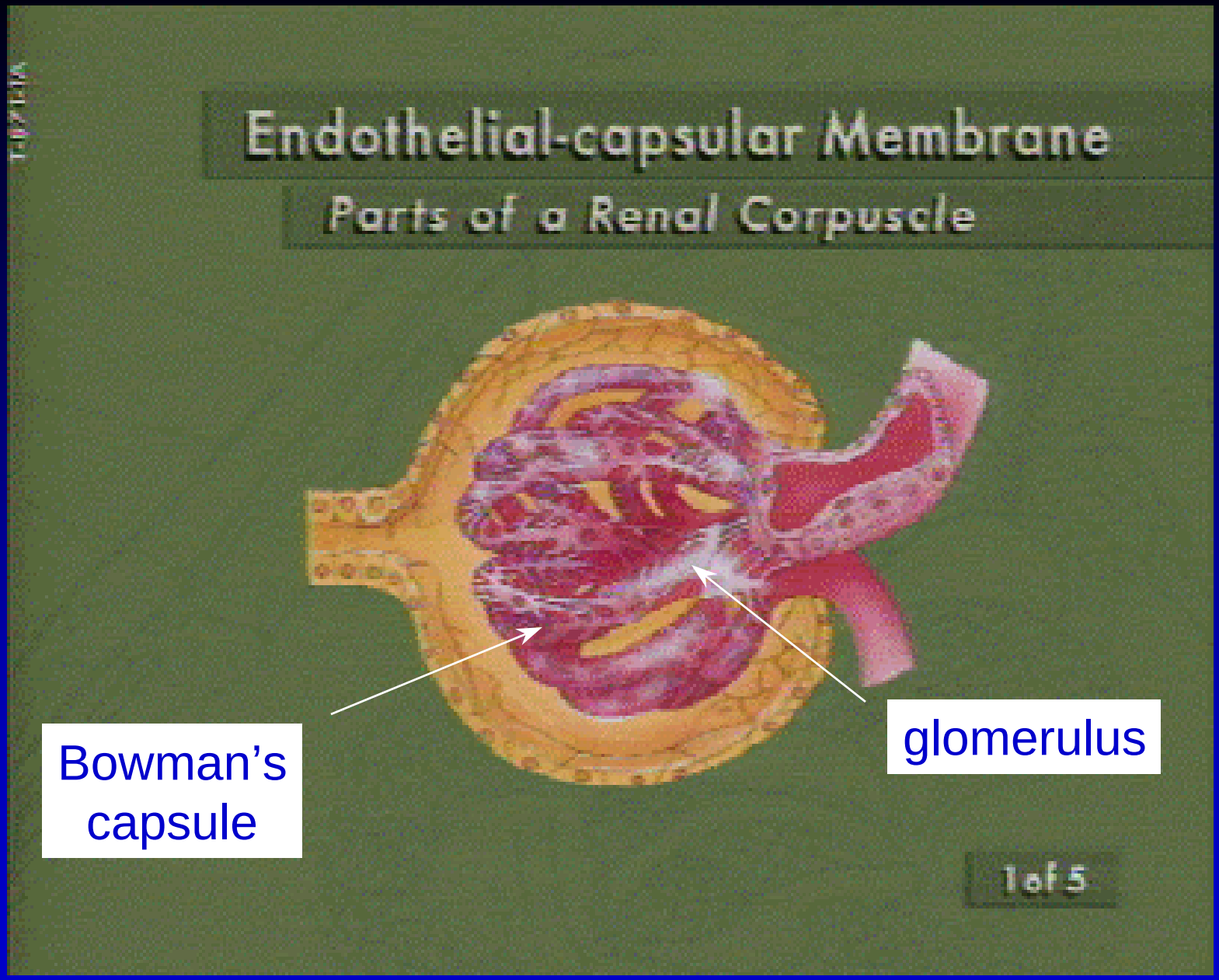
nephron


collecting duct
descending limb of loop of Henle
prox. conv. tubule
capsule
dist. conv. tubule
thick ascend. limb
thin ascend. limb of loop of Henle
Livingstone, © BIODIDAC

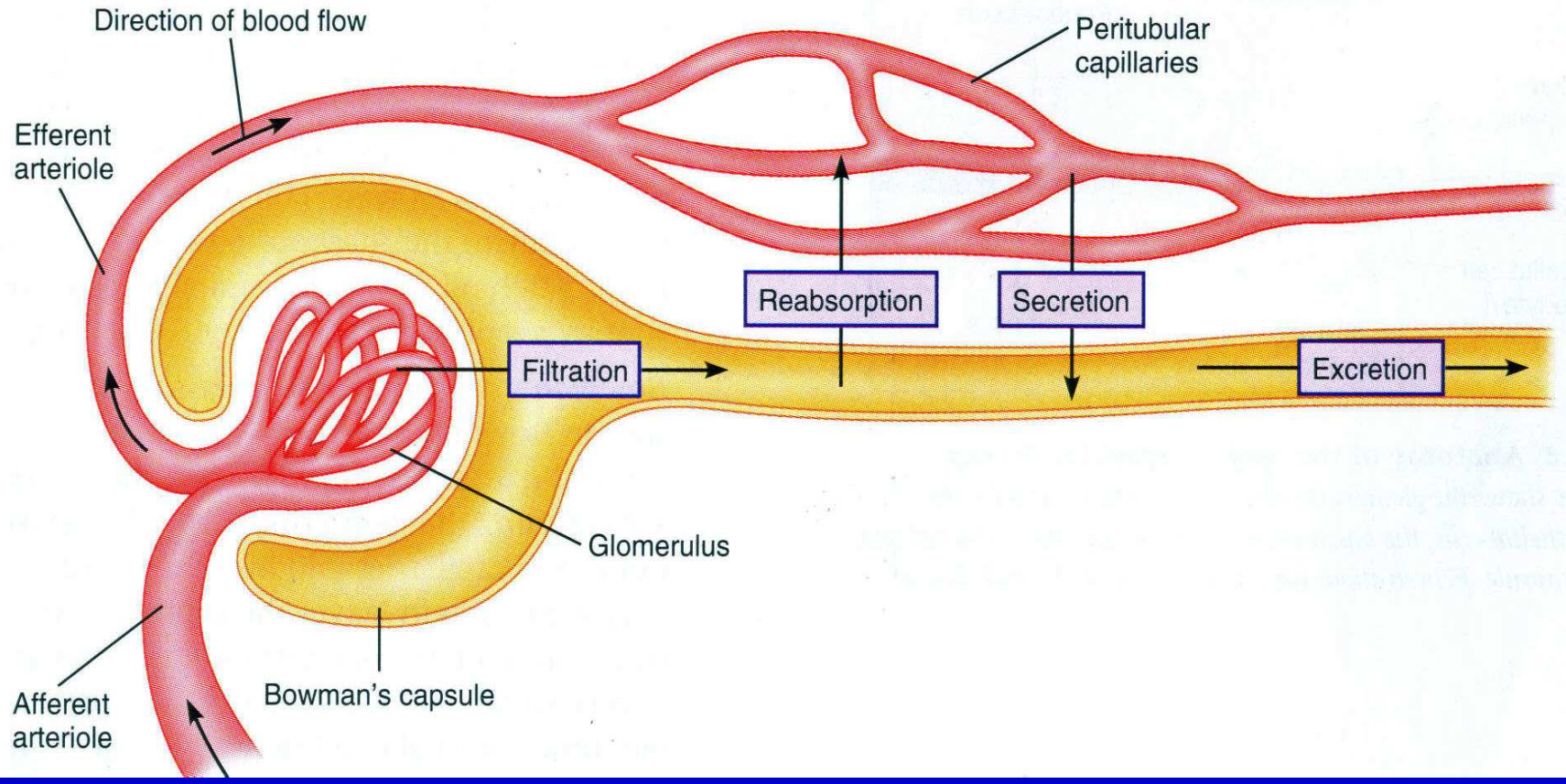

Efferent arteriole
Glomerulus
Afferent arteriole
Interlobular arter
Interlobar artery
Arcuate artery
Arcuate vein
Interlobar vein
Interlobular vein
Peritubular capillaries
Cortex
Medulla
Vasa recta

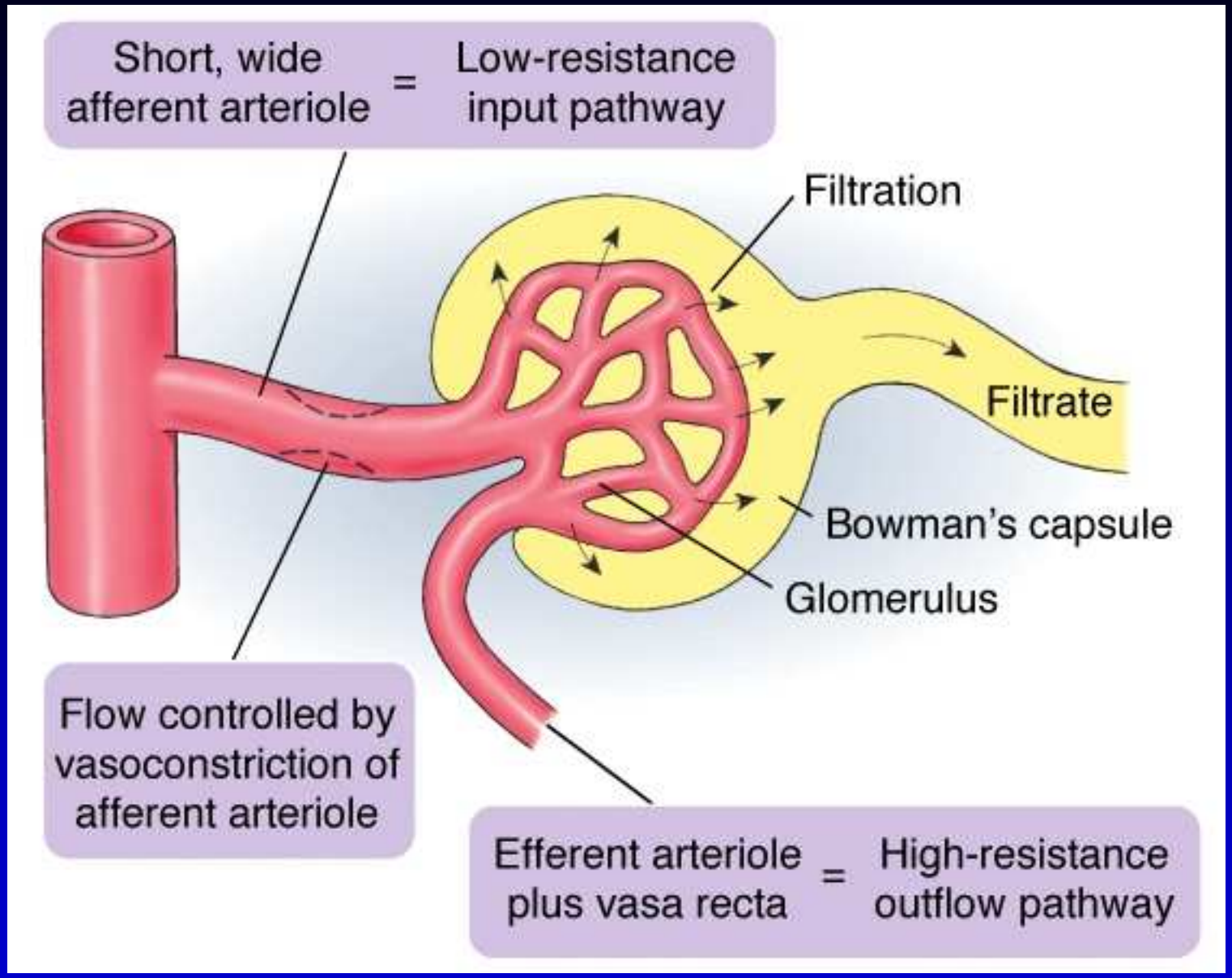
(b)

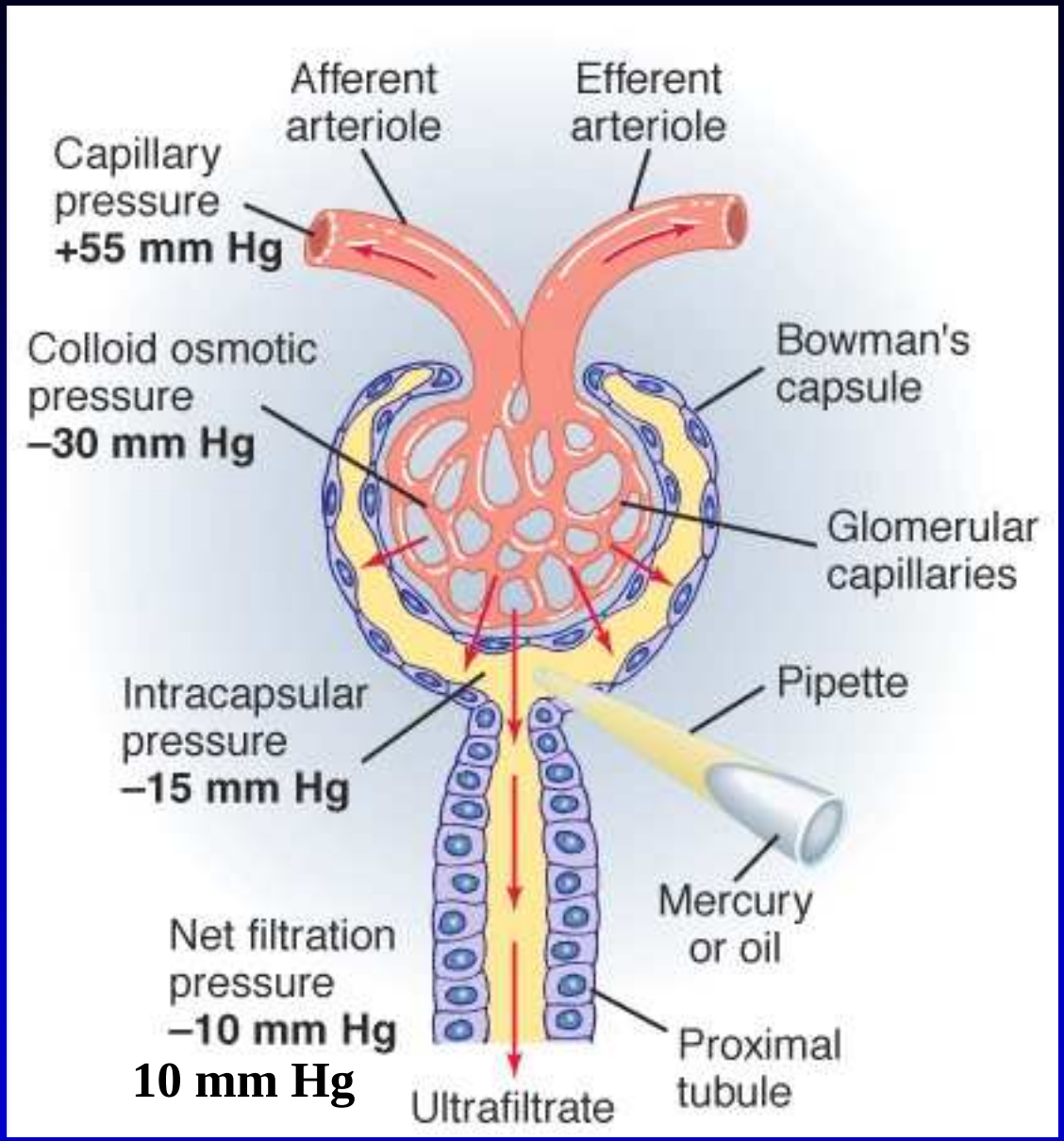

Bowman's capsule
Proximal tubule
Distal tubule
Loop of Henle
Collecting duct
(a) Cortical nephron
Bowman's capsule
Proximal tubule
Distal tubule
Loop of Henle
Collecting duct
(b) Juxtamedullary nephron
Renal cortex
Renal medulla


Endothelial-capsular Membrane
Parts of a Renal Corpuscle
Bowman's capsule
glomerulus
1 of 5

Four Processes of the Nephron




Short, wide afferent arteriole = Low-resistance input pathway
Filtration
Filtrate
Bowman's capsule
Glomerulus
Flow controlled by vasoconstriction of afferent arteriole
Efferent arteriole plus vasa recta = High-resistance outflow pathway


Afferent arteriole
Efferent arteriole
Capillary pressure
+55 mm Hg
Colloid osmotic pressure
–30 mm Hg
Bowman's capsule
Glomerular capillaries
Intracapsular pressure
–15 mm Hg
Pipette
Mercury or oil
Net filtration pressure
–10 mm Hg
Proximal tubule
Ultrafiltrate

10 mm Hg

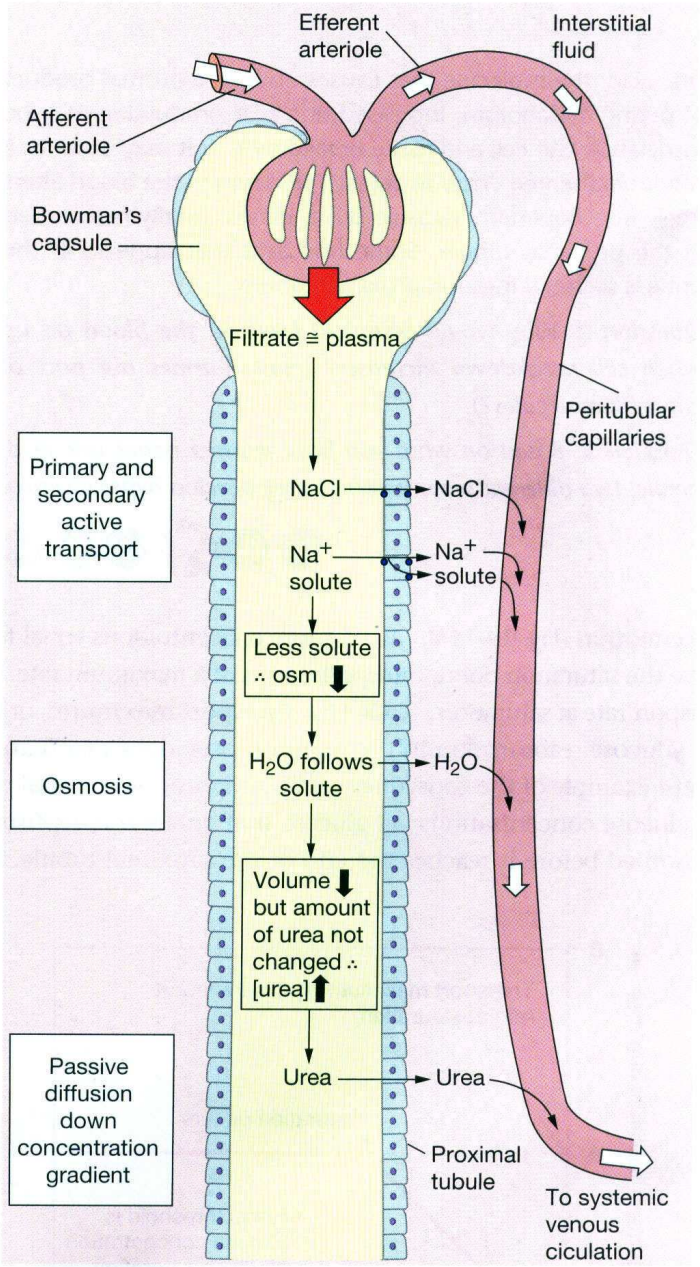
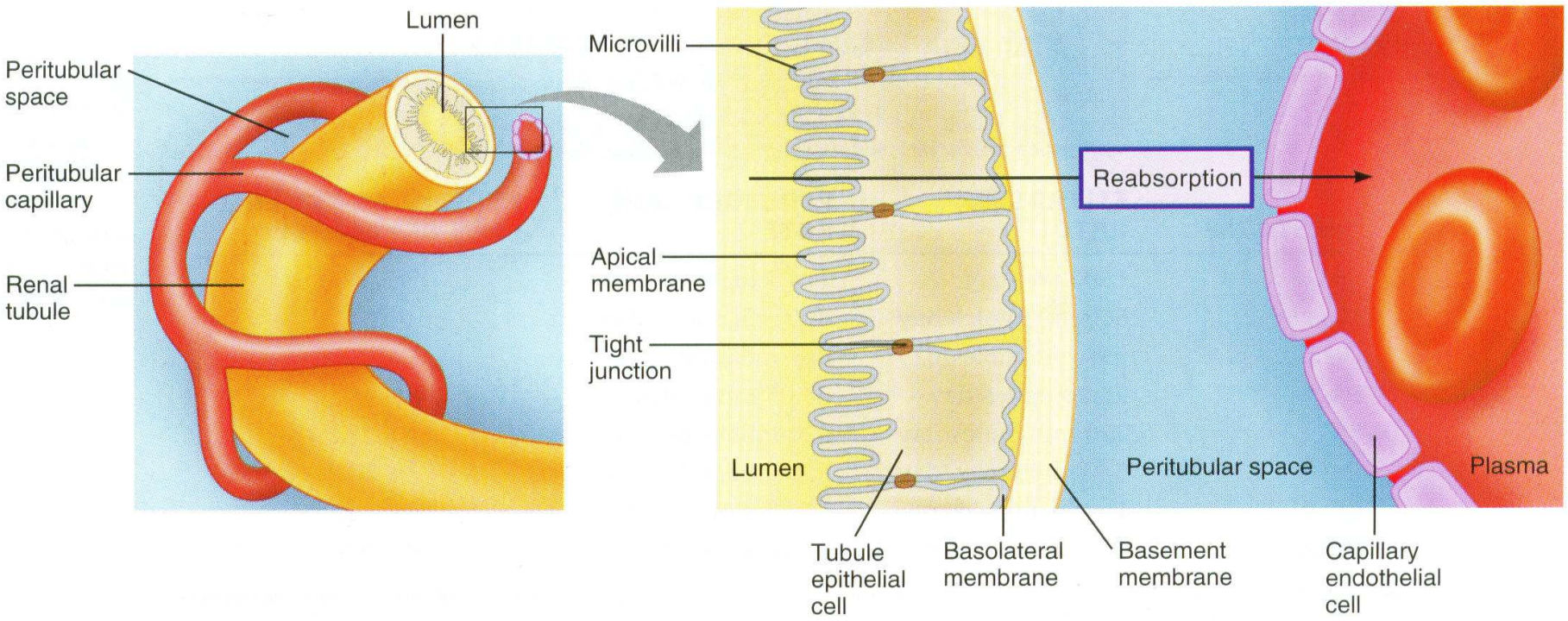
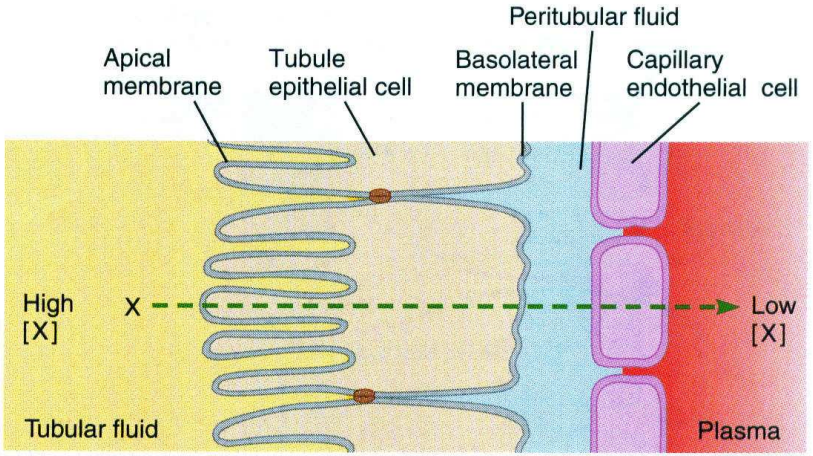


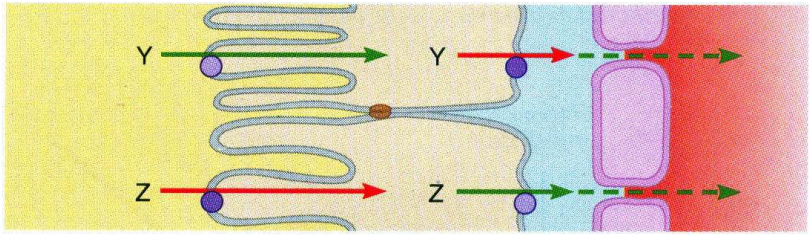
Figure 19-13 *Passive reabsorption of urea in the proximal tubule*

GFR = 125 ml/min

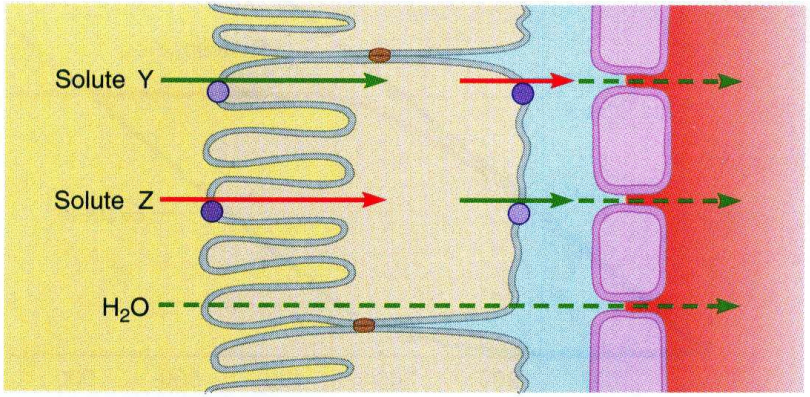

Lumen
Peritubular space
Peritubular capillary
Renal tubule
Microvilli
Reabsorption
Apical membrane
Tight junction
Lumen
Peritubular space
Plasma
Tubule epithelial cell
Basolateral membrane
Basement membrane
Capillary endothelial cell



(a) Passive solute reabsorption via diffusion



(b) Active solute reabsorption



(c) Water reabsorption (passive)