

	Osmoregulation	Excretory System	Thermoregulation
Marine invertebrate	Isosmotic to seawater, osmoconformer	Diffusion of ammonia through body wall	Ectothermic
Marine bony fish	Drink water to compensate for loss to hyperosmotic seawater, salt glands in gills pump out salt	Little urine excreted, ammonia diffuses out	Ectothermic, may have heat exchanger
Freshwater fish	Dilute urine to compensate for osmotic gain, may pump salts in through gills	Kidneys produce copious, dilute urine, ammonia lost across epithelium of gills	Ectothermic
Flatworm	Flame-cell system, dilute fluid excreted; protonephridia	Most wastes excreted into gastrovascular cavity	Ectothermic
Earthworm	Metanephridia, excrete dilute urine to offset osmosis from habitat	Metanephridia	Ectothermic, behavior responses
Insect	Malpighian tubules, salt pumped back and most water reabsorbed	Malpighian tubules, uric acid conserves water	Ectothermic, behavior responses
Reptile	Nephron in kidney, uric acid conserves water	Nephron in kidney, uric acid in most, related to shelled egg	Ectothermic, behavior responses
Bird	Nephron in kidney, nasal salt glands in sea birds, uric acid conserves water	Nephron in kidney, juxtamedullary nephron, uric acid related to shelled egg	Endothermic, high metabolism, pant, heat exchanger
Mammal	Nephron in kidney, concentration of urine related to habitat, hormonal, feedback control	Nephron in kidney, juxtamedullary nephron, urea	Endothermic, vasodilation and constriction, heat production, behavior responses

Environment	Osmoregulation	Nitrogenous Waste	Thermoregulation
Seawater	Most are osmoconformers, hypoosmotic fish lose water, drink sea water, secrete salt	Ammonia diffuses out easily into water, excreted by gills in fish	Stable environment mostly ectotherms, mammals have blubber, countercurrent
Freshwater	Animals are hyperosmotic, gain water, excrete large quantities of urine, ion uptake across gills in fish	Ammonia diffuses easily into water, exchanged across gills for $\text{Na}^+$ in fish	Fairly stable environment, mostly ectotherms
Terrestrial	Lose water by evaporation, drink, regulate water lost through excretion	Urea less toxic, needs less water to excrete, uric acid most concentrated, found in animals with shelled egg	Variable environment, behavioral adaptations if ectotherms, endotherms can maintain temperature and move rapidly