Achievable

USMLE STEP 1 DUMP SHEET

Renal and gastrointestinal physiology

GI hormones

Hormone	Released by	Main actions
Gastrin	Protein, distension	↑ acid, mucosal growth
CCK	Protein, fat	Enzymes, bile; slows emptying
Secretin	Acid, fatty acids	Pancreatic HCO_3^-; ↓ acid
GIP	Oral glucose	↑ insulin (incretin)
GLP-1	Glucose, fat	↑ insulin, ↓ glucagon, satiety
Somatostatin	Low luminal pH	Inhibits hormones, acid
Motilin	Fasting	Migrating motor complexes
Ghrelin	Fasting	Appetite, ↑ GH

Gastric acid

- **Parietal:** HCl, intrinsic factor. **Chief:** pepsinogen. **G cells:** gastrin
- **ACh** (M3) and **gastrin** (CCK-B): Gq, Ca^{2+}. **Histamine** (H2): Gs, cAMP. Together they potentiate
- **Gastrin** also releases histamine from ECL cells. **Somatostatin** (Gi) inhibits
- **H+/K+ ATPase** apical; HCO_3^- to blood: postmeal alkaline tide
- **Zollinger-Ellison:** gastrin over 10× normal; secretin ↑ gastrin

Secretions and bile

- **Saliva:** hypotonic; K^+, HCO_3^- above plasma, Na^+, Cl^- below. Faster flow: closer to plasma
- **Pancreatic juice:** faster flow → ↑ HCO_3^-, ↓ Cl^-. Enteropeptidase activates trypsin
- **Bile acids:** cholic, chenodeoxycholic (→ deoxycholic, lithocholic); conjugated to glycine, taurine
- **Bilirubin:** albumin → UDP-glucuronyl transferase → bile → urobilinogen; urobilin (urine), stercobilin (brown feces)

Absorption

- **Glucose, galactose:** SGLT1 (Na^+) in, GLUT2 out. **Fructose:** GLUT5 in, GLUT2 out
- **Duodenum:** iron, Ca^{2+}. **Jejunum:** most sugar, protein. **Terminal ileum:** bile salts, B12
- **B12:** R protein → freed by pancreatic proteases → intrinsic factor → ileum → transcobalamin II
- **Iron:** Fe^{3+} → Fe^{2+}; DMT1 in, ferroportin out. **Hepcidin** blocks ferroportin (↑ iron, inflammation)
- **Fat:** micelles → chylomicrons → lacteals (lymph)

Motility

- **Slow waves** (cells of Cajal): 3/min stomach, 12/min duodenum
- **Contract:** ACh, substance P. **Relax:** NO, VIP

Filtration and clearance

- GFR $= K_f[(P_{GC} - P_{BS}) - (\pi_{GC} - \pi_{BS})]$; $\pi_{BS} \approx 0$
- **Clearance** $C_x = U_x V / P_x$: inulin = GFR
- **PAH** = effective RPF; $\text{RBF} = \text{RPF}/(1 - \text{Hct})$; $\text{FF} = \text{GFR}/\text{RPF} \approx 20\%$
- **Creatinine** clearance overestimates GFR. **Alport:** COL4A3—5

Renal blood flow

- **Sympathetic:** constricts both, afferent more. **PGE2, PGI2:** dilate
- **Angiotensin II:** low dose efferent (↑ GFR); high dose both
- **Macula densa:** ↑ NaCl → adenosine → afferent constricts

Tubule segments

Segment	Transport	Notes
PCT	70% Na^+, glucose, HCO_3^-	PTH ↓ PO_4
Thick limb	NKCC; Mg^{2+}, Ca^{2+} paracellular	Loop diuretics
Early DCT	NaCl; Ca^{2+} (PTH)	Thiazides
Principal cell	ENaC Na^+, K^+ out; AQP2	Aldosterone, ADH
α-intercalated	H^+ out, K^+ in	H+/K+ ATPase

- **Glucose:** threshold 200 mg/dL, Tm about 375 mg/min. **Probenecid** blocks PAH, penicillin secretion
- **Liddle:** ENaC gain: hypertension, ↓ K^+, ↓ aldosterone
- **K+ into cells:** insulin, β2 agonists, alkalosis. **Out:** acidosis, digoxin, cell lysis

Concentrating urine

- **Medulla** to 1200 mOsm/kg: thick limb NaCl, urea (ADH)
- **Thick limb, early DCT** dilute; ADH concentrates
- **Free water clearance:** + no ADH; − with ADH; 0 loop diuretics

Body fluids

- **60-40-20:** % of weight in TBW, ICF, ECF; plasma ¼ of ECF
- **Markers:** TBW D_2O; ECF inulin; plasma Evans blue
- **Osmolarity** $\approx 2[Na^+] + \text{glucose}/18 + \text{BUN}/2.8$

Change	Example	ECF	ICF
Isosmotic loss	Diarrhea, burns	↓	=
Hyperosmotic loss	Sweating, DI	↓	↓
Hyposmotic loss	Adrenal insufficiency	↓	↑
Isosmotic gain	Isotonic saline	↑	=
Hyposmotic gain	SIADH	↑	↑
Hyperosmotic gain	High salt intake	↑	↓