Kidney structure

EXCRETORY SYSTEMS C All work in the same basic way: Body fluid is filtered by a special organ. Selectively permeable membranes remove urea or uric acid. Osmolarity is controlled by selective reabsorption/secretion. C 5 types of excretory systems: None in porifera, cnidaria Protonephridia in planaria & rotifers Metanephridia in annelids Malpighian tubules in terrestrial arthropods Kidneys (with nephrons) in vertebrates Protonephridia Have flame bulbs, tubules, and nephridopores. C Flame bulbs selectively filter body fluid to nitrogenous waste. C Fluid collects in tubules and drips outside through the nephridopore. Metanephridia are found in annelids. C Nephrostomes collect and filter body fluid. C Waste concentrates inside the collecting tubules, which are wrapped by capillaries. Capillaries reabsorb water. C Concentrated waste drips down the tubules and outside the body via a nephridopore. C The bottom line: wash your hands after handling worms! Malpighian tubules are found in insects. C Malpighian tubules filter body fluid, collecting nitrogenous waste, salt and water. C Contents of the tubules are dumped into the intestines. C Intestine reabsorbs water, ions and nutrients. C Nitrogen wastes are eliminated along with feces - very efficient! KIDNEYS C Nephron is the functional unit. C Nephron spans the cortex and medulla. C Nephrons are wrapped by a capillary network. C Nutrients are returned to the bloodstream by active transport. C Water and salt are returned to the blood via the capillary network, in concentrations that preserve blood osmolarity. Pathway for urine: Blood vessels enter glomerulus Fluid is filtered into Bowman’s capsule. Fluid flows through: proximal tubule loop of Henle distal tubule collecting duct ureter Along the way, fluid volume decreases, salts and nutrients are returned to the bloodstream, [urea] increases. HOW A NEPHRON WORKS There is a very strong concentration gradient between the

nephron tubules and the kidney tissue. Low [salt and urea] in the cortex. High [salt and urea] in the medulla. Nephron tubules are selectively permeable, and different parts of the tubes are permeable to different substances. Osmosis and diffusion cause most of the water and salt retrieval. Energy is used for active transport of proteins and some salts back into the bloodstream. Efficiency rating: C 1, 000-2, 000 L of blood flow through kidneys each day. C Only about 1. 5 L of urine is made! C Blood is 300 mosm/L. C Urine can be up to 1, 200 mosm/L. Here’s what happens along the way, after fluid is filtered by the glomerulus and moves into the proximal tubule. The initial glomerular filtrate content is just like blood plasma. ÃŽ Proteins/nutrient/salt/buffer removed by active transport. H+ ions added to acidify urine. Ã€ Urine volume 9 in the descending Loop, due to water lost by osmosis. Because of water loss, [urine] 8 in the descending Loop. Ã€ Salt is reclaimed via active transport and diffusion in ascending Loop. This action temporarily 9the [urine]. Ã‘ In the distal tubule, water is lost via osmosis, and salt/buffers are removed by active transport. [Urine] 9 and so does the volume. Ã’ [Urine] 8 in collecting duct due to water loss via osmosis. NOTE: Water and salt loss in distal tubule and collecting duct are regulated by hormones aldosterone and ADH. Net result: Urine has MUCH LESS VOLUME and HIGHER [UREA] than the initial glomerular filtrate. RECAP of Nephron Activity and Urine Molarity: Glomerular Filtrate [Urine] is = blood plasma Urine volume high Distal tubule [Urine] = plasma Volume medium ºlow Hormones affect salt & water reabsorption in distal tubule and collecting duct [Urine] 8due to tubule permeability for water [Urine] 9 due to transport of salt Collecting Tubule [Urine] is high Urine volume is very low Bottom Loop of Henle [Urine] high, volume medium Study tool: re-label this from memory!