

Focused Learning Lesson Science
Science
Grades: 10-12
LS-H-F1

Overview:

This lesson is to be used to help students identify the structure and function of the excretory system. Students will complete and use a concept map to understand the interrelationships of the organs in the excretory system. They will then answer guided questions to further clarify how the excretory system functions.

Approximate duration: 45 minutes

Benchmark:

LS-H-F1 identifying the structure and functions of organ systems

Biology GLEs:

32. Analyze the interrelationships of organs in major systems.
33. Compare structure to function of organs in a variety of organisms.
In addition, this lesson partially addresses GLE 34 for benchmark LS-H-F2.
34. Explain how body systems maintain homeostasis.

Benchmark:

SI-H-A3 using technology and mathematics to improve investigations and communications

SI GLE: 5. Utilize mathematics, organizational tools, and graphing skills to solve problems.

Objective:

The learner will identify the major organs of excretion and summarize the function of each.

Teacher Preparation:

1. Copy Excretory System Concept map and Questions and answer page (Attachment 1a and 1b). One for every student.
2. Make a transparency of the unfilled concept map worksheet.
3. Prepare to explain each part of the concept map as it is completed with the students.

Materials/Equipment/Resources:

- Overhead projector
- Excretory system Concept map(Attachment1a)
- Excretory system Question and answer page (Attachment 1b)
- Key for concept map (Attachment 2)
- Rubric for questions on worksheet (Attachment 3)

Lesson Procedures:*Set or Opener:*

Teacher should ask students “What is the purpose of the excretory system?” Accept all reasonable answers. The teacher should give guided questions to students using their answers to give a complete definition of the purpose of the excretory system. For a short answer such as, “removes wastes from our bodies,” the teacher should then ask the students, “How does the excretory system remove wastes?” There are three possible answers. The teacher should guide the students to eventually answer all three possibilities; i.e., breathing, sweating and urinating. All three of these possibilities should be briefly explained as the students answer them.

Body of the Lesson:

1. Pass out the excretory concept map. (Attachment 1A)
2. Place the concept map transparency on the overhead projector.
3. Begin by pointing out to the students the center of the map.
4. Using student answers to guided questions and the key, the teacher should complete the concept map and have the students fill in their own as the lesson continues.
5. When the concept map is complete, the teacher should hand out Part B, question and answer page, and read the directions to part B. Have the students complete the questions independently. Allow students approximately 20 minutes to finish section B.
6. When students are finished, collect all worksheets.

Closure:

Review the concept map, asking guided questions. Ask students the questions that appeared on the worksheet, accepting all reasonable responses and reaching an agreement on the most satisfactory responses.

Attachments:

- Attachment 1A: Excretory System Concept Map
- Attachment 1B: Part B, Questions
- Attachment 2: Concept Map Key
- Attachment 3: Rubric (for questions on worksheet)
- Attachment 4: Background Information

Assessment items: The question and answer page will be used to assess student understanding and for performance points.

Reference Links and Technology Connections:

Daniel, Hummer, Kaskel. *Biology: An Everyday Experience*. Ohio:Glencoe/McGraw-Hill, 2003. pp.274-280.

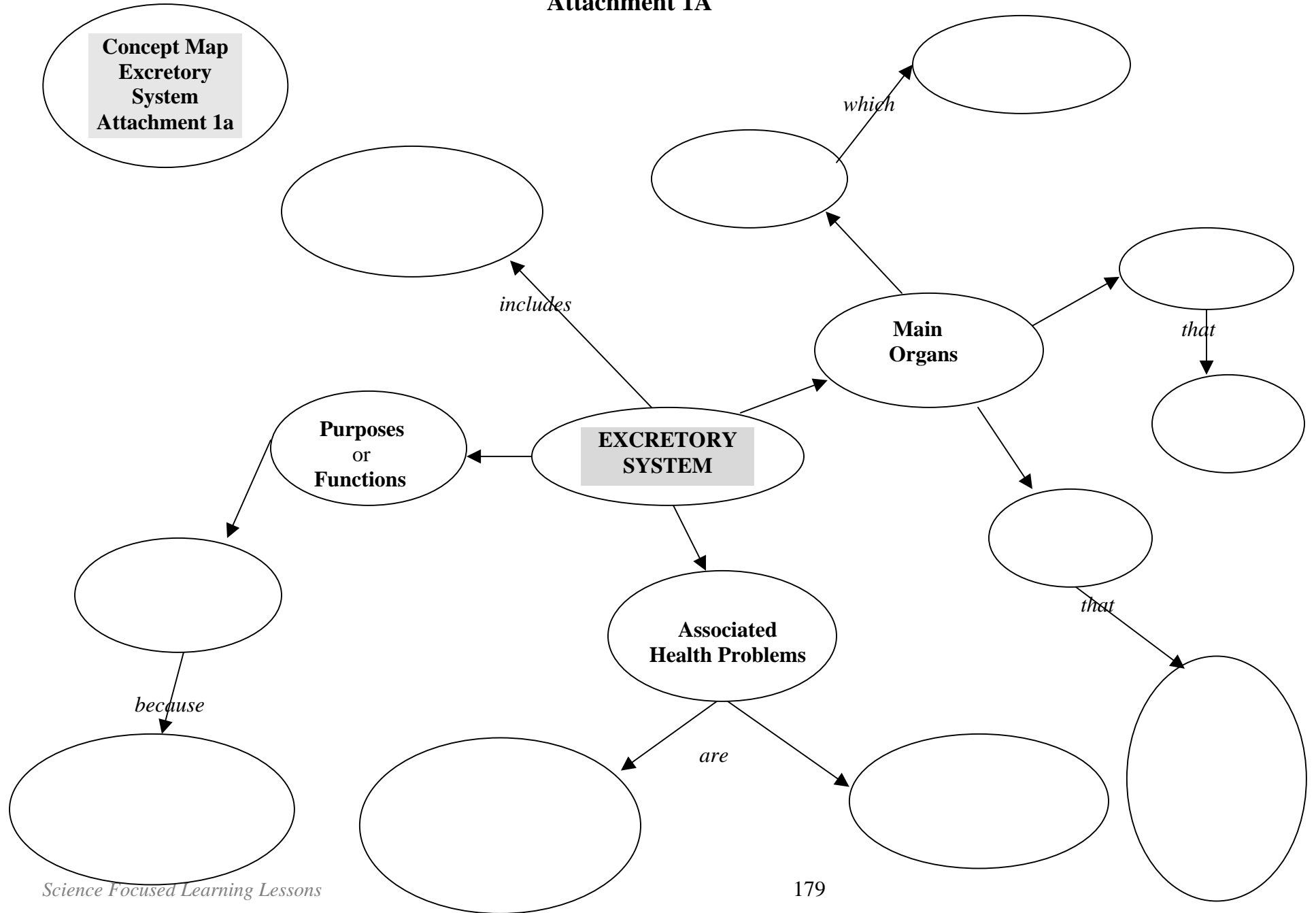
Bernstein, Leonard. *Globe Biology*. New Jersey: Globe Fearon, 1999. pp. 409-412.

Online Biology Book. (February, 2004).

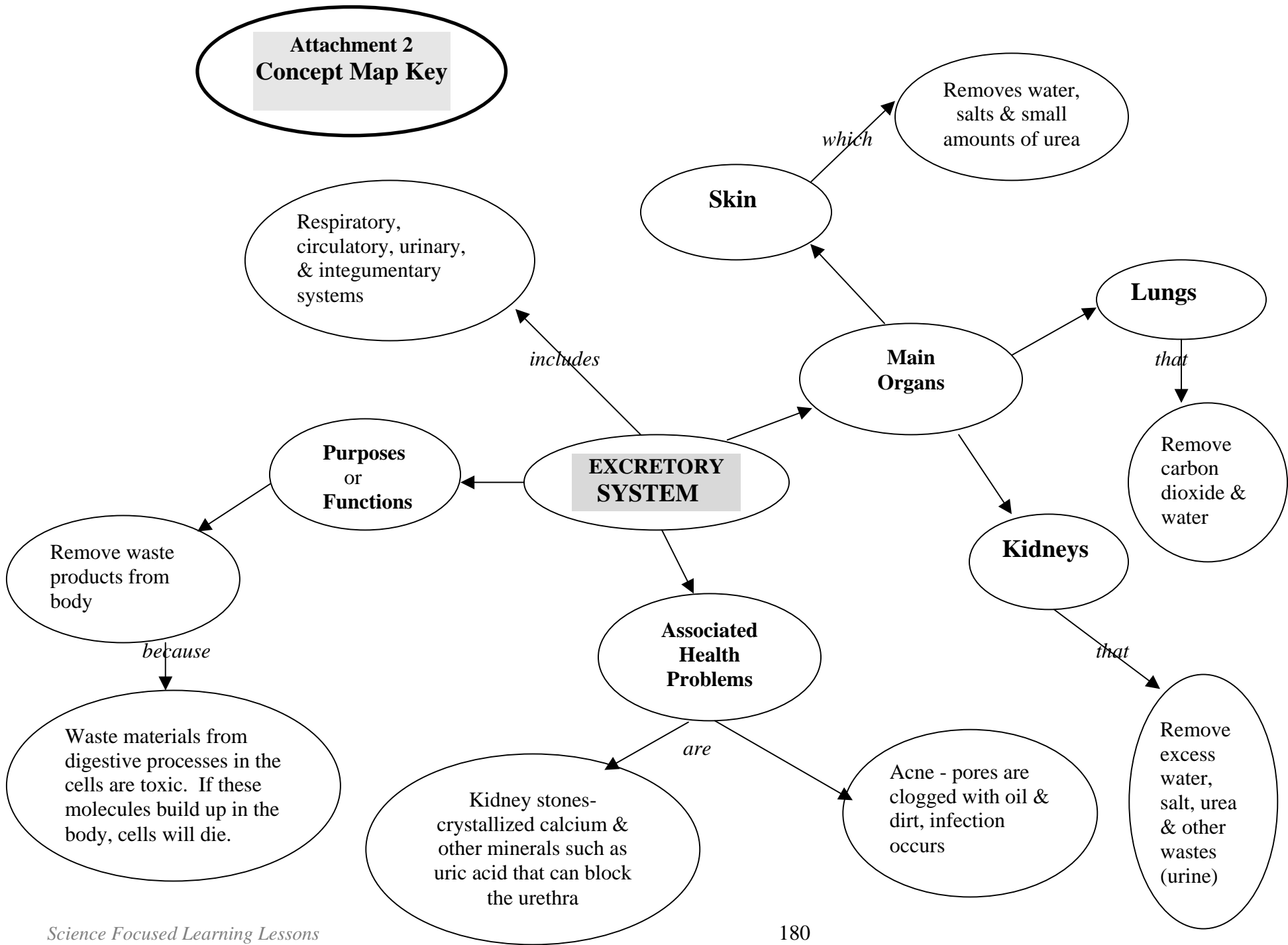
[www.emc.maricopa.edu/faculty/farabee/ BIOBK/BioBookEXCRET.html](http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookEXCRET.html)

Lubey’s BioHELP! (February, 2004) www.borg.com/~lubehawk/hexcrcsys.htm

Attachment 1A



**Attachment 2
Concept Map Key**



Attachment 3
Rubric for Questions 1-5
Excretory System

Score	Description
4	<ul style="list-style-type: none"> • The response demonstrates in-depth understanding of the relevant content. • Where appropriate, student offers insightful interpretations. • Response is written in complete sentences.
3	<ul style="list-style-type: none"> • The response demonstrates an understanding of major concepts, although less important ideas or details may be overlooked or misunderstood. • Response is written with one incomplete sentence.
2	<ul style="list-style-type: none"> • The response demonstrates gaps in conceptual understanding. • Response is written with one or more incomplete sentences.
1	<ul style="list-style-type: none"> • The response shows minimal understanding of the concepts. • Response is written with one or more incomplete sentences.
0	<ul style="list-style-type: none"> • The response is completely incorrect. • No response written.

Attachment 4

Background Information

Cells produce water and carbon dioxide as by-products of metabolic breakdown of sugars, fats, and proteins. Chemical groups such as nitrogen, sulfur, and phosphorous must be stripped from the large molecules to which they were formerly attached as part of preparing them for energy conversion. The continuous production of metabolic wastes establishes a steep concentration gradient across the plasma membrane, causing wastes to diffuse out of cells and into the extra-cellular fluid.

The process of excretion involves finding and removing waste materials produced by the body. The primary organs of excretion are the lungs, kidneys, and skin. Waste gases are carried by blood traveling through the veins to the lungs, where gas exchange takes place. Dead cells and sweat are removed from the body through the skin, which is part of the integumentary system.

Single-celled organisms have most of their wastes diffuse out into the outside environment. Multi-cellular organisms, and animals in particular, must have a specialized organ system to concentrate and remove wastes from intercellular fluids into the blood capillaries and eventually deposit that material at a collection point for removal entirely from the body.

Regulation of Extra-cellular Fluids

Excretory systems regulate the chemical composition of body fluids by removing metabolic wastes and retaining the proper amounts of water, salts, and nutrients. Components of this system in vertebrates include the kidneys, liver, lungs, and skin. Not all animals use the same routes or excrete their wastes the same way humans do. Excretion applies to metabolic waste products that cross a plasma membrane. Elimination of solid waste is the removal of feces.

Nitrogen Wastes

Nitrogen wastes are a byproduct of protein metabolism. Amine groups are removed from amino acids prior to energy conversion. The NH_2 (amine group) combines with a hydrogen ion (proton) to form ammonia (NH_3). Ammonia is very toxic and usually is excreted directly by marine animals. Terrestrial animals usually need to conserve water. Ammonia is converted to urea, a compound the body can tolerate at higher concentrations than ammonia. Birds and insects secrete uric acid that they make through large energy expenditure but little water loss. Amphibians and mammals secrete urea that they form in their liver. Amino groups are turned into ammonia, which in turn is converted to urea, dumped into the blood and concentrated by the kidneys.

Excretory System Functions:

1. Collect water and filter body fluids.
2. Remove and concentrate waste products from body fluids and return other substances to body fluids as necessary for homeostasis.
3. Eliminate excretory products from the body.

Human Excretory Organs

1. KIDNEYS

You probably know that the kidneys filter blood, so it's no surprise that there are a couple of blood vessels attached directly to each kidney. The full names of these vessels are the *renal artery* and the *renal vein*. Kidneys are the major organs of the excretory system!

2. LIVER

The liver is a large, important organ. In fact it is the largest internal organ in our bodies. Its numerous functions make it "part" of the circulatory, digestive, and excretory systems. Its function in the excretory system includes:

- Some proteins & other nitrogenous compounds are broken down in the liver by a process called *deamination*.
- As a result of these reactions, a nitrogenous waste called *urea* is formed.

3. SKIN

As you already know, sweat comes out of pores in your skin. As you may not know, sweat is a mixture of three metabolic wastes: water, salts, & urea. So as you sweat, your body accomplishes two things:

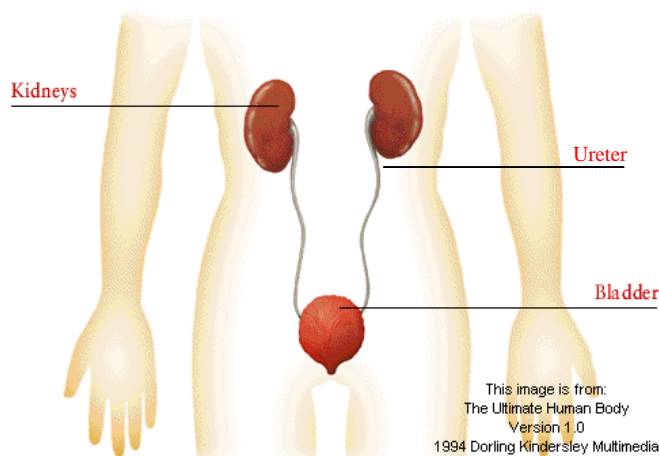
- Sweating has a cooling effect on the body.
- Metabolic wastes are excreted.

4. LUNGS

As respiration occurs, carbon dioxide is produced as a waste product. As the carbon dioxide accumulates in body cells, it eventually diffuses out of the cells and into the bloodstream, which eventually circulates to the lungs. And here, in the alveoli of the lungs, carbon dioxide diffuses from the blood, into the lung tissue, and then leaves the body every time we exhale. We should note that some water vapor also exits the body during exhalation.

The Human Urinary System (Often called the excretory system)

The urinary system is made-up of the kidneys, ureters, bladder, and urethra. The nephron, an evolutionary modification of the nephridium, and is the kidney's functional unit. Waste is filtered from the blood and collected as urine in each kidney. Urine leaves the kidneys by ureters, and collects in the bladder. The bladder can distend to store urine that eventually leaves through the urethra.



Homeostasis

Kidneys perform a number of homeostatic functions:

- Maintain volume of extra-cellular fluid
- Maintain ionic balance in extra-cellular fluid
- Maintain pH and osmotic concentration of the extra-cellular fluid
- Excrete toxic metabolic by-products such as urea, ammonia, and uric acid

Hormone Control of Water and Salt

Water reabsorption is controlled by the antidiuretic hormone (ADH) in negative feedback. ADH is released from the pituitary gland in the brain. Dropping levels of fluid in the blood signal the hypothalamus to cause the pituitary to release ADH into the blood. ADH acts to increase water absorption in the kidneys. This puts more water back into the blood, increasing the concentration of the urine. When too much fluid is present in the blood, sensors in the heart signal the hypothalamus to cause a reduction of the amounts of ADH in the blood. This increases the amount of water absorbed by the kidneys, producing large quantities of more dilute urine.

References for Background Information:

Online Biology Book (February, 2004)

[www.emc.maricopa.edu/faculty/farabee/ BIOBK/BioBookEXCRET.html](http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookEXCRET.html)

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