

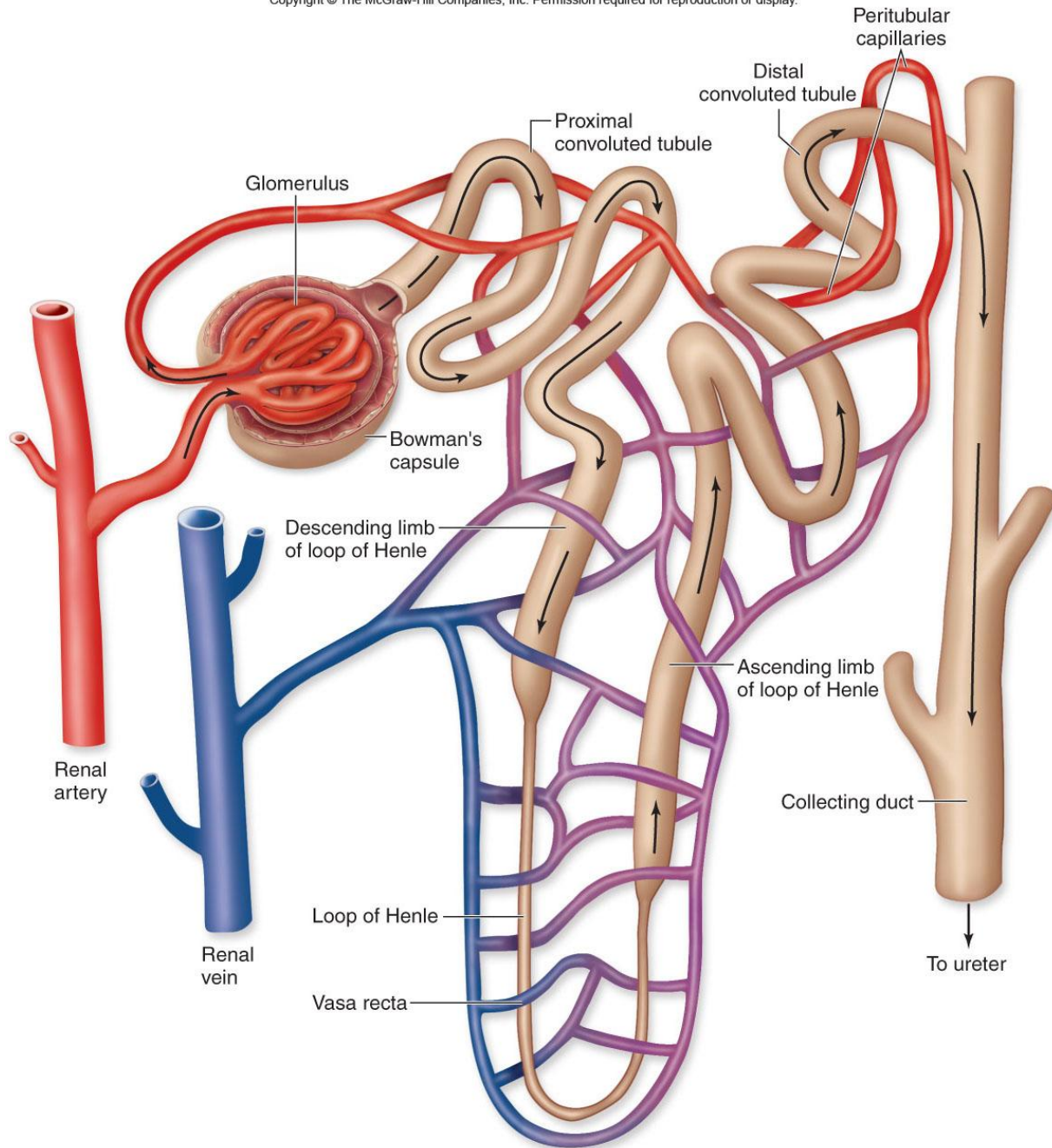
The Mammalian Kidney

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After leaving the loop, the fluid is delivered to a **distal convoluted tubule** in the cortex

- Drains into a **collecting duct**

- Merges with other collecting ducts to empty its contents, now called urine, into the renal pelvis



Reabsorption and Secretion

Most of the water and dissolved solutes that enter the glomerular filtrate must be returned to the blood by reabsorption

- Water is reabsorbed by the proximal convoluted tubule

- Reabsorption of glucose and amino acids is driven by active transport carriers

Secretion of waste products involves transport across capillary membranes and kidney tubules into the filtrate

Excretion

A major function of the kidney is elimination of a variety of potentially harmful substances that animals eat and drink

-In addition, urine contains nitrogenous wastes, and may contain excess K^+ , H^+ and other ions that are removed from blood

Kidneys are critically involved in maintaining homeostasis

Transport in the Nephron

- A mechanism is needed to create an osmotic gradient between the glomerular filtrate and the blood, to allow reabsorption of water
- Virtually all nutrient molecules in the filtrate, and two-thirds of the NaCl and water, are reabsorbed by proximal convoluted tubule
 - Active transport of Na^+ out of proximal tubule is followed by passive movement of K^+ and water

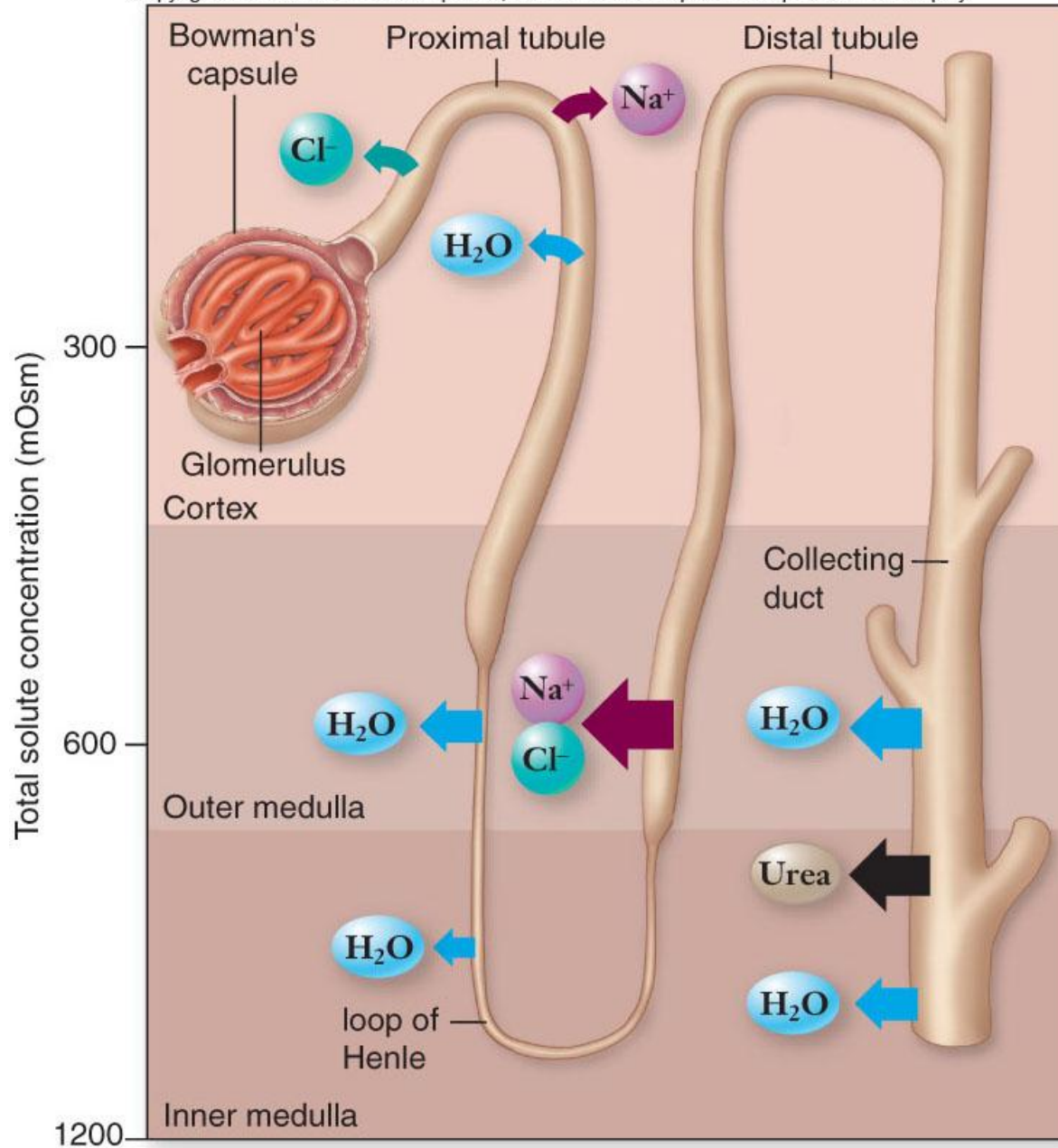
Transport in the Nephron

The function of the loop of Henle is to create a gradient of increasing osmolarity from the cortex to the medulla

- Active extrusion of NaCl from the ascending loop creates an osmotic gradient

 - Allows reabsorption of water from descending loop and collecting duct

- The two limbs of the loop form a **countercurrent multiplier system**, that creates a hypertonic renal medulla



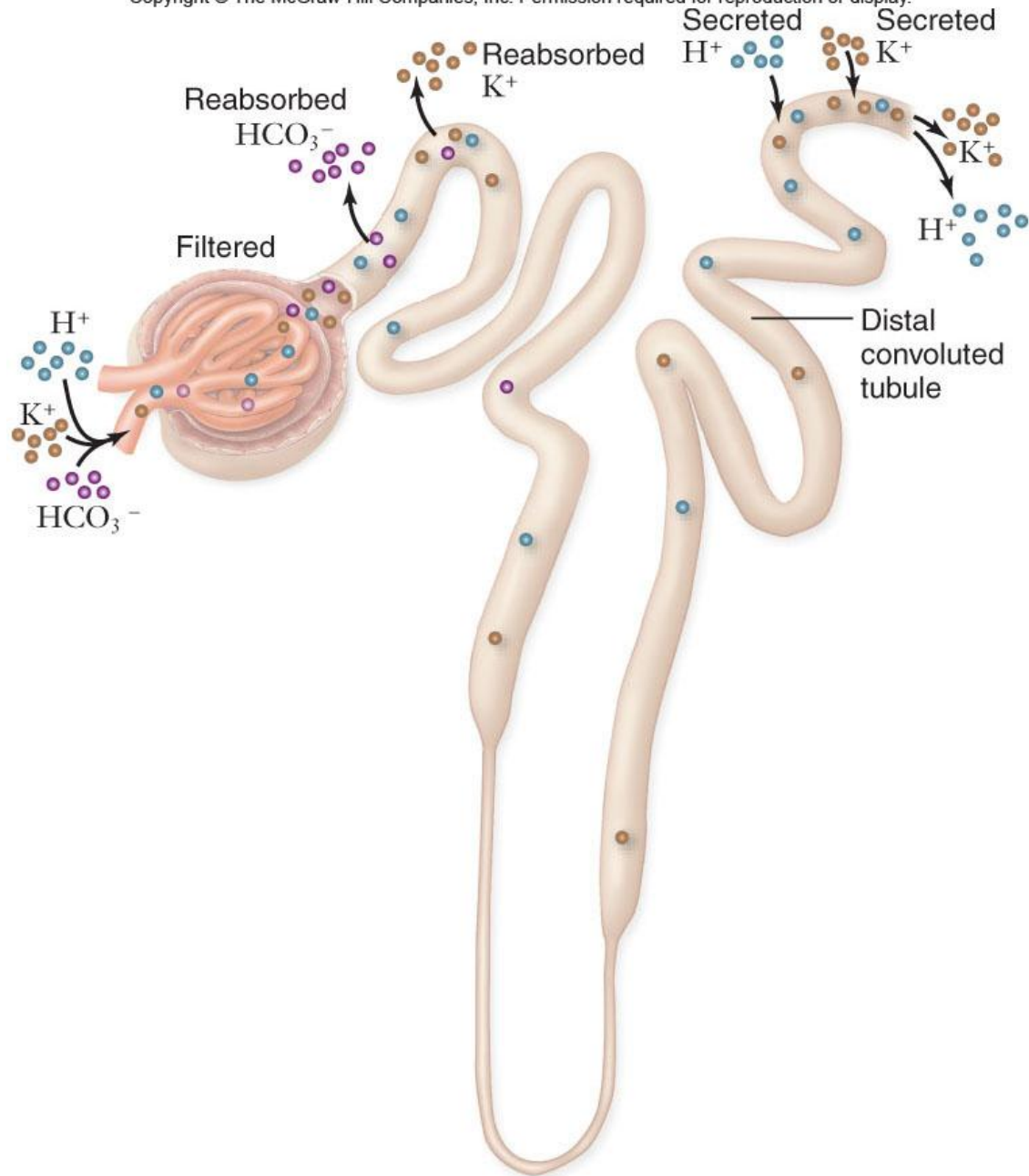
Transport in the Nephron

Filtrate that reaches distal convoluted tubule and enters the collecting duct is hypotonic

-The hypertonic interstitial fluid of the renal medulla pulls water out of the collecting duct and into the surrounding blood vessels

Kidneys also regulate electrolyte balance in the blood by reabsorption and secretion

-K⁺, H⁺, and HCO₃⁻



Hormones Control Osmoregulation

Kidneys maintain relatively constant levels of blood volume, pressure, and osmolarity

-Also regulate the plasma K^+ and Na^+ concentrations and blood pH within narrow limits

-These homeostatic functions of kidneys are coordinated primarily by hormones

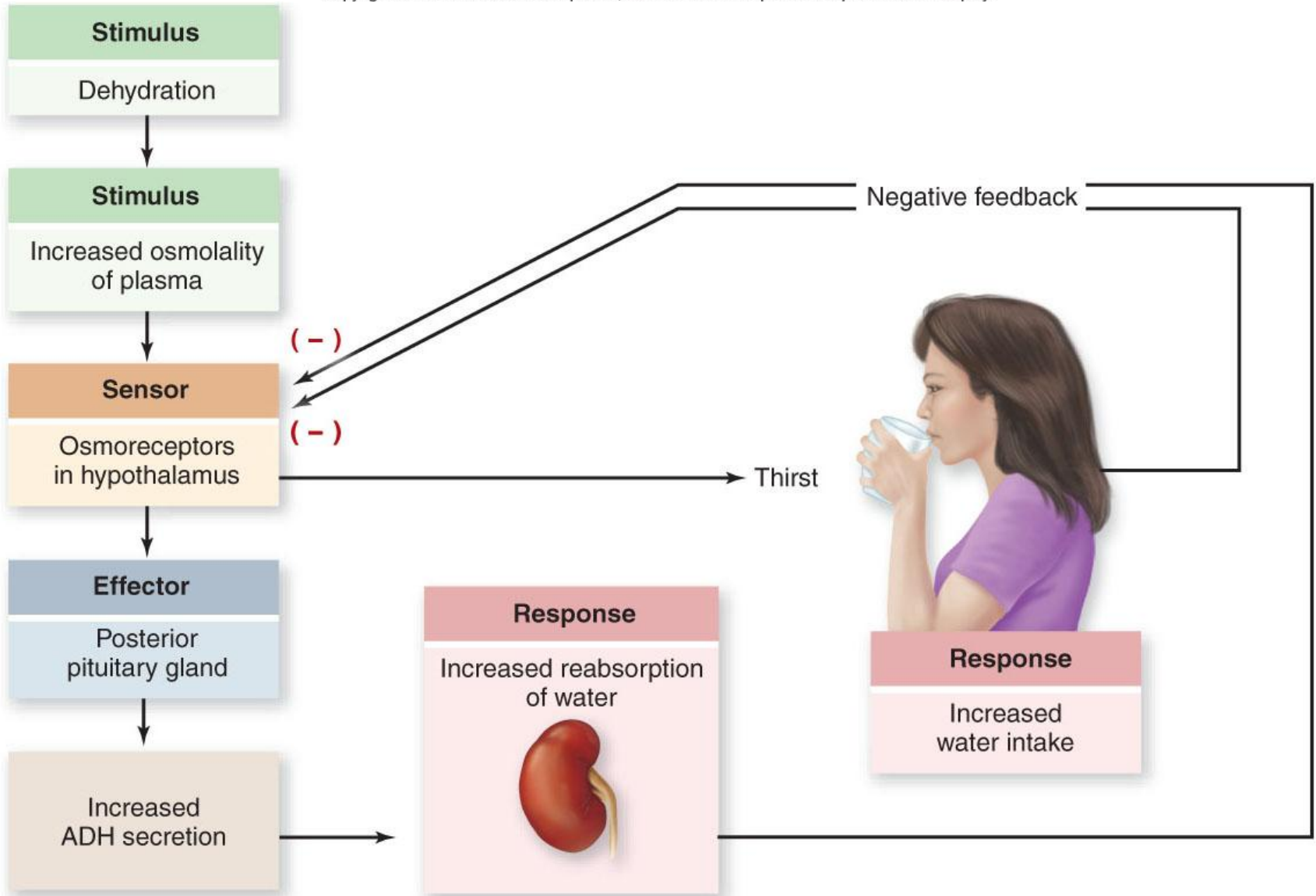
Hormones Control Osmoregulation

Antidiuretic hormone (ADH) is produced by the hypothalamus and secreted by the posterior pituitary gland

- Stimulated by an increase in the osmolarity of blood

- Causes walls of distal tubule and collecting ducts to become more permeable to water

- Increases reabsorption of water



Hormones Control Osmoregulation

Aldosterone is secreted by the adrenal cortex

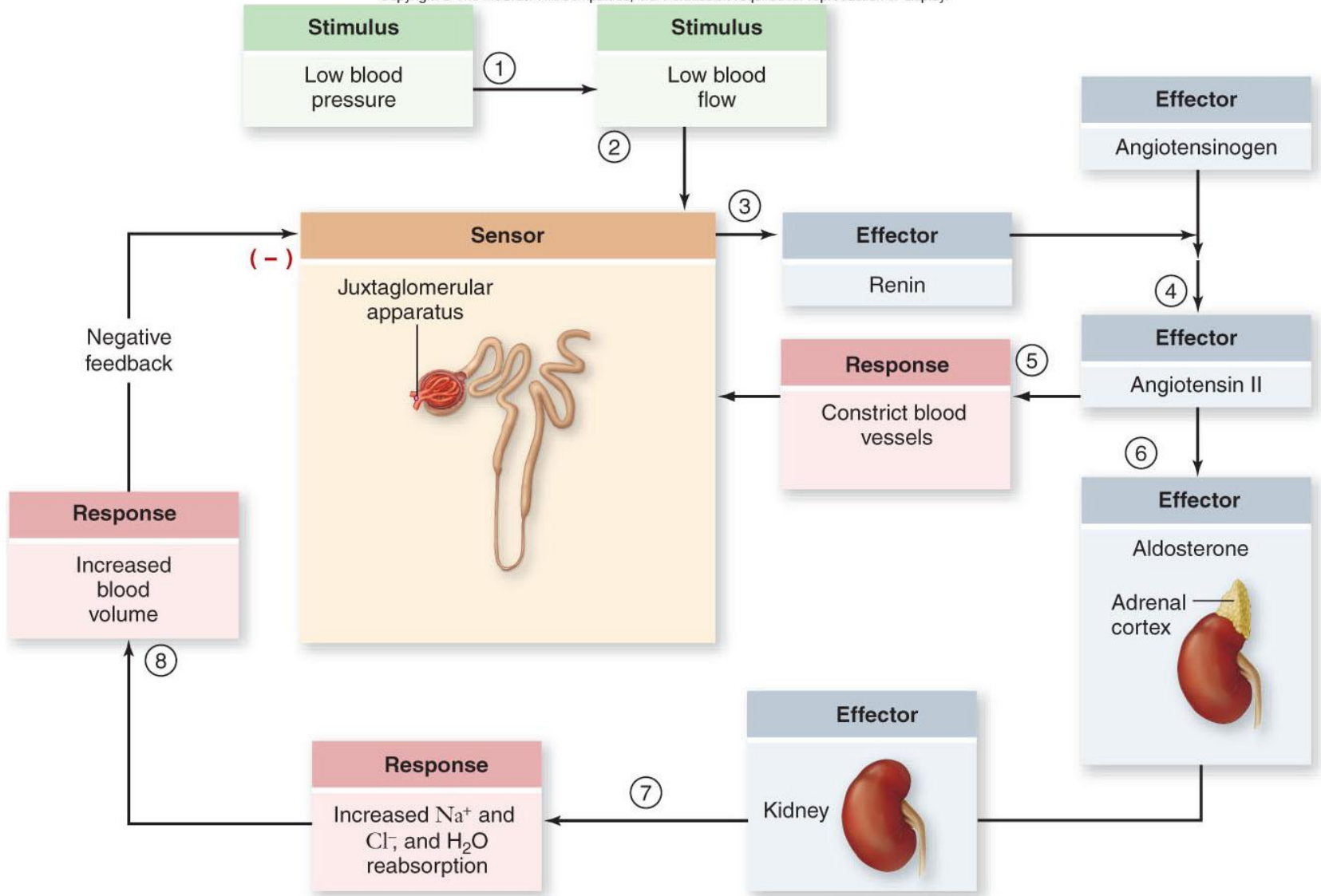
- Stimulated by low levels of Na^+ the blood

 - Causes distal tubule and collecting ducts to reabsorb Na^+

 - Reabsorption of Cl^- and water follows

Low levels of Na^+ the blood are accompanied by a decrease in blood volume

- Renin-angiotensin-aldosterone system is activated



Hormones Control Osmoregulation

Atrial natriuretic hormone opposes the action of aldosterone in promoting salt and water retention

- Secreted by the right atrium of the heart in response to an increased blood volume

- Promotes the excretion of salt and water in the urine and lowering blood volume