



A Kidney Problem?

Teacher information

Summary:

Students analyze simulated urine samples to determine if the patient's symptoms might be caused by kidney disease. Students model normal kidney function and propose an explanation for the presence of protein and red blood cells in the patient's urine.

Core concepts:

- To maintain homeostasis the internal environment must be kept stable - within normal limits that are favorable for cell activities.
- The components of the human body interact to maintain a balanced internal environment. To successfully accomplish this, organisms possess a diversity of control mechanisms that detect deviations and make corrective actions.
- If there is a disruption in any human system, there may be a corresponding imbalance in homeostasis.
- The processes of diffusion and active transport are important in the movement of materials into and out of the cell.
- Homeostasis in an organism is constantly threatened. Failure to respond effectively can result in disease or death.
- Disease may be caused by inheritance, toxic substances, poor nutrition, organ malfunction, and some personal behavior. Some effects show up right away; others may not show up for years.
- A failure to take corrective action to restore systems to normal range can result in disease or even death.

Class time required:

Two 40-minute class periods

Teacher preparation:

Each student will need

- 1 copy of *A Kidney Problem?*
- 1 color copy of the *Instructions for Urine Testing* (Consider laminating this for reuse)
- 1 color copy of the *Circulatory and Excretory System Interaction* diagram sheet (Consider laminating this for reuse)

Each team of students will need

- A 2 mL microtube or small test tube filled with pH 12 buffer or a 5% dilution of colorless household ammonia that has been colored with a small amount of yellow food coloring. Label this tube “Patient Urine”
- A small plastic bag that contains 1 strip of EMD pH 0 -14 pH paper (Order from VWR: Catalog # EM-9590-1, Colorpast pH Test strips Universal Range 0-14, EMD Chemicals. Pack of 100 strips is approximately \$17.00. <http://vwrlabshop.com/colorbphbast-ph-test-strips-emd-chemicals/p/0011566/>)
- 3 oz. plastic cup labeled “Blood in Renal Artery Entering the Kidney”
- 3 oz. plastic cup labeled “Blood in Renal Vein Leaving the Kidney”
- 10 oz. low form plastic cup or small plastic bowl labeled “Nephron”
- 1 screen, large enough to fit over the “Nephron” (approx 5 X 5 inches) with large openings that allow the small beads, but not the large beads, to pass through freely. Latch hook fabric, mesh anti-slip rug mats, or light weight deer fence work well for this. Test the screen to be certain small beads pass through and large beads do not.
- 3 plastic spoons - green, blue, and white. Label green spoon “Amino Acid Transport Protein”. Label blue spoon “Glucose Transport Protein”. Label white spoon “Salt Transport Protein”.
- 1 small plastic bag labeled “Blood Components” that contains approximately the amounts of these beads. Beads can purchased at a local craft store or ordered from www.consumercrafts.com (see chart below for catalog number).

Large Beads (will not pass through screen)	12mm transparent red faceted beads, catalog # 06119-3-T19 (simulates red blood cells)	3-4 beads
	15mm white berry beads, catalog # 03906-3-202AB (simulates white blood cells)	3-4 beads
	12mm transparent green starflakes, catalog # 06508-7-T12 (simulates protein)	3-4 beads
Small Beads (will pass through screen)	4mm white faceted bead, catalog # 06122-7-02 (simulates salt)	15-20 beads
	4mm green faceted bead, catalog # 06122-7-T12 (simulates amino acids)	15-20 beads
	4mm dark sapphire faceted bead, catalog # 06122-7-T24 (simulates glucose)	15-20 beads
	4mm yellow faceted bead, catalog # 06122-7-T3 (simulates urine)	15-20 beads

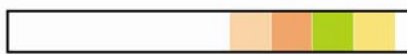
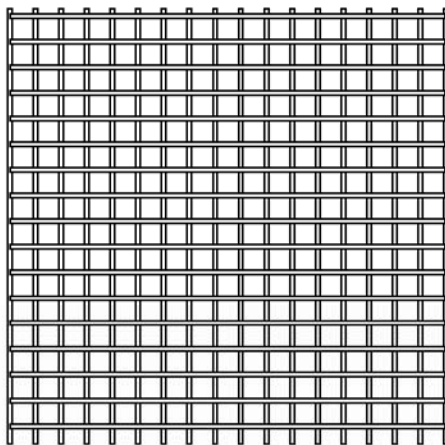
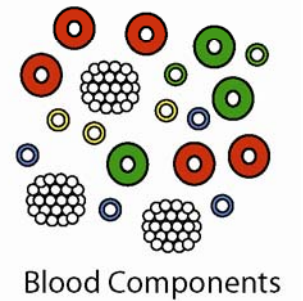
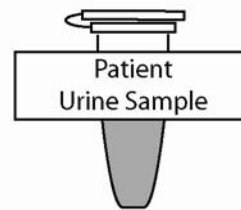
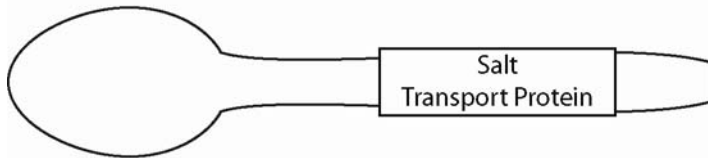
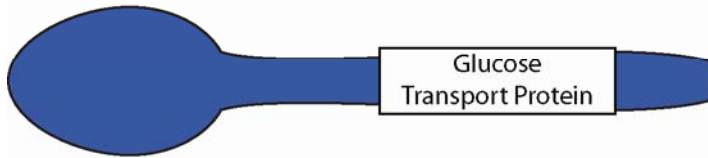
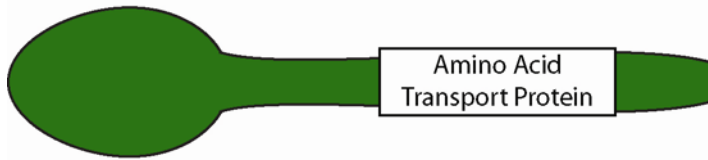
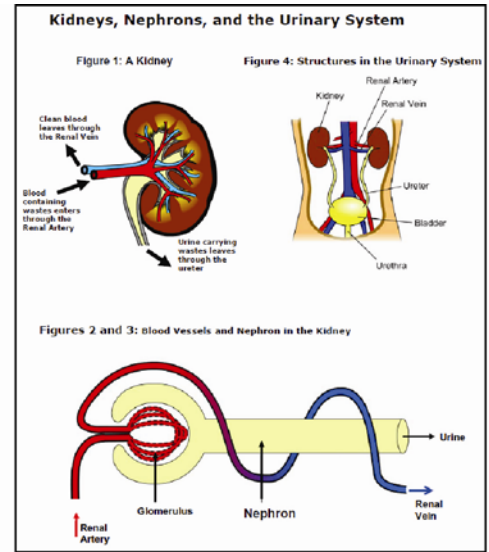
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Quick Guide:

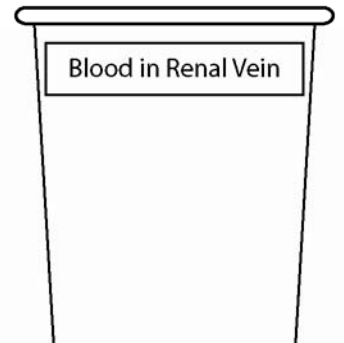
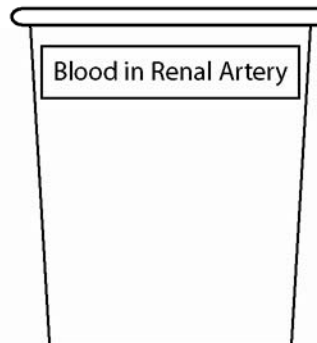
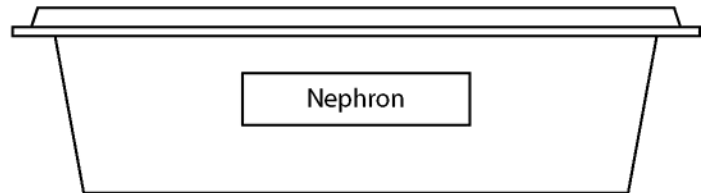
Instructions for Urine Testing

1. Dip the test strip (for 1 second) into the tube containing the urine sample.
2. Immediately compare the color of the test strip to the strips shown on the right.
3. Record whether the levels of each substance (Ketones, Blood, Protein, and Glucose) are NORMAL or HIGH.

	NORMAL	HIGH
Ketones		
Blood		
Protein		
Glucose		



Urine Test Strip

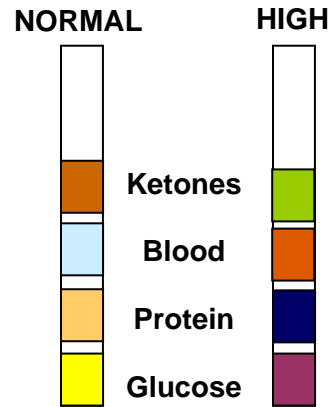


During Class:

1. Group students into lab teams of 2-4 students.
2. *Distribute to each student: A Kidney Problem, color Instructions for Urine Testing, and color graphics Kidney, Nephrons and the Urinary System.*
3. Read *The Case* and *Part 1: Your Task* aloud to the entire class.
4. Students work with their team members to complete Part 1. Because reading the information and instructions is very important for this activity, you should suggest that students in a team take turns being “readers” and “doers.”
5. Read *The Case* and *Your Task* for Part 2.
6. Students work with their team members to complete Part 2. Because reading the information and instructions is very important for this activity, you should suggest that students in a team take turns being “readers” and “doers.”
7. Optional follow-up: If students have access computers, consider having them use the interactive animation of kidney function at <http://www.biologymad.com/resources/kidney.swf>. This tutorial/animation reviews basic urinary structure and function. Students can click on different types of molecules and watch what happens they go through the kidney nephron.

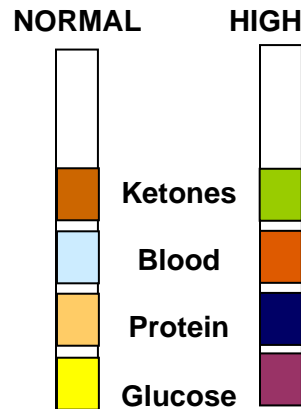
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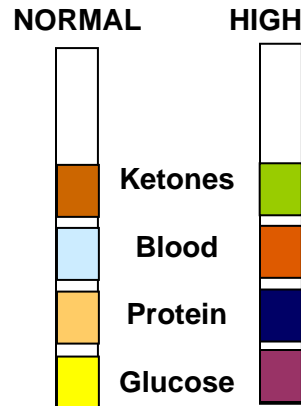
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Kidneys, Nephrons, and the Urinary System

Figure 1: A Kidney

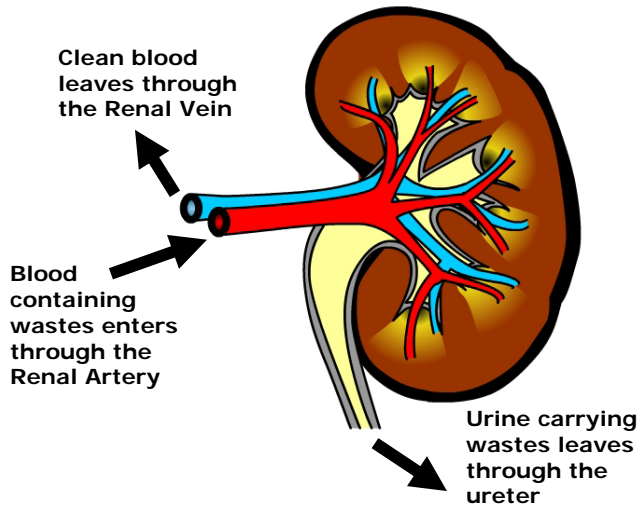
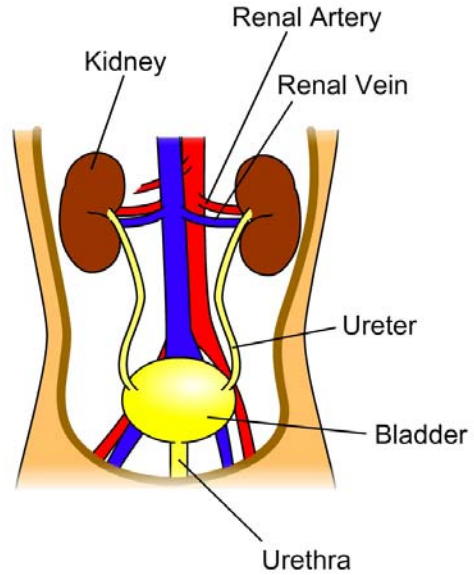


Figure 4: Structures in the Urinary System



Figures 2 and 3: Blood Vessels and Nephron in the Kidney

