

UNIT 4:

EXCRETION AND WASTE MANAGEMENT

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Unit 4: Excretion and Waste Management

Specific Learning Outcomes

- B11-4-01:** Identify the primary metabolic wastes produced in the human body and the source of each. (GLO: D1)
Include: ammonia, urea, mineral salts, carbon dioxide, and water
- B11-4-02:** Describe the roles of the major excretory structures in eliminating wastes and helping the body maintain homeostasis.
(GLOs: D1, E2)
Include: kidneys, lungs, skin, and intestines
- B11-4-03:** Describe the important role of the liver in the process of excretion and the maintenance of homeostasis. (GLOs: D1, E2)
- B11-4-04:** Identify structures of the human urinary system from a diagram, model, or specimen, and describe the function of each.
(GLO: D1)
Include: kidneys, renal cortex, renal medulla, renal pelvis, renal arteries and veins, ureters, urinary bladder, urethra, and urinary sphincters
- B11-4-05:** Explain the processes of filtration, reabsorption, and secretion in the nephron. (GLO: D1)
- B11-4-06:** Describe the feedback mechanisms associated with water and salt balance and their role in the maintenance of homeostasis in the human body. (GLOs: D1, E2)
Include: antidiuretic hormone (ADH) and aldosterone
- B11-4-07:** Describe what types of information can be gained through urinalysis. (GLOs: B3, D1)
Examples: performance-enhancing drugs, diabetes, recreational drugs, pregnancy, infections, kidney failure or damage...
- B11-4-08:** Investigate and describe issues related to kidney failure and treatment options available. (GLOs: B3, C6, C8, D1)
Examples: organ transplant, personal lifestyle, dialysis...

METABOLIC WASTES

SPECIFIC LEARNING OUTCOMES

- B11-4-01:** Identify the primary metabolic wastes produced in the human body and the source of each. (GLO: D1)
Include: ammonia, urea, mineral salts, carbon dioxide, and water
- B11-4-02:** Describe the roles of the major excretory structures in eliminating wastes and helping the body maintain homeostasis. (GLOs: D1, E2)
Include: kidneys, lungs, skin, and intestines
- B11-4-03:** Describe the important role of the liver in the process of excretion and the maintenance of homeostasis. (GLOs: D1, E2)

SLO: B11-4-01
SLO: B11-4-02
SLO: B11-4-03

SUGGESTIONS FOR INSTRUCTION

ACTIVATE

What Are Waste Products?

Ask students the following questions and record their responses.

- What would happen if you never threw out your garbage or leftover food?
- Why do we sweat?
- Why do we urinate?

Have students list as many waste products of the human body as possible.

ACQUIRE/APPLY

Charting Waste (U1)

Explain to students that *excretion* is the removal of the waste products of cellular metabolism from the body. Ammonia, one of the products of cellular metabolism, is very toxic. This is why it is converted to urea (which is much less toxic than ammonia) in the liver before being released into the bloodstream. With the use of resources such as texts or the Internet, have students acquire information to create a chart that links metabolic waste products with the organ that excretes this product.

Example:

Waste Product	Origin of Waste Product	Excretory Organ
Ammonia	<i>breakdown of amino acids in the liver</i>	<i>kidneys</i>
Urea	<i>conversion of ammonia in the liver</i>	<i>kidneys, skin</i>
Carbon dioxide	<i>cellular respiration (breakdown of glucose in cells)</i>	<i>lungs, intestines, skin</i>
Water	<i>cellular respiration (breakdown of glucose in cells)</i>	<i>kidneys, lungs, intestines, skin</i>
Mineral salts	<i>food and water</i>	<i>kidneys, skin</i>

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts.
(GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames...

Have students answer the following question:

- Why is excrement not included in the list of metabolic wastes?
(Excrement is not a product of cellular metabolism. It is a “leftover” after the body absorbs what nutrients it needs from the small intestine.)



Suggestions for Assessment

Review the completed charts with students to check for comprehension, and re-teach if necessary (formative assessment).

Have students complete a Concept Frame or a Concept Overview for the process of excretion (see *SYSTH*, pp. 11.23–11.25).

Have students answer the following questions:

- What is the liver’s role in excretion?
- Why is the liver not considered an excretory organ?



Cumulative Assessment

Have students create a Concept Map illustrating the liver’s role in various body systems (e.g., digestion, excretion).

URINARY SYSTEM

SPECIFIC LEARNING OUTCOMES

B11-4-04: Identify structures of the human urinary system from a diagram, model, or specimen, and describe the function of each. (GLO: D1)

Include: kidneys, renal cortex, renal medulla, renal pelvis, renal arteries and veins, ureters, urinary bladder, urethra, and urinary sphincters

SLO: B11-4-04

SUGGESTIONS FOR INSTRUCTION

ACTIVATE

Kidney Size

Have students make two fists and place them on their backs just above the hips. Discuss the size and location of their kidneys. Students brainstorm the role of the kidney.

ACQUIRE/APPLY

Charting the Urinary System (S3, S4, S5, S6)

Have students label a diagram of the urinary system while dissecting a specimen or examining models. Using information from texts or the Internet, have students place arrows on the diagram to indicate the direction of the flow of fluids through the system, as well as construct a chart listing the structures of the urinary system and their functions.



Suggestion for Assessment

The diagrams and charts can be used as a formative assessment to determine the level of students' understanding of urinary system structures and their functions.

SKILLS AND ATTITUDES OUTCOMES

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens...

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides...

B11-0-S5: Demonstrate sensitivity toward, and respect for, living and non-living tissues, specimens, and organisms utilized for biological research. (GLOs: B5, C1)

B11-0-S6: Make detailed observations and/or collect data; organize and display this information using an appropriate format. (GLOs: C2, C5)

Include: biological drawings

NOTES

PROCESSES

SPECIFIC LEARNING OUTCOMES

B11-4-05: Explain the processes of filtration, reabsorption, and secretion in the nephron. (GLO: D1)

SLO: B11-4-05

SUGGESTIONS FOR INSTRUCTION

BACKGROUND INFORMATION

The kidneys filter about 125 millilitres of blood every minute, which adds up to about 180 litres per day. We obviously don't excrete 180 litres of urine per day, so most of the water filtered out of the blood is returned to the circulatory system. The body excretes only about two litres of urine every day.

Water isn't the only substance that is reabsorbed into the circulatory system. All the glucose that is filtered out of the blood is reabsorbed. This important nutrient necessary for the production of ATP is actively transported back into the circulatory system so that it reaches the cells. Salt concentration in the blood also needs to remain constant. The amount of salt excreted and reabsorbed into the blood depends on how much salt we get from the foods we eat. If we take in a lot of salt, some is reabsorbed into the bloodstream, and more is excreted into the urine.

ACTIVATE

The Formation of Urine

Have students discuss the following question:

Where does your urine come from and how is it formed?

ACQUIRE/APPLY

Filtration, Reabsorption, and Secretion—Direct Instruction (U1)

Use visuals to show the location of the nephron. Provide students with a variety of views of the parts of the nephron (e.g., micrograph, phase contrast slide). Explain the processes of filtration, reabsorption, and secretion. Have students complete one of the following activities to consolidate their understanding of the nephron and its activities.

- Have students create a labelled diagram of a nephron and place arrows on the diagram to indicate
 - the direction of water and solute movement at the locations of filtration
 - reabsorption and secretion through the nephron to the collecting duct
 - the filtration and reabsorption mechanisms
- Have students use a Chain Concept Map to illustrate
 - the main parts of the nephron
 - the direction of water and solute movement in each part

SKILLS AND ATTITUDES OUTCOMES

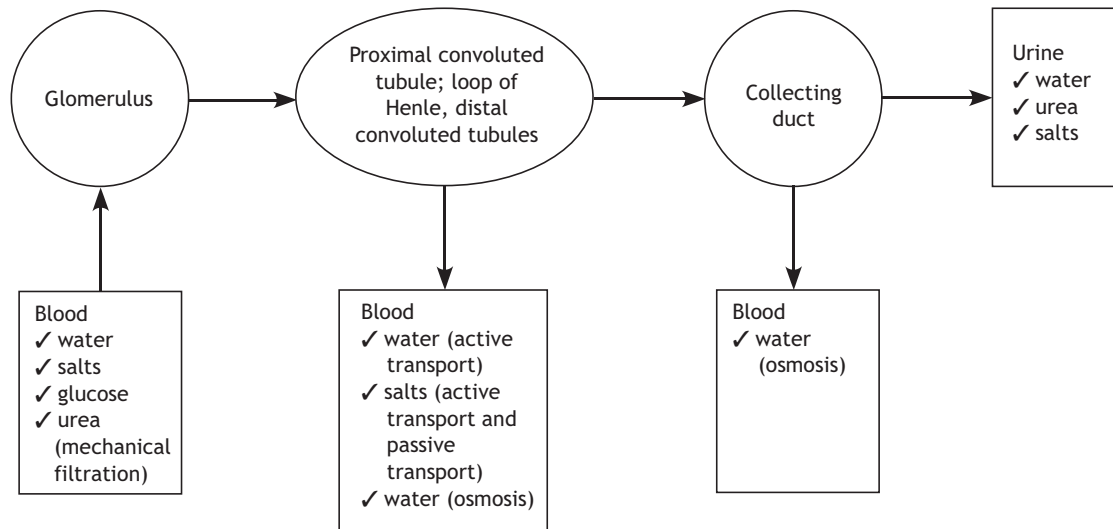
B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames...

B11-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models...

Example:



Suggestion for Assessment

Have students answer the following questions:

- Why do we need to drink regularly?
- How would organisms adapt to an environment such as a desert?

SPECIFIC LEARNING OUTCOMES

B11-4-05: Explain the processes of filtration, reabsorption, and secretion in the nephron. (GLO: D1)

PROCESSES

Kidney Analogies (U2)

Have groups of students create an analogy of the kidney or one of its parts. Students must include the following in their analogy:

- description of the structure (biological concept)
- identification of a familiar object (analogy) that shares some similar characteristics
- identification of the shared characteristics of the structure (biological concept) and the analogy
- indication of where the analogy breaks down

(Glynn, “The Teaching with Analogies Model”; Glynn, Duit, and Thiele)



Suggestion for Assessment

Kidney analogies can be shared with the class and discussed in order to arrive at a consensus as to whether or not the analogy is helpful. The following criteria can help determine the effectiveness of an analogy:

- A familiar analogy is selected.
 - Similarities between the analogy and the structure are clear and help explain the structure and/or function of the structure.
 - Differences between the analogy and the structure are clear.
-

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames...

B11-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models...

NOTES

FEEDBACK

SPECIFIC LEARNING OUTCOMES

B11-4-06: Describe the feedback mechanisms associated with water and salt balance and their role in the maintenance of homeostasis in the human body. (GLOs: D1, E2)
 Include: antidiuretic hormone (ADH) and aldosterone

SLO: B11-4-06

SUGGESTIONS FOR INSTRUCTION

BACKGROUND INFORMATION

The amount of water and salt in the body needs to remain constant. Fluid excreted by the body must, therefore, balance out fluid taken in by the body. The kidneys, acting with hormones named ADH (antidiuretic hormone) and aldosterone, maintain the balance of blood volume and composition through negative feedback mechanisms. Receptors in the hypothalamus sense when the body's fluid intake is low, when blood volume decreases, and when the sodium concentration in blood increases. ADH is then released from the pituitary gland and increases the permeability of the nephron to water. More water is, therefore, reabsorbed into the circulatory system. Aldosterone also helps to regulate water balance. This hormone is released by the adrenal cortex. Factors that cause its release are low blood volume and pressure, which put in motion a complex series of events that start with the release of a hormone called rennin in the kidney. Aldosterone causes the reabsorption of sodium into the circulatory system. Water follows the sodium, and blood volume and pressure are restored.

ACTIVATE

Control of Excretion

Have students discuss the following questions:

- Why do we sometimes excrete a lot of urine and sometimes hardly any?
- Why do we sometimes feel so thirsty we can hardly get enough to drink, but sometimes we don't want to drink anything at all?

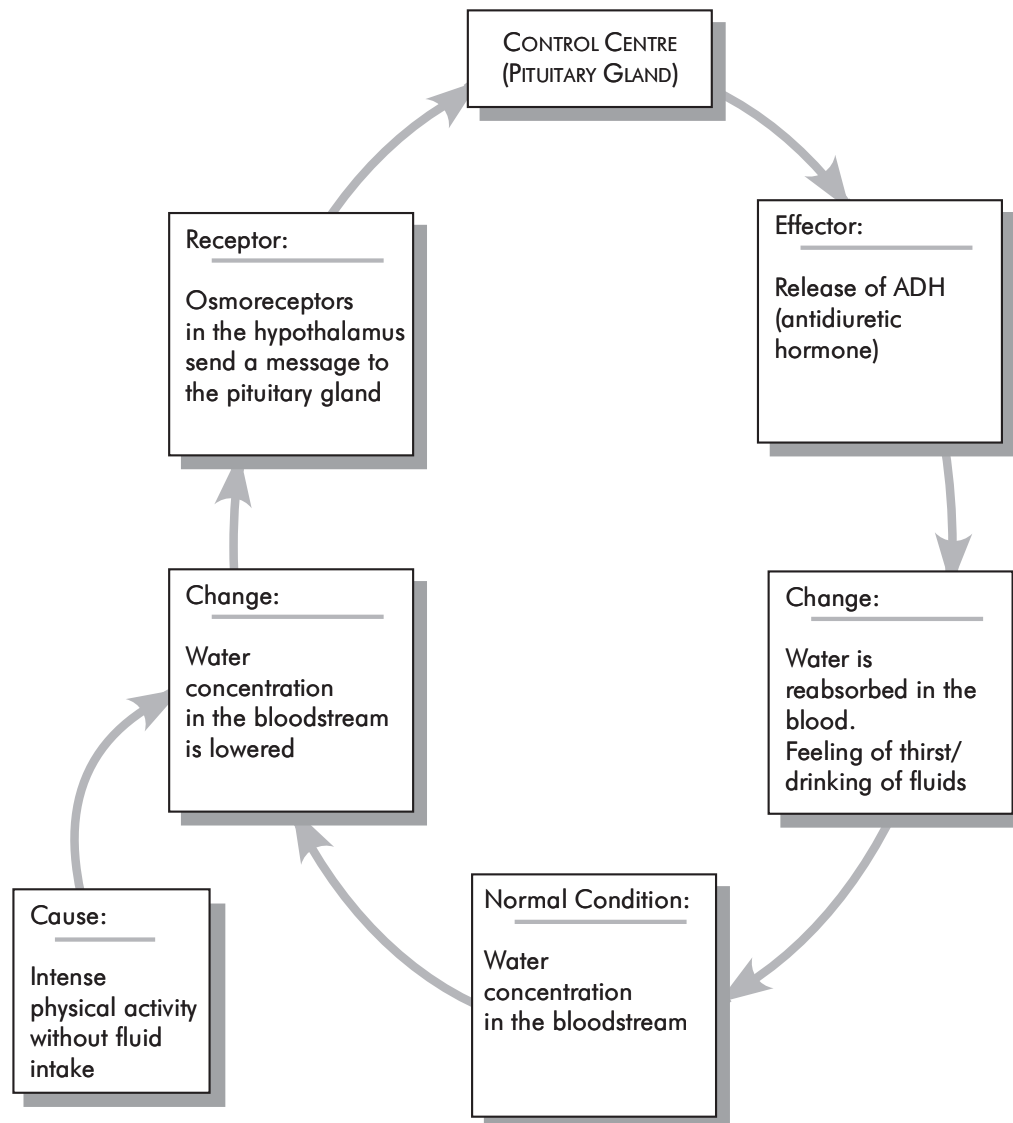
ACQUIRE/APPLY

Water Balance and Hormonal Control—Direct Instruction (U1)

Describe the release of ADH and the relationship to osmotic concentration in terms of a negative feedback mechanism. Have students fill in the Negative Feedback Mechanisms BLM (see Appendix 1.6 in Unit 1) to illustrate the process involved in osmoregulation. The Concept Map of this process could look similar to the following:

SKILLS AND ATTITUDES OUTCOMES

- B11-0-U1:** Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)
Examples: using concept maps, sort-and-predict frames, concept frames...
- B11-0-U2:** Demonstrate an in-depth understanding of biological concepts. (GLO: D1)
Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models...
- B11-0-I4:** Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLO: C5, C6)



FEEDBACK

SPECIFIC LEARNING OUTCOMES

B11-4-06: Describe the feedback mechanisms associated with water and salt balance and their role in the maintenance of homeostasis in the human body. (GLOs: D1, E2)
Include: antidiuretic hormone (ADH) and aldosterone



Suggestions for Assessment

Review students' responses with the class to check for understanding (formative assessment).

Have students complete a second blackline master, this time to illustrate the negative feedback mechanism involved with a high fluid intake by the body. Have students meet in small groups to compare their results. Any discrepancies should be discussed and a consensus reached.

Have students answer the following questions:

- Alcohol inhibits the secretion of ADH. What would be the effect of ingesting alcohol on the process of excretion?
 - What causes a hangover?
 - Caffeine increases glomerular blood pressure and decreases the reabsorption of sodium. What would be the effect of ingesting caffeine on the process of excretion?
 - If you drank a large pop at the beginning of a movie, you would probably have to urinate before the end of the movie. Explain what would happen if you ate salty popcorn with your large pop.
-

Water as a Need—Microtheme (U2, I4)

Provide students with the following information and questions.

“Water, water, everywhere

Nor any drop to drink.”

— Samuel Taylor Coleridge (1798)

In modern English, this phrase from the famous poem “The Rime of the Ancient Mariner” can be read as “Water, water, everywhere but not a drop to drink.” Samuel Coleridge tells the sad tale of survivors of shipwrecks, even though they float on a vast body of water teeming with life.

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames...

B11-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models...

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLO: C5, C6)

Students work in groups to develop responses to the following questions:

- Why can't we drink seawater?
- What will happen to our bodies if we do?
- What systems in the body are most affected?
- What needs to be done to the seawater to make it drinkable?
- How can this be done?
- What does dehydration do to the human body?

Following the discussions, have students write a microtheme about what they could do to conserve their body's water, if they were in a survival situation where drinkable water is unavailable.

*“And every tongue, through utter drought,
Was withered at the root;
We could not speak, no more than if
We had been choked with soot.”*

— Samuel Taylor Coleridge (1798)



Suggestion for Assessment

Refer to Appendix 1.3B: Microthemes – First Draft Checklist (BLM) and Appendix 1.3C: Microthemes – Final Draft Assessment (BLM) from Unit 1 for assessment tools.

URINALYSIS

SPECIFIC LEARNING OUTCOMES

B11-4-07: Describe what types of information can be gained through urinalysis. (GLOs: B3, D1)

Examples: performance-enhancing drugs, diabetes, recreational drugs, pregnancy, infections, kidney failure or damage...

SLO: B11-4-07

SUGGESTIONS FOR INSTRUCTION

ACTIVATE

Thinking about Urine Tests

Pose the following questions to the class:

- Why do we give urine samples when we visit the doctor for a physical examination?
- What kinds of things can doctors detect with a urine test?
- Why do athletes get their urine tested?

Have students discuss the issue using a Think-Pair-Share strategy (see *SYSTH*, p. 3.10).

ACQUIRE/APPLY

Fake Urine—Laboratory (S3, S4, S6, S7, S8)

Have students complete a urinalysis laboratory activity using synthetic urine. They analyze results to determine potential disorders (i.e., clarity of urine—opaque sample may indicate yeast). See Appendix 4.1A: Urinalysis Lab—Student Handout (BLM) and Appendix 4.1B: Urinalysis Lab (Teacher Background).

Note: Students are not permitted to use samples of actual human fluid or tissue in the classroom. Refer to *Science Safety: A Kindergarten to Senior 4 Resource Manual for Teachers, Schools, and School Divisions* (Manitoba Education and Training) for more information on safety procedures.



Suggestions for Assessment

Refer to Appendix 1.8: Student Lab Skills (Teacher Background) in Unit 1 for information on assessing and evaluating student lab skills.

Refer to Appendix 1.13A: Lab Skills Checklist—General Skills and Appendix 1.13B: Lab Skills Checklist in Unit 1 for templates on assessing general lab skills and thinking skills.

SKILLS AND ATTITUDES OUTCOMES

- B11-0-S3:** Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)
Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens...
- B11-0-S4:** Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)
Examples: microscopes, dissection equipment, prepared slides...
- B11-0-S6:** Make detailed observations and/or collect data; organize and display this information using an appropriate format. (GLOs: C2, C5)
Include: biological drawings
- B11-0-S7:** Evaluate the relevance, reliability, and adequacy of data and data collection methods. (GLOs: C2, C4, C5, C8)
Include: discrepancies in data or observations and sources of error
- B11-0-S8:** Analyze data and/or observations in order to identify patterns or draw conclusions. (GLOs: C2, C5, C8)
- B11-0-I1:** Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)
Include: print and electronic sources, resource people, and personal observations
- B11-0-I2:** Evaluate the quality of sources of information, as well as the information itself. (GLOs: C2, C4, C5, C8)
Examples: scientific accuracy, reliability, currency, balance of perspectives, bias, fact versus opinion...
- B11-0-I3:** Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)
- B11-0-I4:** Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)
- B11-0-G1:** Collaborate with others to achieve group goals and responsibilities. (GLOs: C2, C4, C7)
- B11-0-G2:** Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions. (GLOs: C2, C4, C7)
- B11-0-G3:** Evaluate individual and group processes used. (GLOs: C2, C4, C7)
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Researching Urine Tests (I1, I2, I3, I4)

Have students research how a commercial pregnancy test kit works, or conduct research about one specific type of urine test, and possible diseases or illnesses that can be detected with this test. Students may also choose to investigate urine tests used with high-performance athletes. As part of this research process, have students evaluate information sources and the quality of the information, to identify potential problems with scientific accuracy, bias, and so on, that may be present, especially in materials promoting the sale of commercial products.



Suggestion for Assessment

Develop assessment criteria with students. Criteria might include

- a description of how the urine test works
- a description of the condition that the urine test can detect
- use of appropriate vocabulary
- minimal evidence of spelling or grammatical errors
- evaluation of the sources and the information contained within them

URINALYSIS

SPECIFIC LEARNING OUTCOMES

B11-4-07: Describe what types of information can be gained through urinalysis. (GLOs: B3, D1)

Examples: performance-enhancing drugs, diabetes, recreational drugs, pregnancy, infections, kidney failure or damage...

Mandatory Testing Debate (I1, I2, I4, G1, G2, G3)

Have students debate whether urinalysis should be mandatory at all athletic competitions. Have them create a Fact and Opinion Recording Sheet while conducting research in preparation for the debate. To create such a sheet, students fold a sheet of paper in half and label one half "Fact" and the other half "Opinion." During the course of their research, students document statements that are either Facts or Opinions. If no opinions are stated in a given article, students can add their own opinions.

Senior 2 English Language Arts: A Foundation for Implementation (Manitoba Education and Training) suggests a debating strategy called Creative Controversy (see Senior 2, p. 34). This debating strategy requires students to gather arguments so that they can switch sides in a debate, and then move to consensus.



Suggestion for Assessment

Collect students' Fact and Opinion Recording Sheets and assess them based on accuracy of categorized statements. Establish performance criteria with the class before a debate and use the classroom-based criteria to create a rubric. Use an assessment tool such as Appendix 4.2: Debating Skills Rubric (BLM).

SKILLS AND ATTITUDES OUTCOMES

- B11-0-S3:** Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)
Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens...
- B11-0-S4:** Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)
Examples: microscopes, dissection equipment, prepared slides...
- B11-0-S6:** Make detailed observations and/or collect data; organize and display this information using an appropriate format. (GLOs: C2, C5)
Include: biological drawings
- B11-0-S7:** Evaluate the relevance, reliability, and adequacy of data and data collection methods. (GLOs: C2, C4, C5, C8)
Include: discrepancies in data or observations and sources of error
- B11-0-S8:** Analyze data and/or observations in order to identify patterns or draw conclusions. (GLOs: C2, C5, C8)
- B11-0-I1:** Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)
Include: print and electronic sources, resource people, and personal observations
- B11-0-I2:** Evaluate the quality of sources of information, as well as the information itself. (GLOs: C2, C4, C5, C8)
Examples: scientific accuracy, reliability, currency, balance of perspectives, bias, fact versus opinion...
- B11-0-I3:** Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)
- B11-0-I4:** Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)
- B11-0-G1:** Collaborate with others to achieve group goals and responsibilities. (GLOs: C2, C4, C7)
- B11-0-G2:** Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions. (GLOs: C2, C4, C7)
- B11-0-G3:** Evaluate individual and group processes used. (GLOs: C2, C4, C7)
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NOTES

WELLNESS

SPECIFIC LEARNING OUTCOMES

B11-4-08: Investigate and describe issues related to kidney failure and treatment options available. (GLOs: B3, C6, C8, D1)

Examples: organ transplant, personal lifestyle, dialysis...

SLO: B11-4-08

SUGGESTIONS FOR INSTRUCTION

ACTIVATE

Kidney Disease

Have students brainstorm what could cause kidney failure, malfunction, and disease.

Ask students whether they have signed a donor card and discuss reasons for deciding to sign or not to sign.

ACQUIRE/APPLY

The Kidney Dilemma

See The Kidney Dilemma Lesson Plan in *Life Is a Gift* (Manitoba Education and Transplant Manitoba) for learning activities related to Unit 4: Excretion and Waste Management.



Suggestions for Assessment

Depending on the learning activities completed, a range of approaches can be used to assess student understanding (e.g., Concept Maps, notes summarizing key information, questions from the activities included on unit tests). Students should be expected to link this new understanding of organ and tissue transplant with the knowledge acquired throughout this course (e.g., functioning of the kidney, compatible blood types.)

Renal Failure—Research Project (U1, U2, S8, D2, D3, I1, I4)

Another approach to the topic of organ donation is to personalize and contextualize it, similarly to what is done in a microtheme. This can be achieved by providing students with a scenario and the associated questions, such as the following (or brainstorming questions with students).

SKILLS AND ATTITUDES OUTCOMES

- B11-0-U1:** Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)
Examples: using concept maps, sort-and-predict frames, concept frames...
- B11-0-U2:** Demonstrate an in-depth understanding of biological concepts. (GLO: D1)
Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models...
- B11-0-S8:** Analyze data and/or observations in order to identify patterns or draw conclusions. (GLOs: C2, C5, C8)
- B11-0-I1:** Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)
Include: print and electronic sources, resource people, and personal observations
- B11-0-I4:** Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLO: C5, C6)
- B11-0-G1:** Collaborate with others to achieve group goals and responsibilities. (GLOs: C2, C4, C7)
- B11-0-G2:** Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions. (GLOs: C2, C4, C7)
- B11-0-D1:** Identify and explore a current health issue. (GLOs: C4, C8)
Examples: clarify what the issue is, identify different viewpoints and/or stakeholders, research existing data/information...
- B11-0-D2:** Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)
Examples: positive and negative consequences of a decision, strengths, and weaknesses of a position...
- B11-0-D3:** Recognize that decisions reflect values and consider personal values and those of others when making a decision. (GLOs: C4, C5)
- B11-0-D4:** Recommend an alternative or identify a position, and provide justification. (GLO: C4)
- B11-0-D5:** Propose a course of action related to an issue. (GLOs: C4, C5, C8)
- B11-0-D6:** Evaluate the process used by self or others to arrive at a decision. (GLOs: C4, C5)
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Scenario

Imagine that your father has been showing signs of renal failure. Hemodialysis or kidney transplant are the realistic treatments that he will need very soon. Research the impact of hemodialysis treatments on your family's lifestyle. How will your lives change? Examine the current state of organ donation in Canada. What are organ availabilities in Canada? What steps are taken to get access to organs and to harvest them? As a teenager, how can you make your wishes regarding transplantation known? What will influence the likelihood of your father getting a transplant?



Suggestion for Assessment

This research project can be assessed using the microtheme tools provided in Appendix 1.3B: Microthemes – First Draft Checklist (BLM) and Appendix 1.3C: Microthemes – Final Draft Assessment (BLM) in Unit 1.

WELLNESS

SPECIFIC LEARNING OUTCOMES

B11-4-08: Investigate and describe issues related to kidney failure and treatment options available. (GLOs: B3, C6, C8, D1)

Examples: organ transplant, personal lifestyle, dialysis...

Kidney Failure and Treatment Options—Performance Tasks

The following performance tasks can be used in addition to, or instead of, the previous activities in this section. It involves both factual information gathering and decision making.

In these performance tasks, students are expected to develop and apply their knowledge of kidney functioning and treatment options within a context that forces them to take on the role of the doctor (Part 1) and the role of a patient (Part 2). Part 2 is intended to emphasize the personal nature of decision making related to personal health and to help students recognize that there is seldom a “right” decision that would apply to everyone.

You Are a Doctor—Performance Task, Part 1 (U2, I1, I4, G1, G2)

Give students the following scenario:

Imagine you are a new doctor who has received test results for a patient showing signs of renal failure. Your task is to prepare an explanation for the patient on what the problem is, within the context of what normal kidney function looks like, and what the treatment options are (dialysis and transplant). You must describe the options in detail, including pros and cons. Your preparation will take the form of written notes, which will be shared with other doctors to confirm your information.



Suggestion for Assessment

Students must prepare a written submission, which will be assessed by the teacher and shared in small groups. Develop criteria for the written piece, as well as for the oral sharing. Assessment criteria could include

- clear and complete explanation of kidney function
- use of appropriate terminology
- diagrams
- accurate explanation of the consequences of renal failure
- clear, concise, and accurate description of treatment options (understandable by patient, including pros and cons)
- sharing ideas with the group
- listening when others talk
- providing constructive feedback to others

SKILLS AND ATTITUDES OUTCOMES

- B11-0-U1:** Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)
Examples: using concept maps, sort-and-predict frames, concept frames...
- B11-0-U2:** Demonstrate an in-depth understanding of biological concepts. (GLO: D1)
Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models...
- B11-0-S8:** Analyze data and/or observations in order to identify patterns or draw conclusions. (GLOs: C2, C5, C8)
- B11-0-I1:** Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)
Include: print and electronic sources, resource people, and personal observations
- B11-0-I4:** Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLO: C5, C6)
- B11-0-G1:** Collaborate with others to achieve group goals and responsibilities. (GLOs: C2, C4, C7)
- B11-0-G2:** Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions. (GLOs: C2, C4, C7)
- B11-0-D1:** Identify and explore a current health issue. (GLOs: C4, C8)
Examples: clarify what the issue is, identify different viewpoints and/or stakeholders, research existing data/information...
- B11-0-D2:** Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)
Examples: positive and negative consequences of a decision, strengths, and weaknesses of a position...
- B11-0-D3:** Recognize that decisions reflect values and consider personal values and those of others when making a decision. (GLOs: C4, C5)
- B11-0-D4:** Recommend an alternative or identify a position, and provide justification. (GLO: C4)
- B11-0-D5:** Propose a course of action related to an issue. (GLOs: C4, C5, C8)
- B11-0-D6:** Evaluate the process used by self or others to arrive at a decision. (GLOs: C4, C5)
-

You Are the Patient—Performance Task, Part 2 (D1, D2, D3, D4, D5, D6)

Give students the following scenario:

You have just been told that you are experiencing renal failure. You must decide which treatment option to use.

Give different patient scenarios to different students, using Appendix 4.3: Patient Profiles (Teacher Background). Students with the same patient profile can meet to discuss treatment options, but the final decision is made individually, and then shared with a group of students who have different patient profiles. A written decision-making sheet will be submitted to the teacher, along with a reflection about the decision-making process.

WELLNESS

SPECIFIC LEARNING OUTCOMES

B11-4-08: Investigate and describe issues related to kidney failure and treatment options available. (GLOs: B3, C6, C8, D1)

Examples: organ transplant, personal lifestyle, dialysis...

The following questions can help guide students:

- What is the issue?
- What are my alternatives?
- What are the risks and benefits for each alternative?
- What is my decision?
- Why have I made this decision?
- Did the people in my group all make the same decision?
- Why would people make different decisions in a similar situation?



Suggestion for Assessment

Establish an assessment rubric for the decision-making sheet and for the reflection. Assessment criteria could include the following:

- The issue is clearly stated.
- The risks and benefits for each alternative are included.
- The decision is justified with supporting details related to the patient profile.
- The reflection shows an understanding of different factors that can affect a decision (e.g., values) and an awareness that there isn't one right answer.

Organ Donation—Reflection (D3)

Have students write a short reflection for inclusion in their Wellness Portfolio. Ask them to reflect on what their views on organ donation were when they began this section of the unit (see suggested activating strategy) and how their views have further developed, or perhaps even changed, upon completion of the learning activities in this section. Specific reference should be made to whether or not they have signed or will sign permission for organ donation.



SKILLS AND ATTITUDES OUTCOMES

- B11-0-U1:** Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)
Examples: using concept maps, sort-and-predict frames, concept frames...
- B11-0-U2:** Demonstrate an in-depth understanding of biological concepts. (GLO: D1)
Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models...
- B11-0-S8:** Analyze data and/or observations in order to identify patterns or draw conclusions. (GLOs: C2, C5, C8)
- B11-0-I1:** Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)
Include: print and electronic sources, resource people, and personal observations
- B11-0-I4:** Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLO: C5, C6)
- B11-0-G1:** Collaborate with others to achieve group goals and responsibilities. (GLOs: C2, C4, C7)
- B11-0-G2:** Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions. (GLOs: C2, C4, C7)
- B11-0-D1:** Identify and explore a current health issue. (GLOs: C4, C8)
Examples: clarify what the issue is, identify different viewpoints and/or stakeholders, research existing data/information...
- B11-0-D2:** Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)
Examples: positive and negative consequences of a decision, strengths, and weaknesses of a position...
- B11-0-D3:** Recognize that decisions reflect values and consider personal values and those of others when making a decision. (GLOs: C4, C5)
- B11-0-D4:** Recommend an alternative or identify a position, and provide justification. (GLO: C4)
- B11-0-D5:** Propose a course of action related to an issue. (GLOs: C4, C5, C8)
- B11-0-D6:** Evaluate the process used by self or others to arrive at a decision. (GLOs: C4, C5)
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NOTES

NOTES

UNIT 4:
EXCRETION AND WASTE MANAGEMENT
APPENDICES

Appendix 4.1A: Urinalysis Lab—Student Handout (BLM)

(1 of 3)

Objectives

- Conduct various tests on two known urine samples to identify the characteristics of urine.
- Identify the characteristics of an unknown urine sample.

Procedure

Design a table for your results. The table should have space to record your data and drawings for the following six tests on two known urine samples and a test for one unknown sample.

Part A: Analysis of Known Urine Samples

1. Making Initial Examination of Urine

- a) Examine each urine sample for odour. Describe the odour.
- b) Comment on the colour of the sample. Use terminology such as yellow, amber, dark, pale, and so on.
- c) Describe the clarity of the sample. Use terminology such as clear, cloudy, and so on.

2. Determining Specific Gravity

- a) Remove the hydrometer from its cylinder and empty the water from the cylinder into the sink. Fill the hydrometer cylinder three-quarters full with the urine sample.
- b) With a spinning motion, float the hydrometer in the urine. Be sure that the hydrometer stays suspended in the urine and does not adhere to the sides of the cylinder.
- c) When the hydrometer has stopped spinning and is not touching the sides of the cylinder, read the specific gravity of each sample at the bottom of the meniscus formed at the hydrometer column. Record the specific gravity.
- d) Pour the urine sample from the hydrometer cylinder into a test tube for Tests 3 and 4 of this laboratory activity. Pour any remaining urine back into the sample container.
- e) Rinse and repeat with each sample.
- f) Rinse and fill the hydrometer cylinder with water and place the hydrometer into the water.

3. Testing for pH

- a) Use pHYdrion (pH) testing paper to test the sample.
- b) Compare with the coloured pH scale provided.
- c) Record the pH in the table.
- d) Repeat with each sample.

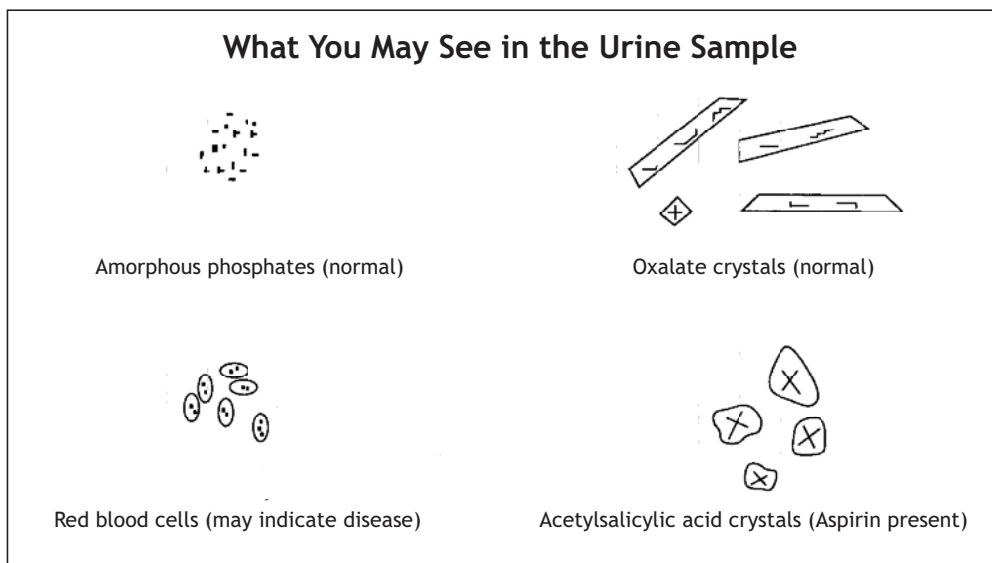
Appendix 4.1A:

Urinalysis Lab—Student Handout (BLM) (continued)

(2 of 3)

4. Analyzing Sediment

- In this test, you will be looking for blood cells, crystals, and phosphate granules in the urine sample. The presence of blood cells in the urine may be indicative of an abnormal condition, while the crystals may indicate the presence of drugs.
- Fill one small test tube with the urine sample.
- Set the tube in the centrifuge opposite someone else's sample and spin for five minutes. (Please check with the teacher that your setup is correct before you turn on the centrifuge.)
- After centrifuging, pour off the liquid or supernatant and place it into a clean test tube. Place the test tube to the side for use in Test 5.



- Shake the test tube to re-suspend the sediment in the small amount of urine left in the test tube. Pour this onto a slide and prepare a wet mount to observe under the microscope.
- Describe the sediment you observe under the microscope. (Remember to include any blood cells, phosphate granules, or crystals you observe.)
- Repeat for each sample.

Appendix 4.1A:

Urinalysis Lab—Student Handout (BLM) *(continued)*

(3 of 3)

5. Testing for Presence of Albumin (Protein)

- a) Observe and record the clarity of the supernatant.
- b) Separate the supernatant into two parts. Place one part to the side for use in Test 6.
- c) Pour the second part of the supernatant into a test tube and place the test tube in a hot water bath.
- d) Compare the cloudiness of the heated supernatant with the unheated portion of the supernatant. If cloudiness increases in the heated sample, then protein is present.
- e) Repeat with each sample.

6. Testing for Presence of Glucose

- a) Add 10 drops of Benedict's solution to the unheated portion of the supernatant from Test 5.
- b) Fill a second test tube one-quarter full of water and add 10 drops of Benedict's solution (this is the control).
- c) Boil both test tubes for 4 to 5 minutes and then allow the test tubes to cool.
- d) An orange precipitate will form when glucose is present.
- e) Repeat with each sample.

Part B: Analysis of an Unknown Urine Sample

You will be required to complete an analysis of an unknown urine sample using the procedures you have learned in Part A.

1. Obtain 50 mL of one of the unknown urine samples.
2. Perform the urine analysis procedure on your unknown sample and compare the results to the known samples.
3. Check your results with the teacher's key.

Analysis

1. Research to determine the normal ranges of the tests you have completed for human urine.
2. Pick one specific test and research the possible diseases or medical illnesses that can occur if a person exceeds the normal range.

Appendix 4.1B:

Urinalysis Lab (Teacher Background)

(1 of 3)

Suggestions for Instruction

The following concepts may be developed in this lab:

- kidney function and disease
- chemical reactions

Review/discuss kidney function and the formation of urine. Include a look at conditions and diseases that might be tested for with a urinalysis.

Procedure

Part A: Analysis of Known Urine Samples

1. Making Initial Examination of Urine

Students make a visual examination of the odour and colour of the urine sample. Although the urine is synthetic, it may take some time for students to “settle down” with the idea of working with urine. It is important for them to consider the samples as “real” and perform the procedures accordingly. This means that they should keep their equipment clean and be aware of potential health concerns if they spill their samples.

2. Determining Specific Gravity

Some time may be needed to show the class the proper use of a hydrometer and how it is used to determine specific gravity. Students should understand that having a change in the specific gravity of urine could indicate a medical problem.

3. Testing for pH

To determine the pH of urine, pH paper is used.

4. Analyzing Sediment

Analysis of sediment can provide clues such as an abnormal condition of blood in the urine or the presence of crystals in the urine that may indicate drug use. Provide students with diagrams to assist in identification.

5. Testing for Presence of Albumin (Protein)

Using part of the supernatant, students heat the liquid. If protein is present, it will denature and make the solution cloudy.

6. Testing for Presence of Glucose

Testing for sugar may give an indication of diseases such as diabetes. Students will need to use care when working with Benedict’s solution and a hot plate.

Appendix 4.1B: Urinalysis Lab (Teacher Background) *(continued)*

(2 of 3)

Part B: Analysis of an Unknown Urine Sample (Practice)

Provide students with urine samples to choose from and ask them to determine the composition of the urine by performing the various tests. Each sample has a different set of conditions based on how you prepare the sample. You may choose to make up your own samples or you may choose to follow a sample preparation key.

Materials

- stock and sample urine solutions
- hydrometers
- pH testing paper
- centrifuge
- microscope (including slides and cover slips)
- test tubes
- beakers
- hot plate
- Benedict's solution
- water
- clock or watch

Preparation of Urine Samples

Basic Stock Solution

To 1 L of distilled water add:

- 3 g sodium chloride (NaCl)
- 3 g ammonium oxalate
- 3 g potassium phosphate

For Tests 1 to 6 of the urine analysis activity, make the following solution:

To the 1 L Basic Stock Solution, add:

- 2 drops of 1M HCl
- 1 acetylsalicylic acid (ASA) tablet
- 1 g glucose
- 1 g albumin powder
- 5 g urea
- blood cells (obtain fresh meat from butcher or meat department)

Appendix 4.1B:
Urinalysis Lab (Teacher Background) (continued)

Sample Solutions

To a 1 L Basic Stock Solution for each sample, add the following:

Sample #1

- 24 mL 0.1M NH₃
- 1 g glucose

Sample #2

- 5 g urea
- 1 g albumin powder

Sample #3

- 1 g glucose
- 1 g albumin powder
- blood cells

Sample #4

- 1 ASA tablet
- 2 drops of 3M HCl

Note

- Solutions will keep for about a week in the fridge.
- Adjust pH as required.
- Fresh blood cells should be added to appropriate sample(s) each time the sample is used, as they tend to lyse in solution.
- Blood obtained from a butcher or a meat department usually contains few whole blood cells. Centrifuge blood and pour off liquid. Re-suspend cells in a small portion of “urine” and add to sample.

Sample Preparation Key

Sample #	pH	Protein (Albumin)	Glucose	Sediment			Specific Gravity
				Amorphous Phosphate	Crystals	Blood	
1	8	–	+	+	Oxalate	–	Varies
2	6	+	–	+	Oxalate	–	Varies
3	6	+	+	+	Oxalate	+	Varies
4	2/3	–	+	+	Oxalate, ASA tablet	–	Varies

Appendix 4.2: Debating Skills Rubric (BLM)

(1 of 1)

Debating Rubric	Exemplary 4	Accomplished 3	Developing 2	Beginning 1
Organization of Opening Statement	always maintains focus on the topic	maintains focus on the topic, with few exceptions	does not consistently maintain focus on the topic	does not maintain focus on the topic
Use of Evidence to Support Claims	always uses evidence to support claims	usually uses evidence to support claims	rarely uses evidence to support claims	does not use evidence to support claims
Persuasiveness	arguments are always clear and convincing	arguments are generally clear and convincing	arguments are sometimes clear and convincing	arguments are not clear or not convincing
Teamwork	always uses team members effectively	generally uses team members equally effectively	sometime uses team members equally effectively	team members are not used effectively
Organization of Closing Statement	always responds with points that are specific to the topic	usually responds with points that are specific to the topic	sometimes responds with points that are specific to the topic	does not respond with points specific to the topic

Appendix 4.3: Patient Profiles (Teacher Background)

(1 of 1)

- ✓ 15-year-old who has had kidney disease since the age of three
- ✓ 23-year-old who received a kidney transplant five years ago, but the kidney was rejected
- ✓ 45-year-old recovering alcoholic who was diagnosed with kidney failure three years ago due to the medications he was taking
- ✓ 61-year-old woman with years of high blood pressure, which probably caused her kidneys to fail
- ✓ 26-year-old male who has a rare kidney disease
- ✓ 55-year-old female, smoker, with type 2 diabetes, who does not exercise regularly
- ✓ 65-year-old male with atherosclerosis, who has a heart condition and suffered a stroke one year ago
- ✓ 70-year-old female from a remote northern community