

EDVOTEK® MyLab™ #1236

Blood Dialysis and Kidney Function

STORE AT ROOM TEMP.



Designed for the Classroom
SINCE 1987

1236.200810

OBJECTIVES

In this experiment students will dialyze simulated blood from normal and kidney disease patients. They will discover how healthy kidneys work, learn about different conditions that contribute to kidney diseases, and carry out three simulated diagnostic tests of their own.

COMPONENTS

This experiment contains reagents and disposables for three (3) experiments. All reagents are simulations.

- A Normal Patient Blood Sample
- B Kidney Patient 1 Blood Sample
- C Kidney Patient 2 Blood Sample
- Dialysis tubing
- Calibrated transfer pipet

REQUIREMENTS

- Three small beakers or jars (not larger than 250 mL size)
- Distilled or deionized water
- Scissors
- Ruler
- Timer or clock
- Paper towels
- String (optional)

WARNING: Choking hazard. Product may contain small parts.
Not appropriate for children under 5 years old.
No human or animal products are used in any experiments.

GENERAL SAFETY PRECAUTIONS

Parental or adult supervision required.

1. Designate a clean and uncluttered area for performing experiments.
2. Read all instructions before you begin.
3. Do not eat or drink. Do not apply make-up or contact lenses. Adult(s) should not smoke while performing experiments.
4. Wash your hands before and after performing the experiment.
5. Gloves and goggles should be worn routinely as good laboratory practice.
6. Disinfect the counter top or bench with 70% isopropyl alcohol (rubbing alcohol, or place clean newspaper over the area to be used.

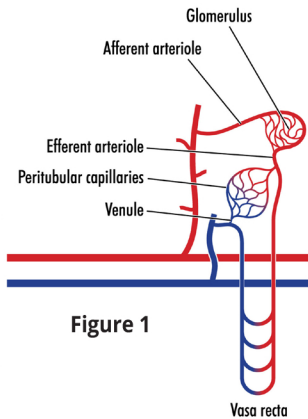
SAFETY PRECAUTIONS

The solutions can be disposed down the drain. All other materials can be disposed in regular solid waste (trash).

INTRODUCTION

Most people have two kidneys. These vital organs are bean-shaped, and the size of your fist. They are located near the middle of your back below your rib cage. Their main function is to get rid of waste and excess fluid. By filtering the blood, our kidneys allow us to retain certain chemicals, remove others, and maintain chemical balance. They also help the body regulate blood pressure.

When you eat or drink the foods and liquids that go into your body are digested and processed in your stomach and intestines. Next, nutrients and fluids are absorbed into your blood and travel to your cells where they are used as energy and molecular building blocks. However, there are also by-products and waste from cell metabolism that need to be reprocessed or discarded. One way your body gets rid of waste is by having the kidneys filter blood.



About 200 quarts of blood pass through the kidneys daily. Blood enters the kidneys through an artery. Inside the kidney, there are over a million filtering units called nephrons that include a glomerulus – a system of capillaries – that intertwines with a system of tiny tubules that collect waste (Figure 1). Chemical exchange between the capillaries and tubules takes place, and waste is transferred from the blood through the ureter and is then stored in the bladder as urine. After waste and excess fluids and chemicals are removed, the “cleaned” blood re-enters the system via the veins. Meanwhile, the urine eventually passes through the urethra and out of your body.

Without this system, cellular waste would accumulate to high levels and become toxic. This can happen when patients with diabetes, high blood pressure, or a history of substance abuse experience serious kidney damage. Other causes of kidney damage/disease are kidney stones, infections, and autoimmune diseases. Kidney damage can be hard to detect in its earliest stages but can quickly progress into a fatal condition. When the filtering units of the kidneys are not working properly, one of the symptoms is the presence of protein or blood in

INTRODUCTION, *continued*

the urine. Trace amounts of blood and protein can be easily detected by simple tests during routine health checkups or by over the counter tests. Other symptoms of chronic kidney disease are loss of appetite, fatigue, sleep problems, nausea, cramps, twitching, changes in urination frequency, swelling of the feet, chest pain, shortness of breath, high blood pressure, and even persistent itching.

Luckily kidneys are amazing organs. People can survive with only one kidney, and even if that one kidney is damaged up to 75%, the remaining tissue can still do the job. Unfortunately, there are times when the kidneys are permanently and completely damaged. This is called end-stage renal disease and patients must have artificial kidney treatment (dialysis) or have a kidney transplant to survive.

Patients with end-stage renal disease must undergo kidney dialysis to have their waste products removed. There are two types of dialysis: hemodialysis and peritoneal dialysis. In hemodialysis, the patient usually goes to a dialysis center to have their blood pass through an artificial kidney machine that filters their blood and removes waste. The waste-free blood is then returned to the patient. This process takes about 3 hours and must be done three times per week. In peritoneal dialysis, fluid (dialysate) is added to the patient's abdominal or peritoneal cavity. Waste products and extra fluids pass from the blood into the dialysate. After a couple of hours, the extra fluid is drained through a tube. This process is repeated four times a day or during sleep, and patients can do this at home.

One of the best ways to avoid kidney disease is to drink plenty of water. This will help prevent kidney stones. Another influential factor is diet. Consuming foods with lots of vitamins, minerals, and fiber and reducing the intake of fats, cholesterol, salt, and sugar can help prevent diabetes and high blood pressure. It also directly lessens the stress that your kidneys are under. Other important steps are to get plenty of exercise, maintain a proper weight, and not smoke.

In this experiment, you will see how kidneys work by recreating a kidney filtration system using dialysis tubing, simulated patient blood samples, and beakers. You will dialyze simulated blood from normal and kidney-diseased patients. Dialysis tubing filters molecules of different sizes. The tubing has very small pores that allow small molecules to pass through while retaining larger molecules. The fluid that moves out of the dialysis tubing and into the beaker represents the urine of your three patients. You will test for the presence of protein or blood in the urine of the three simulated patients by observing the final color of the solution in each beaker.

EXPERIMENTAL PROCEDURES

1. Cut the dialysis tubing into three 4-inch segments.
2. Soak the segments of dialysis tubing in a jar or beaker filled with distilled water for at least one hour.
3. Add 75 - 100 mL distilled or deionized water to three separate beakers or jars. Label "Normal", "P1", & "P2". These are the water baths.
4. Carefully tie a single knot at one end of all three dialysis tubing segments. Tie the knots as close to the ends as possible. You can also use string to tie the ends.
5. Fill the first dialysis tubing with 2 mL of the Normal Patient Sample. To do this:
 - a. Roll the untied end of the dialysis tubing between your thumb and pointer finger to open the end.
 - b. Squeeze the transfer pipet bulb and fill the tip to the 2 mL mark.
 - c. Gently insert the tip of the transfer pipet deep into the dialysis tubing and slowly transfer the sample into the tubing by applying gentle pressure to the bulb.
 - d. Remove any trapped air in the dialysis tube without displacing the sample.
 - e. Carefully tie the second knot at the open end of the tubing.
 - f. Rinse the filled-tied dialysis tube with water, especially near the tied ends and place the bag on a paper towel in front of the beaker labeled "Normal" (do the same for P1 & P2 when you fill those).
6. In a separate container, rinse the transfer pipet with water by repeatedly squeezing the bulb and flushing the pipet.
7. Repeat steps 5 and 6 for Patients 1 & 2. Quickly place all dialysis tubes in their respective water baths.
8. Monitor the three dialysis water baths every 5 minutes or so, taking notes as to any changes in the color of the water outside the dialysis bag. Allow the bags to soak for up to 30 minutes.
9. After you have recorded your results, you can cut or untie dialysis tubing, empty, and rinse well to reuse for another experimental trial.

EXPERIMENTAL PROCEDURES, *continued*

	Normal	Patient 1	Patient 2
Color at 5 min.			
Color at 10 min.			
Color at 15 min.			

STUDY QUESTIONS

1. What are the functions of kidneys?
2. What are the functional units within kidneys that provide their unique functions?
3. What is Diabetes?
4. How long does it take for all the blood in the body to pass through the artificial kidney dialysis machine?
5. How do you keep your kidneys healthy?

RESULTS

Normal Patient Sample:

Yellow. In normal patients where their kidneys are functioning properly, the blood would filter properly, and the end result would be blood free urine.

Kidney Patient 1:

Orange-ish. In patients with kidney disease, the nephrons ability to filter the blood is compromised and there might be blood in the urine. This patient has kidney disease, since the urine is tinged with simulated blood.

Kidney Patient 2:

Pink-ish. This patient has kidneys that are not functioning. Blood is able to pass directly into the urine.

TERMS AND CONDITIONS

- FOB: Washington, DC
- Safety Data Sheets are available on our web site and by request.

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ANSWERS TO STUDY QUESTIONS

1. Kidneys have several functions; they include: getting rid of waste and excess fluid, filtering the blood, maintaining chemical balance, and regulating blood pressure.
2. Nephrons – filtering unit. Glomerulus – a system of capillaries. Tubules – tiny tubes that collect waste. Ureter – transfer waste & excess fluids (urine) to bladder.
3. Diabetes is a condition where a person cannot use or breakdown glucose. They either do not produce insulin, the hormone necessary to breakdown glucose, or do not produce enough insulin.
4. The process takes about 3 hours and must be done three times per week.
5. It is recommended that you drink plenty of water. This will help prevent kidney stones. Eat a healthy balanced diet that have lots of vitamins, minerals and fiber, and reduce your intake of fats, cholesterol, salt and sugar.