

Investigation

3.9B: Urinary Tract

The **kidneys** are part of the **urinary tract**, which is responsible for eliminating liquid waste and extra water filtered from our blood, without expelling the blood's red and white cells and platelets. Waste products are like trash; you take out the trash so it doesn't accumulate. The same is true for your body. The process of eliminating or retaining fluid waste also affects our **blood pressure**. Consider this: If your vascular system retains too much fluid it places an extra work load on the heart; your heart tries to pump everything that the veins return. If you have too little fluid retained in your blood vessels your blood pressure drops, reducing the blood flow to vital organs. In this case you might feel weak, perhaps even faint when you arise quickly to go play outside. To maintain the right amount of blood volume and blood pressure inside vessels the kidneys make a **hormone** that can **constrict** the **arteries**, keeping blood pressure from getting too low while the kidneys start returning water and salts filtered from the blood stream back into the veins that then leave the kidneys. So the kidneys regulate the volume of the vascular system and also the **resistance** to the flow of the blood which causes the blood pressure in arteries to climb upward.

The urinary tract includes your kidneys, **ureters**, **bladder**, and **urethra**.

Kidneys

In the medical world "**renal**" refers to anything related to the kidneys. **Renal failure** means the kidneys have stopped working. A **Renal biopsy** is a sample of kidney tissue. The kidneys get their blood supply from the **renal artery**. Blood leaves the kidneys thru the **renal veins**. Renal disease is a sickness related to the kidneys. Most people are born with two kidneys. Sometimes a generous person donates one kidney to someone else whose kidneys have both failed, giving them a second chance at life.

Once inside the kidney, the blood goes through a filtering process to remove waste products collected as the blood moves throughout the body. It works a little like a coffee filter, which prevents coffee grounds from slipping through to the coffee cup. The kidneys filter the blood so that all the blood cells, plus some of the large protein

molecules like albumen, stay inside blood vessels and leave the kidneys, less the waste products brought in by the arteries. Then the **nephrons** (tiny tubes lined with very clever cells that do the kidney's job) go to work on the fluid portion separated from the blood stream and pull out sugar, salt, potassium, a few other molecules, plus water if needed, and put those useful substances back into the blood stream in the concentrations the rest of our body likes to see. Each day an adult's two kidneys filter about 150 quarts of fluid (called **filtrate**) out of the blood stream, returning components we can still use back into the blood, and produces one to two quarts of urine depending upon how many beverages the individual enjoyed that day. Each kidney has around a million nephrons that do this complex filtering that eliminates waste but preserves the chemicals our body still needs. More than 99% of everything passing through the nephrons can return to the renal vein and go back into our circulation, especially if you are walking across a desert with no canteen of water. An infection in the nephrons can affect the kidney's ability to do this complex chemical sorting task. You can help keep your kidneys filtering efficiently by drinking six to eight glasses of water each day to keep your nephrons from getting clogged up with waste! On a very hot day when you are exercising, your body loses salts in sweat, so you might elect to drink a sports drink to replace those salts and help your kidneys keep everything in balance.

The collected waste filtered by the nephrons is urine, or pee. It drips into a tube connected at the other end to the **urinary bladder**. What makes pee go to the bladder? Gravity, of course. The kidneys are located at the level of the middle of your back on both sides while the bladder is located well below your belly button. Gravity makes the urine flow downhill to the bladder. What allows urine to travel to the bladder while you sleep, you ask? The ureter has smooth muscle cells in its walls that squeeze in a coordinated way to keep the pee moving in the right direction, even while you sleep (even if you sleep head down hanging from a trapeze... but don't try that).

Urine is constantly under production, yet thankfully we don't have to go pee all the time. We have a special place to store urine until we find a convenient time to visit a bathroom. The bladder is our urine storage tank. Our bladder enlarges like a balloon as it fills with urine; it also contracts in size as it empties during urination. Typically our bladder is about two inches in diameter, but has the ability to enlarge if needed to six inches in length, when we can't find a bathroom. We have stretch sensors in the bladder wall that tell us when we need to pee; this is known as the **micturition reflex**. Our

bladder has a **sphincter** that acts like a faucet; it opens to let urine out and closes to stop the flow. Sometimes due to illness or injury patients partially lose control of their

bladder sphincter and suffer leakage. Pampers for adults can treat this problem. Those who lose total bladder control can wear a **urinary catheter** and **urine bag**, which collects their urine outside of their body. Everyone must eliminate waste products one way or another.

When **urine** is released by relaxation of the bladder sphincter it is still inside our body. In order to reach the outside world urine must travel through the **urethra**, the final leg of the journey. The trip is longer for boys than girls, the shorter distance putting girls at greater risk of bacterial infections in that area. Sometimes the urethra becomes too narrow to allow a smooth flow of urine; this can make peeing a slow and sometimes painful process.

We cannot live without eliminating waste from our bloodstream. Our urinary tract constantly produces urine that we eliminate when we get the urge. Medical textbooks have long taught that urine coming from the kidney contains no bacteria. Recent research has found that urine itself is not **sterile** as it exits your body, but contains small amounts of bacteria that normally reside in the wall of the bladder. Significant amounts of bacteria in the urine still suggest an infection. Our urine is about 95% water, but also contains significant amounts of nitrogen containing compounds plus chloride, potassium, and other compounds. Where did all that **nitrogen** come from? What is the major component of the air we breathe in? Nitrogen, of course! However, the nitrogen in our urine came as a byproduct of the metabolism of the protein we eat to allow our body to repair itself and grow.

Urinary Tract

