### Unit O: Urinary System

**Program Area:** Health Occupations Education

**Course Title:** Medical Sciences I  
**Number:** 7221

**Unit Title:** Urinary System

**Suggested Time for Instruction:**
- 5 class periods (90 minute classes)
- 9 class periods (55 minute classes)

**Course Percent:** 6%

**Unit Evaluation:** 100% Cognitive

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**Competency:** MD15. Analyze the anatomy and physiology of the urinary system.

**Specific Objectives:**

- MD15.01 Describe the structure of the urinary system
- MD15.02 Analyze the function of the urinary system.
- MD15.03 Analyze characteristics and treatment of common urinary disorders.
O. Urinary System

MD15.01 Describe the structure of the urinary system

A. Kidney
   1. Bean-shaped
   2. Located between peritoneum and the back muscles (retroperitoneal)
   3. Renal pelvis – funnel-shaped structure at the beginning of the ureter
   4. Medulla
      a. Inner, striated layer
      b. Striated cones are renal pyramids
      c. Base of pyramids empty into cuplike cavities called calyces
   5. Cortex – composed of millions of microscopic nephrons

B. Nephron – functional unit of kidney
   1. Bowman’s capsule
   2. Glomerulus
   3. Proximal convoluted tubule
   4. Loop of Henle
   5. Distal convoluted tubule
   6. Collecting tubule

C. Ureters
   1. One from each kidney
   2. Smooth muscle tube with mucous membrane lining

D. Urinary bladder
   1. Hollow, muscular organ
   2. Made of elastic fibers and involuntary muscle
   3. Stores urine – about 500 cc

E. Urethra
   1. Connects bladder with urinary meatus
   2. Urinary meatus is opening to body

MD15.02 Analyze the function of the urinary system

A. Four main functions
   1. Excretion – removing nitrogenous wastes, certain salts and excess water from blood.
   2. Maintain acid-base balance
   3. Secrete waste products in the form of urine
   4. Eliminate urine from bladder

B. Nephron – functional unit of the kidney – for urine formation
   1. Filtration
      a. First step in urine formation
      b. Blood from renal artery enters glomerulus
      c. Blood pressure in glomerulus forces fluid (filtrate) to filter into Bowman’s capsule
      d. Filtrate does not contain plasma proteins or RBCs – they’re too big
   2. Reabsorption
      a. Water (90%) and useful substances are reabsorbed
      b. If blood levels of certain substances are high (glucose, amino acids, vitamins, sodium) then those substances will NOT be reabsorbed
3. **Secretion**
   a. Opposite of reabsorption
   b. Secretion transports substances from blood into collecting tubules
   c. Electrolytes are selectively secreted to maintain body’s acid-base balance

C. **Urinary output**
1. Ave = 1500 ml/day
2. Urinalysis – examination of urine to determine presence of blood cells, bacteria, acidity level, specific gravity and physical characteristics

D. **Ureters**
1. Carry urine from kidney to bladder
2. Peristalsis pushes urine down ureters

E. **Urinary bladder**
1. Stores urine – usually about 500 cc
2. Emptying urine (voiding) is involuntary but controlled through nervous system (voluntary)

F. **Control of urinary secretion**
1. Chemical control
   a. Reabsorption of H₂O in distal convoluted tubule controlled by ADH (antidiuretic hormone)
   b. Secretion and regulation of ADH controlled by hypothalamus
   c. Diuretics inhibit reabsorption of H₂O
2. Nervous control
   a. Direct control through nerve impulses on kidney blood vessels
   b. Indirect control through stimulation of endocrine glands

**MD15.03 Analyze characteristics and treatment of common urinary disorders.**

A. **Kidney (renal) failure**
1. Acute kidney failure
   1. Caused by nephritis, shock, injury, bleeding, sudden heart failure or poisoning
   2. Symps – oliguria (scant urine) or anuria (no urine produced)
2. Chronic kidney failure – gradual loss of function of nephrons

B. **Renal calculi (kidney stones)**
1. Made of calcium and uric acid crystals
2. Gradually they get larger until they block ureters
3. First symptom – severe pain
4. Other symps – nausea and vomiting, frequency, chills, fever, hematuria
5. Diagnosis – by symptoms, ultrasound or x-ray
6. Rx – increase fluids, medications, lithotripsy

C. **Lithotripsy**
1. Surgical procedure to remove kidney stones
2. Shock waves hit dense stones and break them up
3. Done on outpatient basis

D. **Nephritis – infection or inflammation of the kidney**

E. **Cystitis**
1. Bladder infection, usually caused by E. Coli bacteria
2. Symps – dysuria (painful urination) and frequency
3. More often in females (shorter urethra)
4. Rx - antibiotics

F. **Incontinence – involuntary urination**
G. Dialysis (hemodialysis)
   1. Treatment for kidney failure
   2. Involves the passage of blood through a semipermeable membrane
   3. Dialysis serves as substitute kidney
   4. Can be done at home or in clinic
   5. Usually takes 2-4 hours, 2-3 times a week

H. Kidney transplant
   1. As a last resort to treat kidney failure
   2. Involves donor organ from someone with a similar immune system
   3. Main complication - rejection

I. Terminology and Treatments
   1. Enuresis – bedwetting
   2. Glycosuria – sugar in urine
   3. Nocturia – frequent urination at night
   4. Polyuria – large amounts of urine
   5. Pyuria – pus in urine
   6. Anuria – no urine
   7. Dysuria – painful urination
   8. Hematuria – blood in urine
   9. Diuretic – a drug or substance that increases the amount of urine secreted
Unit O  Urinary System

Competency MD15: Analyze the anatomy and physiology of the urinary system.

Materials/Resources


Teaching/Learning Indicators: The following letters are used to indicate specific skills/areas required in the instructional activity.

R  Reading
W  Writing
M  Math
H  Health professional/parent/community involvement

SS  Social Studies
S  Science
A  The Arts

Summer 2005  O.5
Objective MD15.01  Describe the structure of the urinary system.

**Teaching/Learning Activities**

- **Basic Skills**  S, R
  Have students read chapter 19 in *Body Structures and Functions*. Give students a copy of the terminology list, and have them make flash cards on terms associated with the structure of the urinary system.  (*Appendix MD15.01A*) Instruct students to write the term on one side of the card, and the definition on the other side of the card.

- **Cognitive**  S
  Have students label the illustrations of the kidney and male/female urinary organ systems.  (*Appendices MD15.01B and MD15.01C*)

- **Teamwork**  S, A
  Assign students in groups of 2-3 to create a three-dimensional model of the urinary system. They should label the different urinary system structures. Evaluation should be based on accuracy, color, neatness, and originality.

- **Special Needs**
  Each student will reach the highest level of mastery in the least restrictive environment as recommended in the student's IEP.
Objective MD15.02 Analyze the function of the urinary system

Teaching/Learning Activities

- **Cognitive**  
  Have students complete the matching exercise related to the function of the urinary system. *(Appendix MD15.02A)*

- **Critical Thinking**  
  Using the flash cards created in the first objective, have students put their cards in an order that illustrates the correct path of urine formation.

- **Employability Skills**  
  To help students understand the function of the kidneys, invite a guest speaker from dialysis unit to come to class and talk about filtration, reabsorption and secretion – related to the functioning kidney and in hemodialysis.

- **Basic Skills**  
  Following discussion of the functions of the urinary system, have students keep an accurate record of their intake and output for a 24 hour period, as assigned by the teacher. They should complete the “Intake and Output Diary” *(Appendix MD15.02B)* and then bring it to class for analysis and discussion. *(Note: Teachers may wish to modify the measurement of output from cc to counting number of times the student voids. Modifications are at the teacher’s discretion.)*

  An important part of the above exercise is the debriefing and data analysis. Teachers may ask questions about the comparison of data (female output frequency compared to male), comparison of intake mean, median and range, etc. Ask student to make observations and draw conclusions from the data.

  If students do not know how to use military time, a quick lesson on the topic will be necessary.

- **Special Needs**  
  Each student will reach the highest level of mastery in the least restrictive environment as recommended in the student’s IEP.
Objective MD15.03
Analyze characteristics and treatment of common urinary disorders.

Teaching/Learning Activities

• **HOSA**  S, SS
  Divide students into groups of 3-4, and have them complete the exercise “Medical Decisions” (*Appendix MD15.03A*) using the Creative Problem Solving guidelines and rating sheet.

• **Technology**  S, A, SS
  Prior to the assignment, the teacher should watch the movie “Steel Magnolias” and develop a worksheet about the important kidney-related facts in the movie.

  As a homework assignment (or for extra credit) have students check out “Steel Magnolias” and answer the questions on the teacher-created worksheet. If possible, allow students to view the movie in small groups, or the discuss the important information from the movie in small groups during class.

  *Note: Teachers must be aware of and follow local Board of Education policies in relation to the use of videos in and out of the classroom.*

• **Employability Skills**  S
  Have students complete the assignment “What Happened?” (*Appendix MD15.03B*)

• **HOSA**  S
  Following the HOSA competitive event guidelines for Medical Laboratory Assisting, have students perform urinalysis procedures. Use reagent trips such as ChemStrips. Students can check their own urine, or the teacher can purchase simulated urine. If desired, the teacher can make urine with water and food coloring, and then add a little acetone, sugar, and other kitchen ingredients that will give interesting results.

  As part of the above, have students fill out a lab slip for the test they performed.

• **Basic Skills**  S, M
  Have students complete the scientific inquiry project “Urinary Tract Infection Survey.” (*MD15.03C*) *Note the Teacher Information in the appendix that supports this activity.*

• **Special Needs**
  Each student will reach the highest level of mastery in the least restrictive environment as recommended in the student’s IEP.
# Daily Lesson Plans

## Unit O: Urinary System

**Lessons:** 5  
**Hours:** 7 ½ clock hours

<table>
<thead>
<tr>
<th>Steps</th>
<th>Lesson #1</th>
<th>Lesson #2</th>
<th>Lesson #3</th>
</tr>
</thead>
</table>
| **Focus and Review** | Use “Urinary System Matching” *(MD15.02A)* as a pretest to determine current level of understanding of the Urinary System. Collect the pretest. | Give quiz on structure of the kidney and nephron *(MD15.01C and D)*  
Grade the quiz in class for instant feedback. | Ask thinking questions about urinary function. For example – “Why is it that the minute you drink something, you have the need to urinate?” |
| **Statement of Objectives** | MD15.01 Describe the structure of the urinary system | MD15.02 Analyze the function of the urinary system.  
MD15.03 Analyze characteristics and treatment of common urinary disorders. | |
| **Teacher Input**    | Have students complete the guided practice activity as noted. (45 mins) | Using overheads, review main points of function of the urinary system. | Using overheads, review the disorders of the Urinary System. |
|                      | Have students put away notecards. Using the overheads, ask questions about the Urinary System before revealing the content in the overheads. Force students to think about what they learned from the reading assignment. | | |
| **Guided Practice**  | Give students a copy of the terminology list for this unit.  
Have them write the term on one side and the definition on the reverse. (28 terms – structure and function) | Let students “retake” the Urinary System matching.  
Have students figure out their “percent improvement” (Good math exercise) | Working in groups of 3-4, review the “Medical Decisions” activity. Decide which patient gets the kidney. Be prepared to defend your decision in the next class period. |
| **Independent Practice** | Label the diagram of “Structure of Urinary System” Appendix MD15.01B | Research kidney transplants – include reading the section in the textbook and in other classroom resources. (Use Internet if available) | Read the textbook section on disorders of the Urinary System. |
|                      | Review urinary anatomy. Tell students they will have a labeling quiz tomorrow on the parts of the kidney and nephron | Ask students to take notecards, select out the structures of the nephron, and put them in proper order. | Ask students if they have ever known anyone with kidney stones. Let them share personal knowledge to reinforce content. |
| **Materials**        | Overheads  
Notecards (for students who don’t have any)  
Handout – Structure of the Urinary System | Handouts (pretest) Urinary System Matching Overheads | Overheads  
Handout – Medical Decisions |
### Unit O: Urinary System (Continued)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Lesson #4</th>
<th>Lesson #5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focus and Review</strong></td>
<td>Ask students questions about kidney disorders.</td>
<td>Answer student questions before the test.</td>
</tr>
<tr>
<td><strong>Statement of Objectives</strong></td>
<td>MD15.03 Analyze characteristics and treatment of common urinary disorders.</td>
<td>MD15.03 Analyze characteristics and treatment of common urinary disorders.</td>
</tr>
<tr>
<td><strong>Teacher Input</strong></td>
<td>Students will present &quot;Medical Decisions&quot; reports.</td>
<td>TEST – Urinary System</td>
</tr>
<tr>
<td></td>
<td>Debrief. Did all groups agree?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>After students complete &quot;What Happened&quot; worksheet, review the correct answers.</td>
<td></td>
</tr>
<tr>
<td><strong>Guided Practice</strong></td>
<td>&quot;Medical Decisions&quot; presentations.</td>
<td>Take unit test.</td>
</tr>
<tr>
<td></td>
<td>Complete &quot;What Happened&quot; worksheet.</td>
<td>Grade test in class.</td>
</tr>
<tr>
<td></td>
<td>With remaining class time, use note cards created during first class to study for test in pairs.</td>
<td></td>
</tr>
<tr>
<td><strong>Independent Practice</strong></td>
<td>Study for test.</td>
<td>Have students look up the answers to the questions they got wrong and turn in their corrected test.</td>
</tr>
<tr>
<td><strong>Closure</strong></td>
<td>Review main points of Urinary System in preparation for test.</td>
<td>Introduce the next unit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Make a reading assignment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use remaining class time for HOSA business/update.</td>
</tr>
<tr>
<td><strong>Materials</strong></td>
<td>Handout – What Happened</td>
<td>Test and key.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Green pens for grading tests.</td>
</tr>
</tbody>
</table>
Unit O: Urinary System
Terminology List

1. ADH
2. Bowman’s capsule
3. calyces
4. collecting tubule
5. cortex
6. distal convoluted tubule
7. excretion
8. filtrate
9. filtration
10. glomerulus
11. kidneys
12. loop of Henle
13. medulla
14. nephron
15. proximal convoluted tubule
16. pyramids
17. reabsorption
18. retroperitoneal
19. secretion
20. ureters
21. urethra
22. urinary bladder
23. urinary meatus
24. urine

Disorders and Related Terminology

1. acute kidney failure
2. anuria
3. chronic renal failure
4. cystitis
5. dialysis (hemodialysis)
6. diuretic
7. dysuria
8. eneuresis
9. glycosuria
10. hematuria
11. incontinence
12. kidney transplant
13. lithotripsy
14. nephritis
15. nocturia
25. oliguria
16. polyuria
17. pyuria
18. renal calculi (kidney stones)
19. urinalysis

Appendix MD15.01A
Structure of the Urinary System

Draw a line from the term to the related structure on each torso.

Bladder
Kidney
Ureter
Renal pelvis
Urinary meatus

Appendix MD15.01B

Name ________________________________________  Date __________________
Structure of the Kidney

Label the following structures:

1. Cortex
2. Medulla
3. Ureter
4. Pyramid
5. Renal pelvis
6. Hilum

Appendix MD15.01C
Structure of the Nephron

Label the following structures:

1. _________________________________  2. _________________________________
3. _________________________________  4. _________________________________
5. _________________________________  6. _________________________________

Appendix MD15.01D
## Urinary System Matching

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Retroperitoneal</td>
<td>The process of removing nitrogenous waste material, certain salts, and excess water from the blood.</td>
</tr>
<tr>
<td>2</td>
<td>Excretion</td>
<td>Performs filtration</td>
</tr>
<tr>
<td>3</td>
<td>Nephron</td>
<td>The basic structural and functional unit of the kidney.</td>
</tr>
<tr>
<td>4</td>
<td>Glomerulus</td>
<td>Located behind the peritoneum.</td>
</tr>
<tr>
<td>5</td>
<td>Filtrate</td>
<td>Performed filtration</td>
</tr>
<tr>
<td>6</td>
<td>Secretion</td>
<td>The opposite of reabsorption</td>
</tr>
<tr>
<td>7</td>
<td>Urinalysis</td>
<td>An examination of the urine</td>
</tr>
<tr>
<td>8</td>
<td>Aldosterone</td>
<td>A hormone released by the kidneys when blood pressure drops.</td>
</tr>
<tr>
<td>9</td>
<td>Diuretics</td>
<td>A hormone that controls urinary secretion</td>
</tr>
<tr>
<td>10</td>
<td>Renin</td>
<td>A hormone released by the kidneys when blood pressure drops.</td>
</tr>
<tr>
<td>11</td>
<td>Proximal convoluted tubules</td>
<td>A fluid consisting of water, glucose, amino acids, some salts and urea.</td>
</tr>
<tr>
<td>12</td>
<td>Filtration</td>
<td>An examination of the urine</td>
</tr>
<tr>
<td>13</td>
<td>Bladder</td>
<td>Stores urine until about 500cc has accumulated</td>
</tr>
<tr>
<td>14</td>
<td>ADH</td>
<td>The first step in urine formation</td>
</tr>
<tr>
<td>15</td>
<td>Cortex</td>
<td>Adrenal hormone that controls urinary secretion</td>
</tr>
</tbody>
</table>

M. Contains

N. Where 80% of the water filtered out of the blood by the glomerulus is reabsorbed

O. They increase urinary output by inhibiting the reabsorption of water.

*Appendix MD15.02A*
Key for Urinary System Matching

__E__1. Retroperitoneal  A. The process of removing nitrogenous waste material, certain salts, and excess water from the blood.
__A__2. Excretion  B. Performs filtration
__D__3. Nephron  C. The opposite of reabsorption
__H__5. Filtrate  E. Located behind the peritoneum.
__C__6. Secretion  F. Under the control of the hypothalamus, this hormone increases the permeability of water in distal and collecting tubules
__I__7. Urinalysis  G. A hormone released by the kidneys when blood pressure drops.
__I__8. Aldosterone  H. A fluid consisting of water, glucose, amino acids, some salts and urea.
__O__9. Diuretics  I. An examination of the urine
__G__10. Renin  J. Stores urine until about 500cc has accumulated
__N__11. Proximal convoluted tubules  K. The first step in urine formation
__K__12. Filtration  L. Adrenal hormone that controls urinary secretion
__J__13. Bladder  M. Contains the nephrons
__F__14. ADH  N. Where 80% of the water filtered out of the blood by the glomerulus is reabsorbed
__M__15. Cortex  O. They increase urinary output by inhibiting the reabsorption of water.
Intake and Output Diary

For one day (24 hours) you are to keep an accurate diary of your fluid intake and output. Be sure you include what you drank (under intake) and the total number of cc. Date to collect data ____________

<table>
<thead>
<tr>
<th>Time</th>
<th>Intake</th>
<th>Output</th>
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<tbody>
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<td><strong>Total</strong></td>
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</table>

Appendix MD15.02B
# Medical Decisions

You have been assigned to a Medical Decisions Board for a university hospital. Today, your decision involves a very common dilemma; one kidney and four patients in complete renal failure, all in need of a kidney transplant.

Date _______ Read information about kidney transplants, either in your textbook, in other class print materials, in your school’s media center, or on the Internet. (Your teacher may assign this part as homework.)

Date _______ Work with your group using the problem solving process to determine who gets the kidney.

Date _______ Present your decision and rationale to a group of judges or your class.

- Note: Your teacher will inform you of the due dates for each part of the process.

All of the following patients are compatible recipients for the kidney to be transplanted. The kidney donor was a 17 year old male who was killed in a car crash. The parents have requested that the kidney be transplanted in a teenager.

<table>
<thead>
<tr>
<th>Name, Age and Occupation</th>
<th>Renal Status</th>
<th>Other Medical factors</th>
<th>Financial Status</th>
<th>Social Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mary Greaves 54 Housewife</td>
<td>Dialysis: 15 years Transplant waiting list: 7 years</td>
<td>Arthritis – Mod. Post-menopausal hormone replacement Hypertension – Mod. Overall health – Fair</td>
<td>$46,000/yr Medicaid</td>
<td>Has 6 grown kids, all supportive Husband is reformed alcoholic with stable income and in good health, age 60</td>
</tr>
<tr>
<td>Michelle Mantle 35 Former tennis pro</td>
<td>Dialysis: 1 year Transplant waiting list: 6 months</td>
<td>Multiple sclerosis – 2 years – Mod. Overall health – Fair</td>
<td>Net worth – 20 million dollars No insurance</td>
<td>High profile patient would bring much media attention to the medical center Potential exists for financial gain for the medical center, publicity for organ donations</td>
</tr>
<tr>
<td>Gary Puckett 19 College student</td>
<td>Dialysis: 2 years Transplant waiting list: 9 months</td>
<td>Overall health – Good Regularly uses cocaine, other illegal substances have been present in blood specimens</td>
<td>Parents: $120,000/yr Blue Cross/Blue Shield</td>
<td>Parents are supportive Patient resists medical regimen as prescribed by physicians</td>
</tr>
<tr>
<td>Gerald Ford 43 Auto mechanic</td>
<td>Dialysis: 7 years Transplant waiting list: 2 years</td>
<td>Overall health – Excellent $25,000/yr Managed care – will cover 50% of costs</td>
<td></td>
<td>Has 16 year old son in school who lives in the home Wife died of Leukemia in 1995</td>
</tr>
</tbody>
</table>

*Appendix MD15.03A*
What Happened?

Read each scenario and, based on your understanding of the anatomy and physiology of the urinary system, what do you think has happened?

1. Taylor is on the track team at school. After just having run a mile on a very hot day, Taylor goes to the bathroom to urinate, and is concerned that there is a very small amount and the color is deep amber.

   What happened?

2. Carlos was playing football this afternoon and was hit pretty hard in his right flank. Tonight, he goes to the bathroom to urinate, and notices the water in the toilet bowl is a light pink.

   What happened?

3. Cara’s grandmother had a stroke and has been hospitalized. When Cara goes to visit her grandmother, there is a clear plastic bag filled with urine hanging on the side of the bed, and a tube leading from the bag to her grandmother.

   What happened?

4. Jermina goes to camp. After a few days there, she begins to have dysuria, and notices that her urine smells funny and is cloudy.

   What happened?

Appendix MD15.03B
# Urinary Tract Infection Survey

Interview ten (juniors) or seniors (no names please) and ask the following:

I would like to ask you a few questions for my Medical Sciences I class.

1. Have you already responded to this survey about urinary tract infections?

   **If yes**, thank them and ask no further questions.

   **If no**, say “I would like to ask you three questions. This survey is anonymous, and your identify will not be revealed.”

<table>
<thead>
<tr>
<th>Survey Number</th>
<th>Gender</th>
<th>Have you ever had cystitis (a urinary bladder infection)?</th>
<th>Did you take antibiotics?</th>
<th>Did you finish the antibiotics?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M or F</td>
<td>Yes No</td>
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Appendix MD15.03C
Urinary Tract Survey Results

1. After instruction on disorders of the urinary system, and before collecting surveys, ask the following questions:
   - What percent of males have had at least one urinary tract infection?
   - What percent of females have had at least one urinary tract infection?
   - What percent will say they have taken antibiotics. Male? Female?
   - Of those who took antibiotics, what percent will say they completed them?

2. Before collecting data, review the following principles:
   - Information is CONFIDENTIAL.
   - Do not ask more than the survey requires. (Avoid being nosey.)
   - Ask the information in a confidential setting, NOT in front of other people.
   - Ask only high school juniors or seniors.

3. Establish a time frame for collecting data.

4. Aggregate the data as a whole class, by gender. (The data can be combined later.)

5. Once the numbers are combined, you should have a total of 100 – 240 samples. Give students actual numbers for the class data, and then divide them into groups to analyze the data.

6. Data analysis should include:
   - Percent of males have had at least one urinary tract infection.
   - Percent of females have had at least one urinary tract infection.
   - Percent of those with infections who have taken antibiotics. Male. Female.
   - Percent of those who took antibiotics and completed them, by gender.
   - Variance between predictions and actual data.
   - If possible, comparison with other classes.

Note: It may be helpful to talk with a science or math teacher for data analysis recommendations, or other suggestions to enhance this assignment.
Unit O: Urinary System

OVERHEAD TRANSPARENCY MASTERS
Functions of Urinary System:
1. Excretion – removing nitrogenous wastes, certain salts and excess water from blood.
2. Maintain acid-base balance
3. Secrete waste products in the form of urine
4. Eliminate urine from bladder

KIDNEYS
- Bean-shaped organs
- Located between peritoneum and the back muscles (RETROPERITONEAL)
- RENAL PELVIS – funnel shaped structure at the beginning of the ureter
MEDULLA
- Inner, striated layer
- Striated cones are RENAL PYRAMIDS
- Base of each pyramid faces cortex, while apex empties into cuplike cavities called CALYCES

CORTEX
- Composed of millions of microscopic functional units called nephrons.

NEPHRON
- Functional unit of the kidney
- Parts include:
  1. Bowman’s capsule
  2. Glomerulus
  3. Proximal convoluted tubule
  4. Loop of Henle
  5. Distal convoluted tubule
  6. Collecting tubule
Urine Formation in the Nephron

1- Filtration
2- Reabsorption
3- Secretion

Filtration
- First step in urine formation
- Blood from renal artery enters glomerulus
- High blood pressure in glomerulus forces fluid (FILTRATE) to filter into Bowman’s capsule
- Filtrate does not contain plasma proteins or RBCs – they’re too big
- Bowman’s capsule filters out 125cc of fluid/min. – 7500cc/hour
- As filtrate continues through nephron, 90% of water is reabsorbed

Reabsorption
- Water and useful substances are reabsorbed
- If blood levels of certain substances are high (glucose, amino acids, vitamins, sodium) then those substances will not be reabsorbed
SECRETION

- Opposite of reabsorption
- Secretion transports substances from blood into collecting tubules
- Substances include creatinine, hydrogen ions, potassium ions, and some drugs
- Electrolytes are selectively secreted to maintain body’s acid-base balance

Urinary Output

- Ave = 1500 ml/day
- URINALYSIS – examination of urine to determine presence of blood cells, bacteria, acidity level, specific gravity and physical characteristics (color, clarity and odor)

URETERS

- One from each kidney
- Carry urine from kidney to bladder
- Smooth muscle tube with mucous membrane lining
- Peristalsis pushes urine down ureters
URINARY BLADDER

- Hollow, muscular organ
- Made of elastic fibers and involuntary muscle
- Stores urine – usually about 500cc
- Emptying urine (voiding) is involuntary but controlled through nervous system (voluntary)
- Urine leaves through URETHRA to outside opening = URINARY MEATUS
Control of Urinary Secretion

Chemical Control

- Reabsorption of H₂O in distal convoluted tubule controlled by ADH (antidiuretic hormone)
- Secretion and regulation of ADH controlled by hypothalamus
- DIURETICS inhibit reabsorption of H₂O

Nervous Control

- Direct control through nerve impulses on kidney blood vessels
- Indirect control though stimulation of endocrine glands
Disorders of the Urinary System

ACUTE KIDNEY FAILURE
- Caused by nephritis, shock, injury, bleeding, sudden heart failure or poisoning
- Symps – Oliguria (scant urine) or Anuria (no urine produced)

CHRONIC RENAL FAILURE - gradual loss of function of nephrons

RENAL CALCULI (Kidney Stones)
- Made of crystals of calcium phosphate and uric acid
- Gradually they get larger until they block ureters
- First symptom – severe pain
- Other symptoms – nausea and vomiting, frequency, chills, fever, hematuria
- Diagnosis – by symptoms, ultrasound, or x-ray
- Rx – increase fluids to flush out stone, medications, and if needed – LITHOTRIPSY
**LITHOTRIPSY**
- Surgical procedure to remove kidney stones
- Shock waves hit dense stones and break them up
- Done on outpatient basis

**NEPHRITIS**
Inflammation of the kidney (kidney infection)

**CYSTITIS**
- Inflammation of the mucous membrane lining of the urinary bladder
- Most common cause – E. Coli
- Symps – **DYSURIA** (painful urination) and frequency
- Usually in females (shorter urethra)
- Rx – antibiotics

**INCONTINENCE** – involuntary urination

**DIALYSIS** (**HEMODIALYSIS**)  
- Used for kidney failure
• Involves the passage of blood through device with semipermeable membrane
• Dialysis serves as substitute kidney
• Blood from patient flows through machine and is filtered
• Can be done at home or in clinic
• Takes 2-4 hours, 2-3 times a week

KIDNEY TRANSPLANT
• As a last resort
• Involves donor organ from someone with a similar immune system
• Main complication – rejection

ENURESIS – bedwetting
GLYCO SURIA – sugar in urine
NOCTURIA – frequent urination at night
POLYURIA – large amounts of urine
PYURIA – pus in urine
ANURIA – no urine produced
HEMATURIA – blood in urine
DIURETIC – drug or substance to increase urine production