

# URINALYSIS

**Level of Difficulty: 4**

**Grade Range: 9-12**

**Activity Time: 45-60 min**

**Career Path: Healthcare**

**Topic: Medical Technologies**

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## OVERVIEW

Students will investigate how laboratory diagnostics are used in obtaining healthcare information. Students will test artificial urine samples for the presence of glucose and protein. Students will examine the samples by sight, protein testing, pH testing, and glucose testing. They will use their results to determine whether the patient has kidney disease or diabetes.

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## STEM LESSON FOCUS

STEM incorporates Science, Technology, Engineering, and Mathematics to focus on real-world issues and problems guided by the engineering design process. This type of instruction supports students in developing critical thinking, collaboration, reasoning, and creative skills to be competitive in the 21<sup>st</sup>-century workforce.

Each Siemens STEM Day classroom activity highlights one or more components of the engineering design cycle and an essential 21<sup>st</sup>-century skill.

Engineering Design Cycle	21 <sup>st</sup> Century Skills
<ul style="list-style-type: none"><li>• Defining the Problem</li><li>• Designing Solutions</li><li>• Creating or Prototyping</li><li>• Refine or Improve</li><li>• <b>Communicating Results</b></li></ul>	<ul style="list-style-type: none"><li>• Collaboration</li><li>• <b>Communication</b></li><li>• <b>Critical Thinking</b></li><li>• Creativity</li></ul>

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## OBJECTIVES

Students will be able to:

- investigate how laboratory diagnostics are used in obtaining healthcare information.
- test artificial urine samples for the presence of glucose and protein.
- apply test results to diagnose patients.

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## MATERIALS

Test tubes, pH paper or pH probe, glucose powder, albumin powder, ammonia solution, Benedict's solution (or glucose test strips), biuret solution, salt, hot water bath at 160 degrees Fahrenheit.

## HAVE YOU EVER WONDERED...

What urine can tell us about our health?

## MAKE CONNECTIONS!

How does this connect to students?	How does this connect to careers?	How does this connect to our world?
<p>Sometimes doctors will order a urine culture. This ensures that the kidneys are functioning normally. Urinary tract infections, diabetes, and dehydration can all be tested through urinalysis.</p>	<ul style="list-style-type: none"> <li>• <b>Laboratory technician:</b> examines the urine culture.</li> <li>• <b>Doctor:</b> Reviews symptoms shared by patient and orders a urine culture.</li> <li>• <b>Field medical service technician:</b> examines and treats patients using laboratory tests.</li> <li>• <b>Center for Disease Control Researcher:</b> works to improve health and save lives around the world.</li> </ul>	<p>Urine is disposed of and recycled differently around the world and even in space. Knowing what healthy urine looks and smells like can help identify indicators of lifestyle, health, and identify diseases you may not know about.</p>

*If you want students to further explore career opportunities connected to this topic, please allow for more classroom time.*

## TEACHER PREPARATION

Prepare artificial samples ahead of time. Many items can be found in a local grocery story.

### Patient #1

Dissolve 3g sodium chloride and 1g albumin powder in 1000mL water. Add 3mL of 1M ammonia solution. Add yellow food coloring.

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## Patient #2

Dissolve 3g sodium chloride, 1g glucose powder and 1g albumin powder in 1000mL water.

## BLUEPRINT FOR DISCOVERY

1. Invite students to complete **Passing Through** to capture their background knowledge on how the body removes waste. Guide students to share their responses with a partner.
2. Explain to students that our excretory system works with other organs in the body to remove toxins and impurities. The kidneys remove waste material, minerals, fluids, and other substances from the blood, that will be passed in the urine. How much you exercise, and what you eat and drink, impact how well your kidneys work. All of these can affect what is in your urine.
3. Share with students that there are unique characteristics about our urine that can help them identify how healthy their body is. Doctors can also learn a lot about a patient from their urine. Urine cultures can indicate problems with kidneys, including urinary tract infections, diabetes, and high blood pressure.
4. Distribute **Patient Health** to students and ask them to read through the protocol. Explain to students that they will be taking on the role of a laboratory technician. Laboratory technicians examine urine cultures and collect data to help treat patients.
5. Point out laboratory equipment and ensure students are following district policies for safety before they begin. Rotate around the room to support students as they work through their examination.
6. Invite students to use the data table on **Patient Health** to summarize their patient results and review their diagnosis.
7. Summarize the lab investigation by asking students the following guiding questions:
  - Describe the structure and function of the kidneys in our bodies.
  - How would a patient's urine, that tests positive for kidney disease, likely appear?
  - What would you likely expect to observe in the urine of a person with diabetes?
  - If a patient's urine was a clear color and had glucose present, what might a doctor diagnose?

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## TAKE ACTION!

Laboratory diagnostics help prevent, detect, diagnosis, and treat patients. This includes fighting threatening diseases around the world. Research some of the current epidemic diseases and identify any monitoring and management tools. Identify if any are threats in your area and determine how you can help spread the word or be part of the solution.

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## NATIONAL STANDARDS

Technology Education

14: Students will develop an understanding of and be able to select and use medical technologies.  
K. Medical technologies include prevention and rehabilitation, vaccines and pharmaceuticals, medical and surgical procedures, genetic engineering, and the systems within which health is protected and maintained.

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## PASSING THROUGH

Which of these is performed by the excretory system?

- Removes excess water
- Produces saliva
- Urinating
- Burping
- Sweating
- Removes excess salt
- Sneezing
- Defecating

## PATIENT HEALTH

1. Examine the sample carefully by eye. Record the color, and write your observations in the Patient Results table.
2. Determine if the sample contains protein by dividing the sample equally between two test tubes.
3. Put one test tube in the hot water bath and leave the other test tube at room temperature. After 5-minutes, remove the test tube out of the water bath, and compare the heated and unheated urine. If the heated sample is cloudy, it contains protein. Protein is normally not found in urine and may be a sign of high blood pressure, diabetes, or kidney disease. Record your results in the Patient Results table.
4. Test the pH of the sample. Normal urine is slightly acidic and pH ranges from 4.5–8.0. A low pH may indicate kidney stones while a high pH may indicate kidney disease, some urinary tract infections, and asthma. Record your results in the Patient Results table.
5. Determine if the urine contains glucose using Benedict's solution. Use the remainder of your unheated sample and add 1 ml of the Benedicts solution. Heat up the sample. Green shows very little or possibly no glucose present in the sample. A reddish orange color indicates a high amount of glucose. Glucose is the type of sugar found in blood. Normally there is very little or no glucose in urine. A high amount may indicate diabetes. Record your results in the Patient Results table.
6. Write a potential diagnosis for each patient by summarizing your data collection.

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## PATIENT RESULTS

TEST	PATIENT 1	PATIENT 2
Color		
pH		
Glucose		
Protein		
Analysis and Diagnosis		