Urinary System: Urine

Unit: Body Systems

Problem Area: Urinary System

Lesson: Urinary System: Urine

Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Compare and contrast the characteristics of normal and abnormal urine.**
2. **Summarize factors that impact urine output.**
3. **Describe urinalysis testing.**

Resources.

The following resources may be useful in teaching this lesson:

E-unit(s) corresponding to this lesson plan. CAERT, Inc. http://www.mycaert.com.

Chabner, Davi-Ellen. *The Language of Medicine,* 11th ed. Elsevier 2017.

Gerdin, Judith. *Health Career Today,* 6th ed. Mosby 2015.

Hegner, Barbara R., Barbara Acello, and Esther Caldwell. *Nursing Assistant: A Nursing Process Approach to the Basics,* 11th ed. Delmar 2016.

Sorrentino, Sheila A., and Leighann N. Remmert. *Mosby's Essentials for Nursing Assistants,* 5th ed. Mosby 2013.

"What the Color of Your Urine Says About You (Infographic)," *Cleveland Clinic*. Accessed April 28, 2017. https://health.clevelandclinic.org/2013/10/what-the-color-of-your-urine-says-about-you-infographic/.



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Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

Key Terms. The following terms are presented in this lesson (shown in bold italics):

- albumin
- albuminuria
- amber
- bacteriuria
- clear
- diabetes mellitus
- diuresis
- glucosuria
- glycosuria
- hematuria
- ketones
- ketone bodies
- ketonuria
- leukocytes
- occult blood
- pH
- proteinuria
- pyuria
- reagent
- reagent strips
- sediment
- specific gravity
- turbid
- urinalysis
- urine
- UTI
- voids
- WBCs

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Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

> *Tell your students: An average person drinks 16,000 gallons of water in a lifetime. The water our body does not need for normal fluid balance is excreted as urine. The average person urinates six times per day. The color of urine depends upon bile pigment, and the degree of urine darkness is an indicator of your hydration level. Then ask students if they have ever noticed a difference in their urine color on a hot day, a day when they have done a strenuous workout, or just a day when they did not have much to drink.*

> *There are many shades of yellow. What shade of yellow is your urine? Project the Cleveland Clinic infographic, "What the Color of Your Urine Says About You" at https://health.clevelandclinic.org/2013/10/what-the-color-of-your-urine-says-about-you-infographic/. Lead a short discussion as an introduction to the lesson.*

CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Compare and contrast the characteristics of normal and abnormal urine.

Anticipated Problem: What are the characteristics of normal and abnormal urine?

I. Urine characteristics

A. ***Urine*** is the yellow watery fluid containing waste products filtered from the blood by the kidneys. When working in a healthcare setting, any abnormal finding must be reported.

1. Normal urine characteristics
   a. Color: Normal urine is yellow or ***amber*** (straw-colored) in color.
   b. Appearance: ***Clear*** is a state in which no particles or sediment appear in the urine.
   c. pH level: ***pH*** is the measurement of a solution's acid or alkaline level. Normal urine is a little acidic, with a pH of 6.5.
   d. Protein: Protein in small amounts may be found in urine but not enough to produce a positive test result.
   e. Odor: Normal urine has a faint odor.

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f. Specific gravity: ***Specific gravity*** is a comparison of the density of urine as compared to water and reflects the amount of wastes, minerals, and solids present.
   (1) The specific gravity of water is 0.99999.
   (2) The specific gravity of normal urine is 1.003 to 1.030.

2. Abnormal urine characteristics
   a. Color: Colorless urine may indicate excess water in the urine. Brown urine may signal dehydration and may be indicative of ***hematuria***—the presence of blood in the urine. In addition, red tinged urine may be indicative of hematuria. [NOTE: Certain medications or foods, such as beets, can contribute to red tinged urine.]
   b. Appearance: ***Turbid*** is cloudy urine that may indicate a UTI. A ***UTI*** is a urinary tract infection caused by microbes (often bacteria) overwhelming the body's defenses in the urinary tract. ***Pyuria*** is the presence of pus (or white blood cells) in the urine and may indicate a bacterial urinary tract infection. ***Bacteriuria*** (bacteria in the urine) may be detected. ***Sediment*** is the presence of solid matter (debris) in the urine. Small quantities may be considered normal and may consist of bacteria, dead cells, or white blood cells—***WBCs***. Another name for WBCs is ***leukocytes***.
   c. pH level: pH may be slightly alkaline when bacteria are present in the urine due to the release of ammonia (an alkaline substance).
   d. Protein: Urine that tests positive for protein (or ***proteinuria***) may signal ***albuminuria*** (the presence of albumin in the urine). ***Albumin*** is the major protein in blood plasma.
   e. Odor: A strong, or ammonia, odor may indicate an infection or other disease process.
   f. Specific gravity: Specific gravity levels are higher in those with diabetes mellitus due to the presence of sugar in the urine. The level is also higher in those who are dehydrated.
   g. Glucose (sugar): Glucose is an abnormal finding in urine. ***Glucosuria*** or ***glycosuria*** is the presence of sugar in the urine and may be a sign of diabetes mellitus. ***Diabetes mellitus*** is a chronic and life-long condition that affects the body's ability to use food energy. Diabetes mellitus causes increased sugar in the bloodstream that then "spills" into the urine.
   h. Ketones bodies: The body's primary fuel is glucose. When the body is low on glucose (or if a person has diabetes) and is not getting enough insulin to help cells absorb the glucose, the body starts breaking down fats for energy. ***Ketones*** or ***ketone bodies*** are a byproduct of the body breaking down fatty acids for quick energy. ***Ketonuria*** is the presence of ketones in the urine. The presence of ketone bodies in the urine indicates the person is rapidly using fat for energy.
   i. Blood: Blood in the urine, or hematuria, is atypical and may be visible as red- or brown-tinged urine. ***Occult blood*** is microscopic blood in the urine that is not visible to the naked eye and can be an indicator of kidney,

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bladder, prostate, or vaginal infection. The presence of occult blood in the urine is discovered through urine testing.

Teaching Strategy: *Many techniques can be used to help students master this objective. Use VM–A.*

Objective 2: Summarize factors that impact urine output.

Anticipated Problem: What factors contribute to changes in urine output?

II. Changes in urinary output

A. Factors that may affect the amount of urine a person ***voids*** (the act of expelling urine) are:

1. Generally, as a person ages, less urine is produced. In turn, there is less urine to expel.
2. A person also loses water through perspiration that negatively affects the amount of urine produced.
3. The following illnesses may decrease urine output:
   a. Renal failure
   b. Congestive heart failure (causes the body to retain fluid)
   c. Fever (causes increased perspiration)
   d. Enlarged prostate (can cause an obstruction)
4. Diuretic drugs treat the build-up of excess fluid in the body and can cause a person to experience ***diuresis*** (increased urine production). The use of diuretics prevents fluid imbalance in the body.
5. Fluid intake affects urine output (e.g., drinking large amounts of water increases urine output). Certain chemicals (e.g., caffeine) may increase urine output. A normal output of urine is 1500 mL per day or the equivalent of about three water bottles of fluid.

Teaching Strategy: *Many techniques can be used to help students master this objective. Use VM–B.*

Objective 3: Describe urinalysis testing.

Anticipated Problem: What routine tests are performed on urine samples?

III. Routine urine tests

A. ***Urinalysis*** is testing done to evaluate urine using different means to detect disease or abnormal contents. Urinalysis tests can detect diabetes, gout, kidney disease, etc. Urine samples are evaluated in three ways: visual exam (color),

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dipstick test (reagent strips), and microscopic exam. Routine urinalysis involves collecting several common urine specimens.

1. Each test is conducted for a specific reason, such as to:
    a. Detect blood in the urine
    b. Detect glucose (or sugar) in the urine
    c. Assess the pH of the urine
    d. Measure specific gravity
    e. Detect the presence of protein in the urine
2. The routine test process includes:
    a. Collection any time of day in a clean specimen container
    b. No special patient preparation
    c. Specimen requirement of 4 ounces or 120mL
    d. Use of reagent strips for urine testing (***Reagent strips*** are thin pieces of paper covered with a substance that reacts with protein in urine and indicates its presence and level as a basic diagnostic tool. A ***reagent*** is a material that causes a chemical reaction to occur with a specific substance. This specimen may be sent to the lab or tested in a bathroom.)
3. Microscopic testing is conducted to determine if any of the following is present in the sample:
    a. White blood cells (may be a sign of an infection)
    b. Red blood cells (may be a sign of kidney disease, blood disorder, or other diseases)
    c. Bacteria or yeasts (may indicate an infection)
    d. Casts (may form as a result of kidney disorders)
    e. Crystals (may be a sign of kidney stones)

B. A midstream or clean catch urine test is conducted to detect infection.
    1. The test requires a sterile container.
    2. It is conducted to detect bacteria in the urine.
    3. The test requires cleaning of the genital area prior to obtaining the specimen.
    4. Process:
        a. Beginning to void
        b. Stopping the urine stream
        c. Collecting specimen from the middle of the urine stream
    5. A specimen of 1 to 2 ounces is required.

C. A 24-hour urine specimen test is usually conducted to diagnose kidney problems.
    1. The test includes collecting all urine for a 24-hour period.
    2. It requires setting a start date and time.
        a. The patient is told to void at a specific time.
        b. This first void of urine is discarded.
        c. The patient is told to void 10 minutes prior to the end of the 24- hour period.

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d. The last urine is saved, and the collection is ended.

3. Urine is kept in a large container, usually in the patient's bathroom.
4. Urine must be kept on ice to prevent bacterial growth. A basin to hold a bag of ice is standard for keeping the urine cold.
5. Depending on the type of test ordered, the laboratory may put a preservative in the container prior to the specimen collection.

Teaching Strategy: *Many techniques can be used to help students master this objective. Use VM–C and VM–D. Assign LS–A.*

Review/Summary.

Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. If a textbook is being used, questions at the ends of chapters may be included in the Review/Summary.

Application.

Use the included visual master(s) and lab sheet(s) to apply the information presented in the lesson.

Evaluation.

Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

Answers to Sample Test:

Part One: Matching

1. g
2. a
3. b
4. c
5. f
6. d
7. h
8. e

Part Two: Multiple Choice

1. b
2. a
3. b
4. c
5. d
6. b

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Part Three: Short Answer

1. Answers may vary and should be similar to the following description of the procedure for starting and ending a 24-hour urine specimen: Instruct the person to void at a specific time, discard the first urine, and save the urine for 24 hours. Keep the voided urine on ice in a container. Then 10 minutes before the 24 hours has elapsed, ask the person to void. Add that urine to the container.
2. Answers may vary and should similar to the following description of the procedure for obtaining a midstream urine specimen. Instruct the person to cleanse his or her genital area. Next, instruct the person to begin the urine stream, stop the stream, and position the provided container. Then he or she should continue to urinate in the specimen container.

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Sample Test

Name _____

Urinary System: Urine

Part One: Matching

Instructions: **Match the term with the correct definition.**

a. pH
b. pyuria
c. ketones or ketone bodies
d. voids
e. sediment
f. turbid
g. glucosuria
h. hematuria

_____1. The presence of sugar in the urine and a possible sign of diabetes mellitus

_____2. The measurement of a solution's acid or alkaline level

_____3. The presence of pus (or white blood cells) in the urine, which may indicate a bacterial urinary tract infection

_____4. A byproduct of the body breaking down fatty acids for quick energy

_____5. Cloudy urine that may indicate a UTI

_____6. The act of expelling urine

_____7. The presence of blood in the urine

_____8. The presence of solid matter (debris) in the urine

Part Two: Multiple Choice

Instructions: **Circle the letter of the correct answer.**

1. A midstream urine specimen is used to detect _____.

   a. kidney failure
   b. infections, usually bacterial
   c. pH and color
   d. specific gravity and odor

2. A UTI is caused by _____.

   a. microbes (often bacteria)
   b. acids in the urine
   c. viruses in the urine
   d. sediment in the urine

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3. Specific gravity measures the _____.

   a. presence of blood in the urine
   b. density of the urine
   c. presence of bacteria in the urine
   d. presence of glucose in the urine

4. Occult blood in the urine means the _____.

   a. urine is red
   b. urine is brown
   c. blood can only be seen with a microscope
   d. person has diabetes

5. A characteristic of normal urine is a/an _____.

   a. brown color
   b. specific gravity of 1.035
   c. turbid appearance
   d. amber color

6. Increased urine output may be the result of _____.

   a. having a fever
   b. taking a diuretic
   c. renal failure
   d. a man having an enlarged prostate

Part Three: Short Answer

Instructions: **Answer the following.**

1. Describe the procedure for starting and ending a 24-hour urine specimen.

2. Describe the procedure for obtaining a midstream urine specimen.

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VM–A

URINE COLOR CHART

Urine color reflects your degree of hydration, presence of blood, or reactions from food and medication.

URINE COLOR CHART

NO COLOR. TRANSPARENT
You're drinking a lot of water

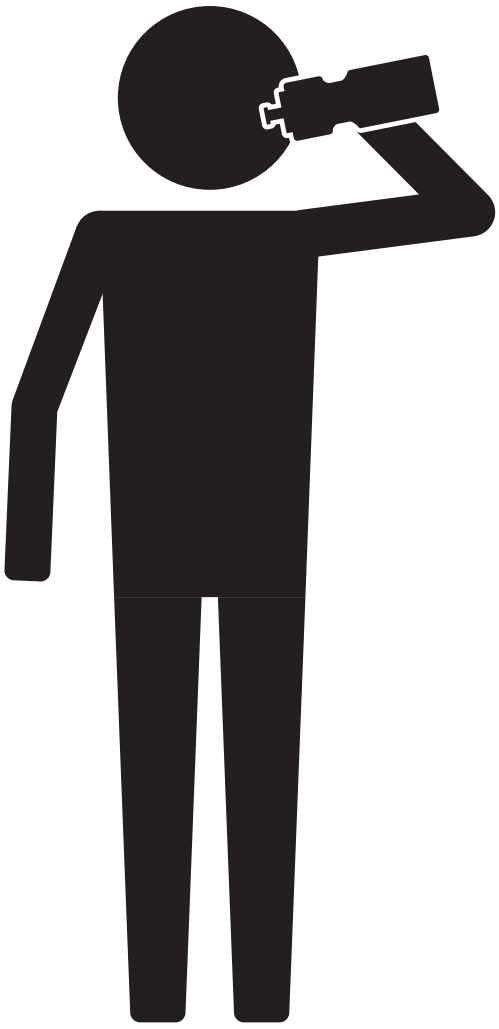
PALE STRAW COLOR
You're normal & well hydrated

TRANSPARENT YELLOW
Normal

DARK YELLOW
You need to drink some water soon

AMBER OR HONEY
Your body isn't getting enough water.

SYRUP OR BROWN ALE
You need to drink water. NOW & A LOT!



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VM–B

VISUAL REPRESENTATION OF NORMAL AND BLOODY URINE

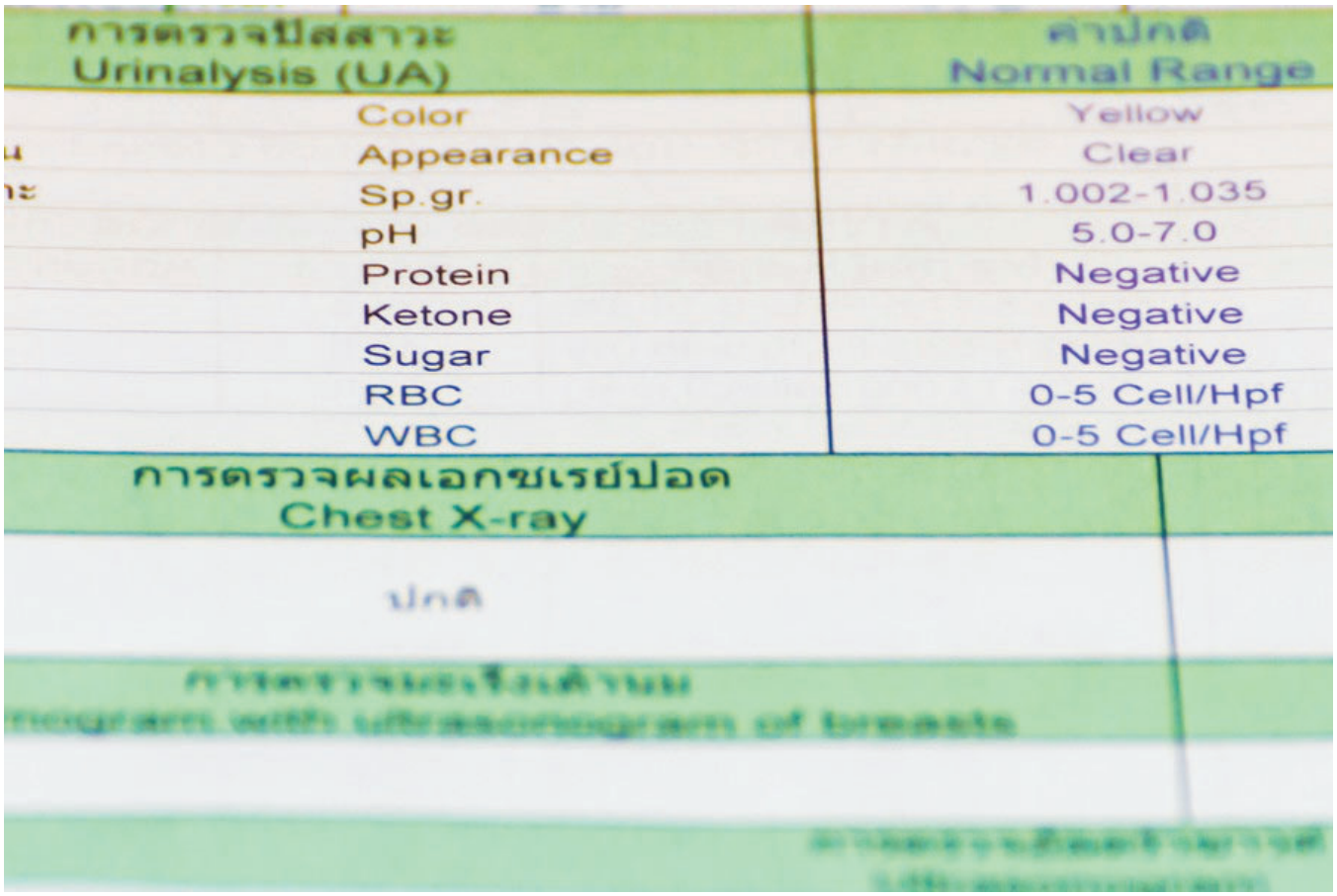
Hematuria is blood in the urine. Red-tinged urine may be indicative of hematuria. Certain medications or foods, such as beets, can contribute to red-tinged urine.



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SAMPLE URINALYSIS REPORT

Urinalysis is testing done to evaluate urine using different means to detect disease or abnormal contents. Urinalysis tests can detect diabetes, gout, and kidney disease. Routine urinalysis involves collecting several common urine specimens.



การตรวจปัสสาวะ Urinalysis (UA)		ค่าปกติ Normal Range
	Color	Yellow
	Appearance	Clear
	Sp.gr.	1.002-1.035
	pH	5.0-7.0
	Protein	Negative
	Ketone	Negative
	Sugar	Negative
	RBC	0-5 Cell/Hpf
	WBC	0-5 Cell/Hpf
การตรวจผลเอกซเรย์ปอด Chest X-ray		
ปกติ		

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VM–D

REAGENT STRIP FOR URINE TESTING

Reagent strips are thin pieces of paper covered with a substance that reacts with protein in urine and indicates its presence and level as a basic diagnostic tool. A reagent is a material that causes a chemical reaction to occur with a specific substance. The strip, with up to 10 different chemical pads, is dipped in the specimen and is compared to the chart on the test strip bottle.



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Name _____

Urine Specimen Observations

Purpose

The purpose of this activity is to visually assess urine specimens for abnormalities.

Objectives

1. Assess five urine specimens for color, clarity, odor, and amount.
2. Record the qualities of each urine specimen as to normal or abnormal.
3. Write a short summary of the normal and abnormal urine indicators you observed.
4. Participate in a class discussion of the five urine samples observed.

Materials

- lab sheet
- writing utensil
- class notes
- writing utensil
- paper
- five “urine” specimens

Procedure

1. Work with a partner to complete this activity. Review your class notes about urine characteristics.
2. Assess the five urine specimens for color, clarity, odor, and amount.
3. On your paper, record your observations of each specimen as follows: color, clarity, odor, and amount. Indicate which characteristics are “normal” and which are “abnormal.”
4. Which specific observations, from Procedure 3, were normal and which were abnormal?
5. Participate in a class discussion of the five urine samples.
6. Turn in your completed lab sheet to your instructor.



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Urine Specimen Observations

1. Materials required include five clear cups for “urine samples,” a graduated cylinder to measure the “urine,” and small amounts of:
   a. Yellow and red food coloring
   b. Ammonia
   c. Tea
   d. Flour
2. Specimens can be prepared as follows in clear cups:
   a. Hematuria: Red food coloring in water to represent blood in the urine
   b. Normal: Yellow food coloring in water at the appropriate concentration
   c. Dehydration: Tea in water to give a brown appearance for dehydration with a little ammonia to increase odor (This sample would be smaller in volume than the other four samples.)
   d. Turbid or UTI: Yellow food coloring in water with ammonia and some flour or something similar to make it cloudy
   e. Diuretic present: Yellow food coloring to make pale urine to represent someone who is taking a diuretic and is excreting large amounts of water in the urine.
3. Label each sample (e.g., Sample #1)

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