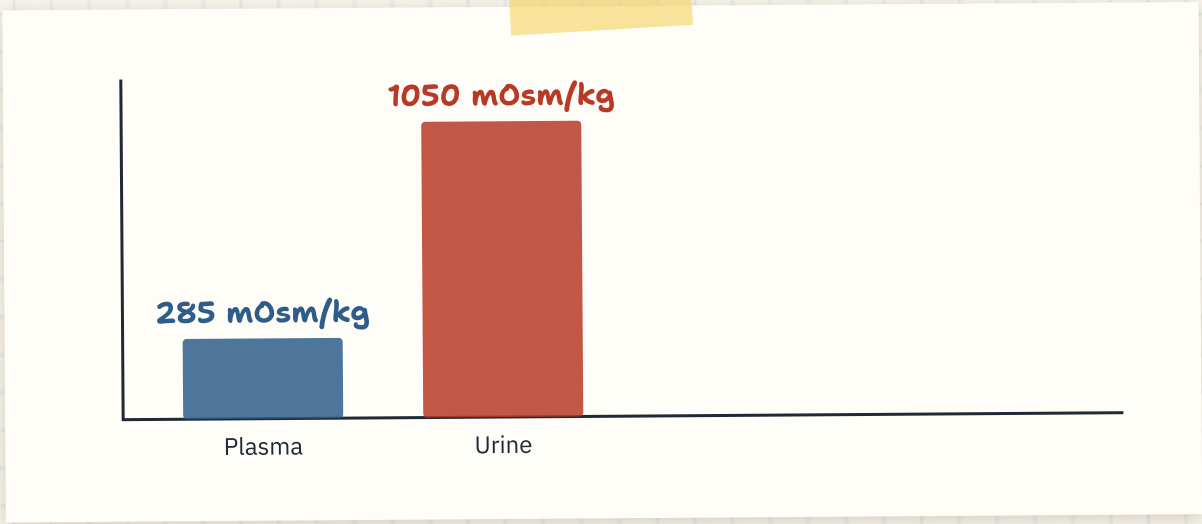
Countercurrent multiplier in one page

Single effect, urea, vasa recta and ADH



Step by step

1. Fluid enters the loop at about 300 mOsm/kg
2. Thick ascending limb pumps NaCl without water
3. Descending limb equilibrates with the interstitium
4. Flow carries it round the bend: repeat
5. ADH lets the collecting duct use the gradient

Structure	Role in the gradient
Thick ascending limb	NKCC2 pumps NaCl, waterproof: single effect about 200
Thin descending limb	Water leaves via aquaporin 1; fluid matches interstitium
Loop of Henle (flow)	Repeats the single effect: tip toward about 1200
Inner medullary collecting duct	ADH raises urea permeability; urea deepens medulla
Vasa recta	Countercurrent exchange preserves the gradient
Collecting duct (ADH)	Aquaporin 2: water leaves into salty medulla

Who does what in the medulla

Rule of thumb

Pump, equilibrate, flow, repeat

Cortex about 300, tip up to about 1200 mOsm/kg

Exam traps

- ! High ADH cannot concentrate urine if the gradient is blunted.
- ! The thick ascending limb is waterproof; the descending limb is not.
- ! The vasa recta preserve the gradient; they do not create it.
- ! Loop diuretics block NKCC2, shrinking the single effect.

Countercurrent multiplier: how the kidney concentrates urine

Video, written lesson, practice question and sources: medservatory.com/usmle-step-1/renal-physiology/countercurrent-multiplier-urine-concentration

For exam study only, not medical advice. Follow local guidelines and your lab's ranges.
© 2026 Medservatory, a project of ADMR Solutions Ltd. Free to print and share for personal study.