

Activity 3.4.5: Urinalysis

Introduction

We have explored the functions of the urinary system and investigated not only the system’s power to conserve and regulate the water, but also to rid the body of harmful wastes. Because the processes of filtration, reabsorption and secretion in the nephron have set results, abnormalities in the urine that is produced often provide clues to dysfunction in the body. You probably never think about analyzing your urine. You may have been told by a coach or a trainer to check the color of your urine, or even smell your urine to gauge your level of hydration, but that is as far as it goes. Surprisingly, changes in your urine often point to disorders in other body systems. The color, clarity, and composition of your urine tell a story about overall health.

Some of the most helpful medical interventions are interventions that predict or diagnose disease. These *diagnostic tests* help medical professionals target the early stages of illness and begin treatment. One of these diagnostic tests, urinalysis, can unlock the clues hidden in urine. You have studied the normal composition of urine. Now take a look at the composition of urine when the body is in distress.

In this activity, you will investigate patient case studies and test the simulated urine of four different patients. You will apply what you have learned about how the kidneys function and maintain homeostasis as you analyze the urine samples. Think about which substances are filtered back into the blood and which are excreted in urine. You will use the data collected from the urinalysis to research possible health conditions and to diagnose the patients. Think about how malfunctions in body systems (other than the urinary system) can be identified through noticeable changes in the composition of urine.

Equipment

* Computer with Internet access and presentation software
* Urinalysis presentation
* Simulated urine samples in clear disposable cups
* Urine test strips
* Paper towels
* Disposable 1 mL pipettes
* Laboratory journal
* Career journal
* Activity 3.4.4 Student Data Sheet
* Microscope and microscope slides (optional)

Procedure

1. Think back to your exploration of urine production in the nephron. With your partners, brainstorm one substance or molecule that should NOT be found in urine. How do you think the presence of this substance relates to the body’s overall health?
2. Preview the case studies described below. In groups of three, you will perform basic urinalysis tests on urine samples that correspond to four of the six cases.

* **Case Study 1**: A 40-year-old, overweight, pregnant woman comes in for her routine appointment. She is 28 weeks pregnant, complaining that she is constantly thirsty and saying that she spends all of her time running to the bathroom. She has been feeling more lethargic than normal lately and she has lost some weight. No abnormal cells were found in her urine sample.
* **Case Study 2**: An 18-year-old male comes in for his annual physical. He is a cross country runner who is currently training to run a marathon. He feels healthy and energized and has no complaints about his health. In fact, he just finished a rather strenuous training session. Microscopic analysis of his urine does not reveal anything abnormal.
* **Case Study 3**: A 23-year-old female comes in for an emergency appointment. She complains of a strong, persistent desire to urinate, a burning sensation during urination, lower back pain and, a low-grade fever. Microscopic analysis of her urine reveals leukocytes and some crystals.
* **Case Study 4**: A 15-year-old female comes in for her annual physical. Her mom informs you that she is worried because the girl has been on a strict diet and has lost a great deal of weight in the past few months. She has very little energy and does not seem interested in hanging out with her friends. The girl mentions that she has been losing some hair lately and she has not menstruated over three months. Microscopic analysis of her urine does not reveal anything abnormal.
* **Case Study 5**: A 9-year-old male is brought in by his mother because he is complaining of constant thirst and frequent urination. The problem is so bad that the boy is having trouble sleeping because he is constantly getting up to use the bathroom. A few times, he has even wet the bed. The mother suspects that something may be wrong with his pituitary gland as there is a family history of pituitary problems. Microscopic analysis of his urine does not reveal anything abnormal.
* **Case Study 6**: A 60-year-old woman comes in for her annual physical. Even though she usually has a lot of energy, she has been unusually tired for the past few weeks. She occasionally feels dizzy and she is finding it harder to sleep through the night. Her ankles and feet are swollen and her face looks a bit puffy. She frequently feels a burning pain in her lower back, just below the rib cage. She has noticed that her urine is darker in color lately. Preliminary workup shows she has elevated blood pressure. Some red blood cells are present in her urine.

1. Take notes on the components of a complete urinalysis in your laboratory journal as your teacher reviews the Urinalysis presentation. Refer back to the presentation for normal and abnormal values for each category in the testing.
2. Obtain a Student Data Sheet from your teacher. Urine samples for the four case studies you will investigate as well as a control urine sample are found at your lab station.
3. Complete urinalysis on the control sample and then on each of the patient samples. Your testing should include:

* **Macroscopic analysis** - Observe the color and clarity of the urine.
* **Chemical analysis** – Use test strips to monitor urine pH, specific gravity, protein content, glucose content and the presence of ketones. Place the test strip in the simulated sample. Remove the strip onto a clean paper towel and compare your results to those shown on the control strip. Use only one test strip for each sample.
* **Microscopic analysis** – Urine has previously been tested for the presence of white and red blood cells. Information about microscopic analysis results can be found in the case descriptions. Add this information to the chart on the Student Data Sheet. If time permits, your teacher may ask you to examine the provided urine under a microscope.

1. Record the results of your tests on the Student Data Sheet.
2. Once you have collected all data, work individually and use the Internet to research possible clinical connections for each case. Is there a medical condition or disorder that could account for the patient’s physical symptoms and urinalysis results?
3. Meet back with your original group. As a team, discuss your findings and come to consensus on a diagnosis for each patient.
4. Share your findings with the class. Discuss discrepancies in diagnoses.
5. In new groups of four, further research one of the six patient conditions. Record answers to the following questions in your laboratory journal:

* How did the urinalysis results lead you to your diagnosis? What is the relationship between what you see in the urine and the disease or disorder?
* What are the symptoms of the disease or disorder?
* How does this disorder relate directly or indirectly to other human body systems?
* What further tests should be done to confirm your diagnosis?
* What are possible treatments for your patient?

1. Report your findings to the class.
2. Take notes on findings of the other groups.
3. Use the Internet to research a career as a medical technologist. Document the education required, the typical salary range, and the possible duties of this biomedical professional in your career journal. Other than urinalysis, list at least three tests or analyses that may be run by a medical technologist. Next to each test name, summarize the goal of the test and describe how the test provides clues to problems in specific human body systems.
4. Complete the Conclusion questions.

Conclusion

1. Based on what you know about the function of the nephron, why should urine be free of blood cells?
2. Urinalysis is an important diagnostic tool for the determination of medical disorders. However, urinalysis has many other uses. Describe one other reason a person may have his/her urine tested.
3. Explain why diagnostic tests are classified as a type of medical intervention.
4. Explain the effect of one of the conditions described in the case studies on the overall power of the human machine. Make sure to think about how the disease may relate to water, oxygen or food.