Osmolarity and Osmotic Balance

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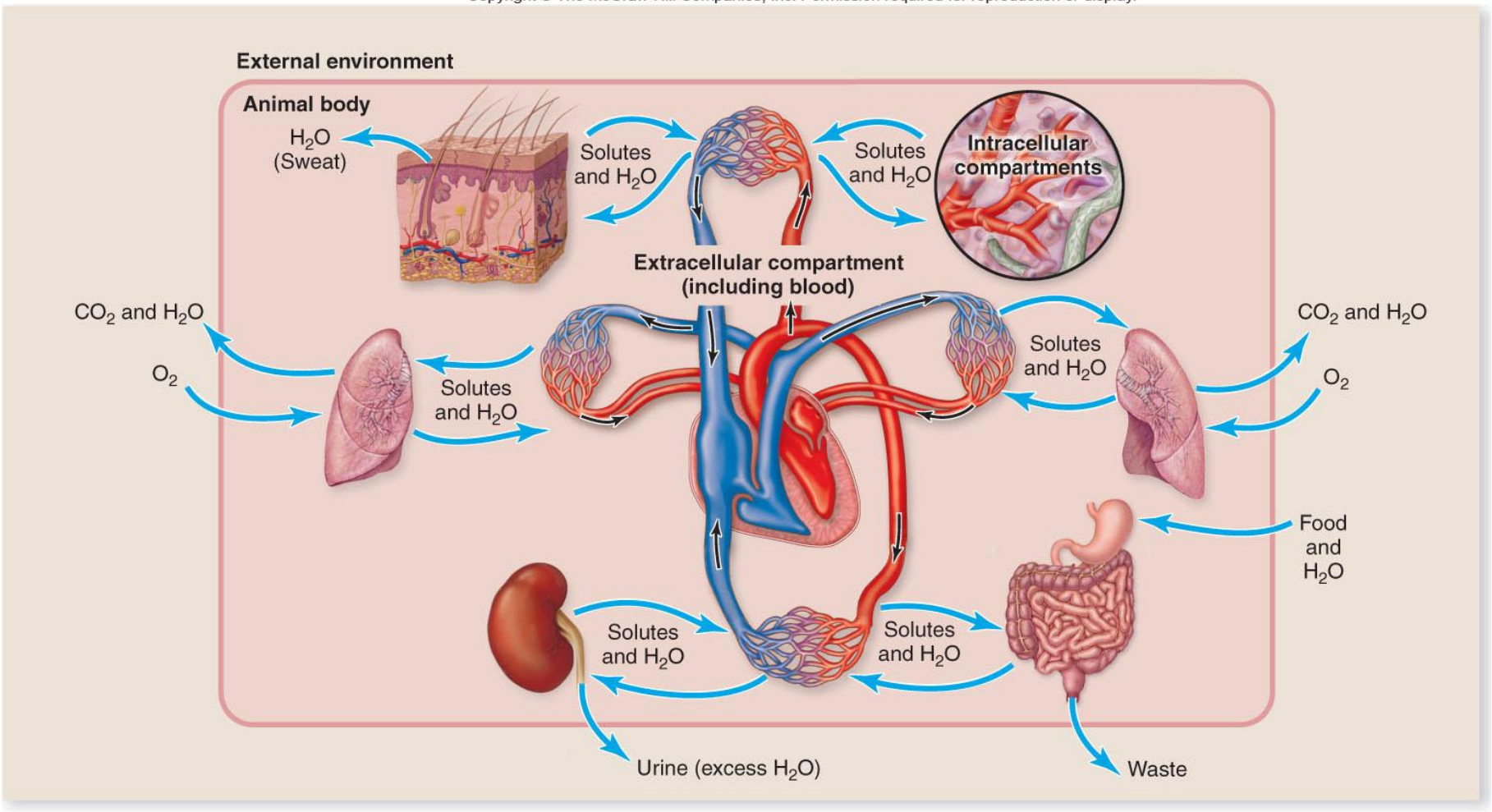
To maintain osmotic balance, the extracellular compartment of an animal's body must be able to take water from and excrete excess water into the environment

-Inorganic ions must also be exchanged to maintain homeostasis

-These exchanges occur across specialized epithelial cells, and, in most vertebrates, through the kidney



Osmolarity and Osmotic Balance

Osmotic pressure is the measure of a solution's tendency to take in water by osmosis

Osmolarity is the number of osmotically active moles of solute per liter of solution

Tonicity is the measure of a solution's ability to change the volume of a cell by osmosis

-Solutions may be **hypertonic**, **hypotonic**, or **isotonic**

Osmolarity and Osmotic Balance

Osmoconformers are organisms that are in osmotic equilibrium with their environment

-Include most marine invertebrates, and cartilaginous fish (sharks and relatives)

All other vertebrates are **osmoregulators**

-Maintain a relatively constant blood osmolarity despite different concentrations in their environment

Osmolarity and Osmotic Balance

Freshwater vertebrates are hypertonic to their environment

-Have adapted to prevent water from entering their bodies, and to actively transport ions back into their bodies

Marine vertebrates are hypotonic to their environment

-Have adapted to retain water by drinking seawater and eliminating the excess ions through kidneys and gills

Osmoregulatory Organs

In many animals, removal of water or salts is coupled with removal of metabolic wastes through the excretory system

A variety of mechanisms have evolved to accomplish this osmoregulatory function.

Osmoregulatory Organs

Insects use **Malpighian tubules**, which are extensions of the digestive tract

-Waste molecules and K^+ are secreted into tubules by active transport

-Create an osmotic gradient that draws water into the tubules by osmosis

-Most of the water and K^+ is then reabsorbed into the open circulatory system through hindgut epithelium

Osmoregulatory Organs

The **kidneys** of vertebrates consist of thousands of repeating units, **nephrons**

-Create a tubular fluid by filtering the blood under pressure through the glomerulus

-Filtrate contains many small molecules, in addition to water and waste products

-Most of these molecules and water are reabsorbed into the blood

-Waste products are eliminated from the body in the form of urine