Urinary System
Excretion and pH Balance
Gross Anatomy of the Urinary System
Blood Supply to the Kidneys

- Abdominal aorta
- Suprarenal vein
- Renal artery
- Renal pelvis
- Renal column
- Calyx
- Renal pyramid
- Papilla
- Medulla
- Cortex
Macroscopic Anatomy of the Kidney (coronal section)

Name the epithelium that lines the renal pelvis.

Why is there so much adipose tissue around the kidneys and ureters?
Renal Circulation

Which blood vessels are involved in transport between the blood and urinary filtrate? Do you see them in this figure?
Renal Pyramid

- Nephron
- Renal cortex
- Collecting duct
- Papilla
- Minor calyx
- Renal medulla
Are both types of neurons involved in urine formation? How does their function differ?
Juxtamedullary Nephrons

FLOW OF FLUID THROUGH A JUXTAMEDULLARY NEPHRON

Glomerular (Bowman's) capsule → Proximal convoluted tubule → Descending limb of the loop of Henle → Thin ascending limb of the loop of Henle → Thick ascending limb of the loop of Henle → Distal convoluted tubule (drains into collecting duct)

Renal capsule → Distal convoluted tubule → Renal corpuscle:
- Glomerular (Bowman's) capsule
- Glomerulus
- Afferent arteriole
- Efferent arteriole
- Interlobular artery
- Interlobular vein
- Arcuate vein
- Arcuate artery
- Corticomedullary junction
- Collecting duct
- Loop of Henle:
  - Descending limb
  - Thick ascending limb
  - Thin ascending limb

Vasa recta → Papillary duct

Renal papilla → Minor calyx → Urine

(b) Juxtamedullary nephron and vascular supply
The Renal Corpuscle:
Glomerulus + Bowman's Capsule

How do the arterioles regulate the rate of filtration in the glomerulus?

Name the specialization for transport visible here.
Overview: the 3 phases of urine formation

Explain why the functional unit of the kidney is best described as more than just the nephron.

For each phase, describe the 1) location along the nephron, 2) the mechanism(s) of transport, and 3) the net direction of movement.
Filtration: the first phase in urine formation

Briefly compare the composition of blood plasma and of urinary filtrate as it enters the proximal convoluted tubule.
Tubular Reabsorption: the second phase in urine formation

Describe the features of cells in the proximal convoluted tubule that make them well suited for selective transport.

What solute is excreted by this mechanism?

What is obligatory water reabsorption? Where and why does this occur?
Tubular Reabsorption of Glucose

In which direction does $Na^+$ leave the cell? Why?

In which direction does $Na^+$ enter the cell? Why?

In which direction does glucose enter the cell? Why?

In which direction does glucose leave the cell? Why?

What other solutes are selectively reabsorbed by similar means?
Tubular Secretion: the third (and last) phase in urine formation

What is the normal pH range of urine?

What is the advantage of using this enzyme-catalyzed reaction to generate $H^+$?

What is the net direction for the movement of materials by tubular secretion? Is this the same direction as in filtration at the renal corpuscle?

What other solutes are secreted this way? Why?
Countercurrent Mechanism

What is the primary purpose of this mechanism?
Homeostatic Mechanism involving ADH to Regulate Water Balance

Is this obligatory or facultative water reabsorption?

What two types of changes result in increased osmolarity of body fluids, and so would stimulate ADH release?
Renin-Angiotensin-Aldosterone System
Review:

- Filtration
- Reabsorption
- Secretion
Acidosis and Alkalosis

Increased concentration of H^+ → pH drops → Acidosis

pH scale: 7.4

Increased concentration of H^+ → pH rises → Alkalosis

Loss of acids → Accumulation of bases → Decreased concentration of H^+
Principle Causes of pH Imbalance

What are the two major classifications of pH imbalance based on cause?

Which of these is more likely to occur?

What is your first line of defense against pH changes?

Figure 26-6 Metabolic pH. Normal pH ranges from 7.35 to 7.45. Alkalosis exists at pH values greater than 7.45 and acidosis exists at pH values less than 7.35.
Acids Produced as a Result of Normal Metabolism

Write the chemical equation for the production of carbonic acid.

Under what circumstances does the body use fats for energy?
Which of these chemical buffer systems operates in the blood plasma?

Which of these physiological mechanisms is only a “temporary fix”...which one is permanent? Explain.
Urinary System—Interconnections

Integumentary System
The urinary system compensates for water loss due to sweating. The kidneys and skin both play a role in vitamin D production.

Cardiovascular System
The urinary system controls blood volume. Blood volume and blood pressure play a role in determining water and solute excretion.

Skeletal System
The kidneys and bone tissue work together to control plasma calcium levels.

Lymphatic System
The kidneys control extracellular fluid volume and composition (including lymph).

Muscular System
Muscle tissue controls urine elimination from the bladder.

Digestive System
The kidneys compensate for fluids lost by the digestive system.

Nervous System
The nervous system influences urine production and elimination.

Respiratory System
The kidneys and the lungs work together to control the pH of the internal environment.

Endocrine System
The endocrine system influences urine production.

Reproductive System
The urinary system in males shares common organs with the reproductive system. The kidneys compensate for fluids lost from the male and female reproductive systems.

URINARY SYSTEM
The urinary system controls the composition of the internal environment.