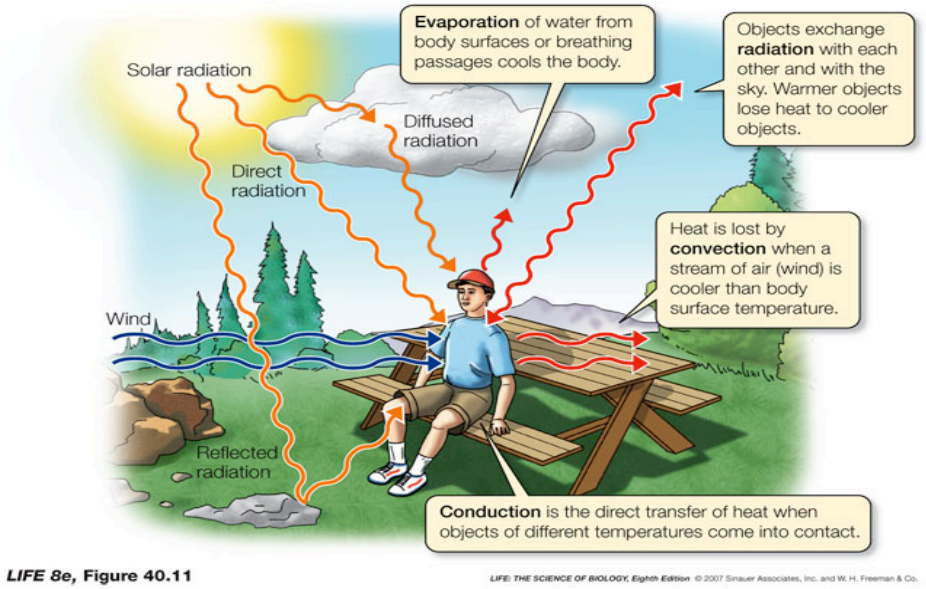
Thermoregulation

Most animals that live on land need to regulate their body temperatures in order to survive and promote the maximum efficiency of their enzymes. The process of managing temperature is called thermoregulation. **Thermoregulation** is defined as the regulation of heat in an animal, usually keeping it within a specific range. Generally, there are two different types of thermoregulators: endotherms and ectotherms. An **endotherm** is able to regulate its body temperature via metabolic processes, these are commonly known warm blooded animals. An **ectotherm**'s body temperature is dictated by the environment surrounding it, the animals are commonly and incorrectly known as cold blooded. Also amongst animals there are poikilotherms and homeotherms. **Poikilotherms** are animals that do not require a fixed body temperature, their temperatures can fluctuate with little to no adverse effects to their overall health. Most terrestrial ectotherm's are poikilotherms, such as snakes and many lizards, also the naked mole rat is considered to be the only mammal poikilotherm. **Homeotherms** are animals that maintain a constant body temperature. All endotherms are homeothermic, but some ectotherms, like desert lizards, are so good at maintaining their body temperature with behavioral means that they are considered homeothermic.

Thermoregulation: Managing Body Heat

When it comes to regulating body temperature, animals typically have four methods: radiation, conduction, convection, and evaporation. **Radiation** is heat gain or heat loss via radiation waves entering or leaving the body, particularly infrared waves. **Conduction** is the gain or loss of heat through direct contact with an object, for example, if a hot animal comes into contact with a cold rock, the rock will get warmer while the animal gets colder. **Convection** is heat gain or loss by moving air or water of a different temperature over the animal. **Evaporation** is heat loss caused by the endothermic reaction of water evaporating off of an organism; this is the only process that can only cool.



LIFE 8e, Figure 40.11

Osmoregulation: Salt Water Fish

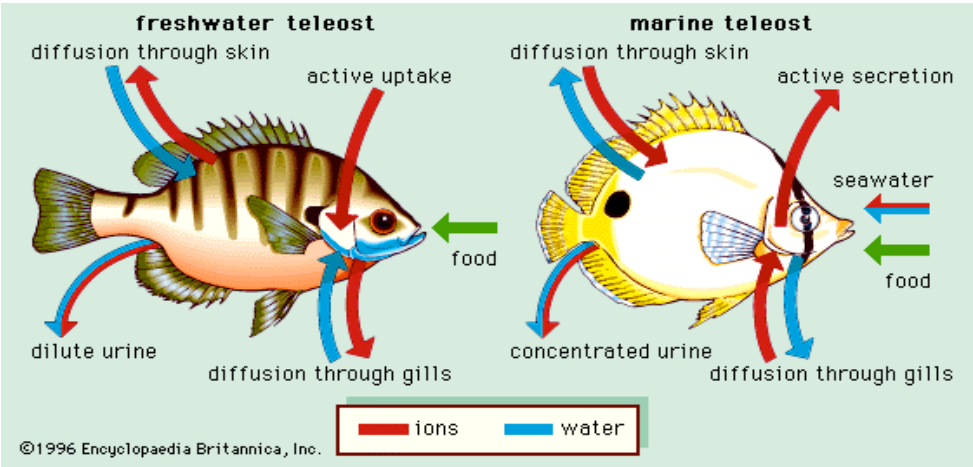
Most marine animals are osmoconformers. An **osmoconformer** is an organism that has the same solute concentration as their environment does, also known as being **isoosmotic**. Marine life loses water osmotically through their skin, so they maintain their osmolarity by taking in sea

water and salt ions through their mouth and food, then removing the salt ions via their gills and excreting small amounts of water through urine. Since these organisms are isoosmotic, if they are exposed to solute concentrations above or below the one they are used to, they will most likely die.

One type of marine animal that is not isoosmotic are Chondrichthyes (sharks, skates, and rays). Rather than having the same solute concentration as their environment, their solute concentration is higher than the ocean, this is called hypertonic. Their bodies hold high amounts of urea and Trimethylamine oxide (TMAO). This creates a concentration gradient between the body and ocean. With this gradient the animal gains water through osmosis, the water passes through the skin to enter the body. They gain salt ions from the food they consume and through the membrane over their gills. Excess ions are removed by the TMAO, which also helps protect the body from being damaged by the high concentrations of urea in the organism's system. The ions and TMAO are removed from the system by the rectal gland or by small amounts of urine.

Osmoregulation: Fresh Water Fish

Most fresh water fish are **osmoregulators**. This means that the fish has to actively control the salt content within its body in order to have the proper solute concentration to survive. These fish will take in fresh water, and lose solutes osmotically due to their surroundings. In order to counter this, fresh water fish release a large amount of diluted urine and uptake Cl- particles with their gills. Most fish are **stenohaline**, which means that they are only able to live in one type of environment, either fresh water or salt water. Some exceptions, like salmon, are **euryhaline**, which means they are able to tolerate both types of environments and can regulate their bodies accordingly.



Osmoregulation: Mammals

Land animals perform osmoregulation with their kidneys. They regulate the amount of fluids and ions the body must retain in order to maintain homeostasis. The kidney is composed of **nephrons**, which are the single most basic functional unit of the kidneys. The basic structures of the nephron are the glomerulus, proximal tubule, loop of henle, distal tubule, and the collecting duct. The **glomerulus** is a collection of capillaries that filtrate waste, ions, and fluids. The filtrate consists of ions and fluids. The proximal tubule, distal tube, and the loop of henle is where substances of the filtrate are either reabsorbed or kept as secretion. The **proximal tubule** is where the filtrate enters first; this is where ions and water are reabsorbed to remain in the body. The **loop of henle** is where sodium, chloride, and water are either reabsorbed or kept as secretion in the filtrate, this is known as countercurrent exchange because the direction and section in the

of the loop of henle where this occurs are different—(either in the ascending or descending limbs). The **distal tubule** is where the final products are either absorbed or secreted such as ammonia, chloride, and potassium ions. The amount of filtrate secreted and reabsorbed is dependent on the amount of anti-diuretic hormone (ADH) release from the posterior pituitary gland in the brain. The **collecting duct** is where the distal tubules of the nephrons combine and lead to the ureter, which connects to the urinary bladder for expulsion from the body; once the filtrate is in the collecting ducts it is considered pure waste—urine.

Sources

Campbell Biology

http://www.unm.edu/~lkravitz/Article%20folder/thermoregulation.html

Webster's Dictionary

Medical Dictionary