

## Chapt. 44 – Osmoregulation & Excretion, pp. 931-939 & selected figures

An organism's **excretory system** helps regulate the chemical composition of the body's principal fluid (blood, coelomic fluid, or hemolymph)

The excretory system selectively removes excess water and wastes from the principal fluid

Breakdown of proteins and nucleic acids produces **ammonia** (a toxin) [Fig. 44.8]

Many aquatic organisms excrete **ammonia**, since it can be effectively diluted with water

Mammalian livers convert ammonia into **urea**, which is much less toxic, and requires less water to excrete

Birds, reptiles, and some other organisms convert ammonia into **uric acid**, which is relatively nontoxic, and can be excreted as a semisolid without much water loss

Vertebrate Excretory Systems [Fig. 44.13]

Key functions: **Filtration, Reabsorption, Secretion, & Excretion** [Fig. 44.9]

Blood enters the **kidneys** via the **renal arteries** and leaves via the **renal veins**

**Urine** (excess water and wastes removed from the blood) is produced by the kidneys and is conveyed to the **urinary bladder** via the **ureters**

Urine exits the body via the **urethra**

Each kidney is divided into a **cortex, medulla, and pelvis**

Each kidney processes about 1000 L of blood per day!

**Nephrons** = the functional units of the kidneys;

Packed into the renal cortex and medulla

Each kidney has ~ 1 million nephrons

A nephron consists of:

a ball of capillaries known as a **glomerulus**

an **afferent arteriole** that leads into the glomerulus, and an **efferent arteriole** that leads out of the glomerulus

**Bowman's capsule**, that surrounds the glomerulus and extends into the **proximal tubule, loop of Henle, and distal tubule**

**capillaries** that surround the **tubules** and **loop of Henle**, and that feed into **venules** returning to the **renal vein**

Nephron function

**Filtration** occurs in **Bowman's capsules**: cells and large molecules remain in the blood, while blood pressure forces water and small molecules from the blood into **Bowman's capsules**

Selective **reabsorption** returns important nutrients (glucose, *etc.*) to the blood, and occurs especially in **proximal** and **distal tubules** [Fig. 44.14]

Selective **secretion** adds additional waste molecules to the filtrate, especially in the **tubules**

Reabsorption of water occurs along the **tubules, loop of Henle, and collecting duct** [Fig. 44.15]

The **descending loop of Henle** is permeable to water, but not very permeable to salt (*e.g.*, NaCl)

The **ascending loop of Henle** is not permeable to water, but it is to NaCl

High concentration of NaCl outside the nephron deep in the kidneys helps concentrate urine in the collecting duct

Mammalian excretory systems are adapted to diverse environments

Mammals that live in environments with plenty of water have short loops of Henle that cannot produce concentrated urine

Mammals that live in very dry environments have very long loops of Henle that can produce highly concentrated urine

## Chapt. 45 – Hormones & the Endocrine System

The **endocrine system** = postal system for the body

**Hormones** are the **chemical messages** that:

Maintain **internal homeostatic conditions**

Regulate **growth, development & differentiation** [often **irreversible**]

Regulate aspects of **behavior** [generally **reversible**]

**Hormone-secreting organs** are called **endocrine glands**, because they secrete their chemical messengers directly into body fluids

In contrast, **exocrine glands** secrete their products into **ducts**; glands that secrete sweat, mucus, digestive enzymes, and milk are **exocrine glands**

Since **hormones** circulate to ALL cells, how do they act at only specific sites?

Only cells with correct **receptors (target cells)** respond to hormones

The **target cell** response is idiosyncratic (*i.e.*, it depends on the type of cell) [Fig. 45.4]

**Hormones** exhibit a diversity of structure and function

**Peptides, proteins, glycoproteins, amines, steroids**

**Table 45.1** [Read through it, but you do not need to memorize it]

**Surface Receptors** [Fig. 45.3]

Most **amino acid-based hormones** are water soluble and target **surface receptors**

A **signal-transduction pathway** is a series of molecular changes that converts an extracellular chemical signal to a specific intracellular response

**Intracellular Receptors** [Fig. 45.3]

Most **steroid hormones** are lipid soluble and target **intracellular receptors**

An **intracellular receptor** usually performs the entire task of **transducing** the signal within the cell

In almost all cases, this is a **transcription factor**, and the response is a change in **gene expression**

Major endocrine organs and glands: [See Fig. 45.5]

## **Hypothalamus-Pituitary Complex**

The **hypothalamus** receives nervous input from throughout the body

The **hypothalamus** contains two sets of **neurosecretory cells** whose **hormonal secretions** are stored in or regulate the **pituitary gland**

The **posterior pituitary** stores and secretes two **hormones** made by the **hypothalamus**

The **anterior pituitary** consists of **endocrine cells** that synthesize and secrete at least 6 different **hormones**

The **hypothalamus-posterior pituitary** provides an example of a simple **neurohormone pathway** [Fig. 45.2b]

The **hypothalamus-anterior pituitary** provides an example of a simple **neuroendocrine pathway** [Fig. 45.2c]

**Pancreas** – regulates blood glucose

**Exocrine function**

Digestive secretions released into pancreatic duct to small intestines

**Endocrine function**

**Islets of Langerhans – endocrine cells**

**Insulin & glucagon** are **antagonistic hormones**

**Insulin** – decreases blood glucose

Stimulates uptake by cells – cells use it or store it as fat and glycogen

An example of a simple endocrine pathway [Fig. 45.2a]

**Glucagon** – increases blood glucose

Stimulates release by cells – breakdown of fat and glycogen

**Diabetes mellitus (all forms)**

Results from defects in the production, release or response to insulin

Hormone-like **regulators** appear to be produced by all the body's cells...

These chemical messengers affect target cells adjacent to or near their point of secretion and can act very rapidly; the process is known as **paracrine signaling**

The same hormones are found across diverse taxa

*E.g.*, Insulin is found in bacteria, fungi, protists, *etc.*

*E.g.*, Thyroxin is found in many vertebrates; increases metabolism in humans & controls metamorphosis in amphibians