LESSON 27.4

Getting Started

Objectives

27.4.1 Describe the methods animals use to manage nitrogenous wastes.

27.4.2 Explain how aquatic animals eliminate wastes.

27.4.3 Explain how land animals eliminate wastes.

Student Resources

Study Workbooks A and B, 27.4 Worksheets

Spanish Study Workbook, 27.4 Worksheets

BIOLOGY.com Lesson Overview • Lesson Notes • Activity: Art in Motion • Assessment: Self-Test, Lesson Assessment

For corresponding lesson in the **Foundation Edition**, see pages 656–659.

Build Background

MATERIALS beaker, household ammonia

As students observe, pour some household ammonia from a commercial bottle into a clear glass beaker. Read the warning labels on the bottle, including cautions about swallowing and avoiding contact with eyes. Explain that although the commercial form is not pure ammonia, it can still be harmful to the body. Then, explain that natural processes within cells, especially the breakdown of proteins, produce ammonia. All animals must have some process for releasing or converting ammonia.

NATIONAL SCIENCE EDUCATION STANDARDS

UNIFYING CONCEPTS AND PROCESSES

I, V

CONTENT

C.1.a, C.5.d

INQUIRY

A.1.b, A.2.a

27.4 Excretion

Key Questions

- *How do animals manage toxic nitrogenous waste?*
- *How do aquatic animals eliminate wastes?*
- *How do land animals remove wastes while conserving water?*

Vocabulary

excretion • kidney • nephridium • Malpighian tubule

Taking Notes

Preview Visuals Note three questions you have about **Figure 27–15**. As you read, try to answer your questions.

THINK ABOUT IT If you think about the first three lessons in this chapter, you'll realize that they are missing something. We've discussed how respiratory systems obtain oxygen and get rid of carbon dioxide. We've also discussed how animals obtain and digest food and get rid of indigestible material. But cellular respiration generates other kinds of wastes that are released into body fluids and that must be eliminated from the body. What are these wastes and how do animals get rid of them?

The Ammonia Problem

How do animals manage toxic nitrogenous waste?

The breakdown of proteins by cells releases a nitrogen-containing, or nitrogenous, waste: ammonia. This creates a problem, because ammonia is poisonous! Even moderate concentrations of ammonia can kill most cells. Animal systems address this difficulty in one of two ways. **Animals either eliminate ammonia from the body quickly or convert it into other nitrogenous compounds that are less toxic.** The elimination of metabolic wastes, such as ammonia, is called **excretion.** Some small animals that live in wet environments rid their bodies of ammonia by allowing it to diffuse out of their body fluids across their skin. Most larger animals, and even some smaller ones that live in dry environments, have excretory systems that process ammonia and eliminate it from the body.

FIGURE 27–13 Ammonia Some aquatic animals, such as this zebra flatworm, release ammonia as soon as they produce it.

Storing Nitrogenous Wastes Animals that cannot dispose of ammonia continuously, as it is produced, have evolved ways to hold, or "store," nitrogenous wastes until they can be eliminated. In most cases, ammonia itself cannot be stored in body fluids, because it is too toxic. Insects, reptiles, and birds typically solve this problem by converting ammonia into a sticky white compound called uric acid, which you can see in **Figure 27–14.** Uric acid is much less toxic than ammonia and is also less soluble in water. Mammals and some amphibians, on the other hand, convert ammonia to a different nitrogenous compound—urea. Like uric acid, urea is less toxic than ammonia, but unlike uric acid, urea is highly soluble in water.

UbD Teach for Understanding

ENDURING UNDERSTANDING Animals have evolved diverse ways to carry out basic life processes and maintain homeostasis.

GUIDING QUESTION How do animals in different environments excrete metabolic wastes?

EVIDENCE OF UNDERSTANDING *After completing the lesson, assign the following assessment to show students understand why animals must remove ammonia from their bodies and how animals excrete nitrogenous wastes.* Have students work in small groups to prepare a brief poster presentation that explains why all animals carry out excretion and how the excretory system of one type of animal functions. Have each group present its poster to the class, and encourage other students to ask questions.

Maintaining Water Balance Getting rid of any type of nitrogenous waste involves water. For that reason, excretory systems are extremely important in maintaining the proper balance of water in blood and body tissues. In some cases, excretory systems eliminate excess water along with nitrogenous wastes. In other cases, excretory systems must eliminate nitrogenous wastes while conserving water. Many animals use **kidneys** to separate wastes and excess water from blood. This waste and water forms a fluid called urine.

Kidneys perform these functions despite a serious limitation: No living cell can actively pump water across a membrane. Yet kidneys need to separate water from waste products. You may recall that cells can pump ions across their membranes. Kidney cells pump ions from salt to create osmotic gradients. Water then "follows" those ions passively by osmosis. This process works well but leaves kidneys with one weakness: They usually cannot excrete excess salt.

In Your Notebook *Explain how kidneys remove excess water from the blood.*

FIGURE 27–14 Other Nitrogenous Compounds Large and/or terrestrial animals either convert ammonia to uric acid and excrete it as sticky white guano, as have these gulls, or they convert ammonia into urea and release it, diluted, as urine.

MYSTERY CLUE

Humans, like most land-dwelling mammals, have evolved kidneys that are designed to conserve salt, not to get rid of it. How could this have posed a problem for the sick "survivor"?

Excretion in Aquatic Animals

How do aquatic animals eliminate wastes?

Aquatic animals have an advantage in getting rid of nitrogenous wastes because they are surrounded by water. **In general, aquatic animals can allow ammonia to diffuse out of their bodies into surrounding water, which dilutes the ammonia and carries it away.** But aquatic animals still face excretory challenges. Many need to either eliminate water from their bodies or to conserve it, depending on whether they live in fresh or salt water. The excretion issues of aquatic animals are summarized in **Figure 27–15** on the next page.

Quick Facts

DEALING WITH AMMONIA

Protein is an essential part of animals' diets, and the digestion of protein produces amino acids. Animals use some of these amino acids to produce the proteins and other compounds they need. The amino acids that proteins are made of also provide energy for cellular respiration, and this process produces ammonia as a byproduct. Because ammonia is highly poisonous, it must be eliminated from the body. Invertebrates that allow ammonia to diffuse out of their bodies are limited to aquatic environments, because water is necessary to dilute the ammonia. Therefore, the ability to produce the relatively harmless uric acid is an important reason why invertebrates, particularly insects, have been so successful on land. Also, because uric acid is excreted in a solid or semisolid form, these land animals are able to conserve precious water.

Teach

Lead a Discussion

Discuss with students the importance of keeping the proper water balance in a body. Explain that methods of maintaining water balance differ among animals, but in order to maintain homeostasis, each type of animal must maintain the appropriate balance of water in its body.

Ask What animals might need to eliminate excess water to maintain a water balance in their bodies? *(animals that live in water, such as fishes and aquatic invertebrates)*

Ask What animals might need to conserve water to maintain water balance? *(terrestrial animals, especially those that live in very dry environments)*

DIFFERENTIATED INSTRUCTION

LPR **Less Proficient Readers** Some students may have trouble following the explanation of how kidney cells separate water from waste products. To help students understand the process of creating osmotic gradients, write the following steps and concepts on the board. Then, make sure students understand each before moving on to the next.

- Kidney cells pump ions from salt across membranes.
- This results in different concentrations of ions on the two sides of the membranes.
- There is a lower concentration of water on the side with more ions than on the other side.
- Water always diffuses across a membrane from the side of higher concentration to the side of lower concentration.
- So, water will diffuse across the membrane to the side where there are more ions (and less water).

MYSTERY CLUE

Have students review why kidneys cannot excrete excess salt. Then, ask them to think about the damage a buildup of salt could cause to the kidneys in terms of water balance in the cells. Students can go online to **Biology.com** to gather their evidence.

Answers

IN YOUR NOTEBOOK Kidney cells pump ions from salt to create osmotic gradients. Water then "follows" those ions passively by osmosis.

Teach continued

VISUAL ANALOGY

Use **Figure 27–15** to discuss the differences in how freshwater and saltwater animals maintain water balance in their bodies.

Ask Why don't freshwater fishes drink water? *(Water moves into their bodies by osmosis. Therefore, to maintain proper water balance in their bodies they need to get rid of water, not take in more.)*

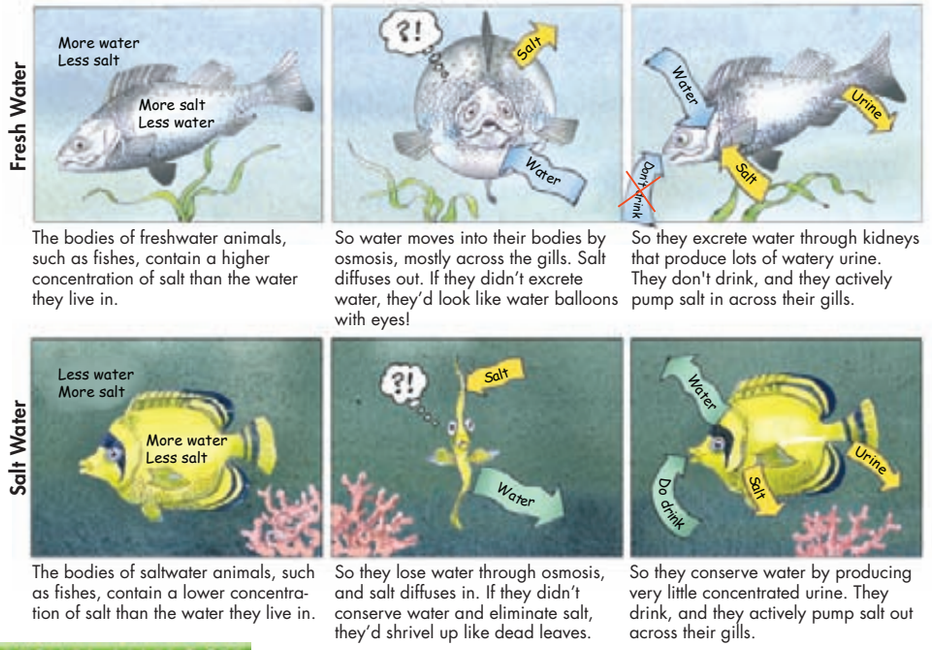
Ask Why do saltwater fishes lose water through osmosis? *(Their bodies contain a lower concentration of salt than the water they live in. As a result, water diffuses out of their bodies.)*

DIFFERENTIATED INSTRUCTION

ELL English Language Learners Call on volunteers to read aloud the annotation for a panel. Then, call on another student to describe what the cartoon in that panel shows. Ask volunteers to summarize what the panel explains.

LPR Less Proficient Readers Suggest students work in pairs to check comprehension of **Figure 27–15.** Have one student ask a question about a panel and the other student answer with a response derived from reading the annotation and looking at the cartoon. Tell students to make sure both partners understand a panel before moving on.

BIOLOGY.com Have students review the differences in how freshwater and saltwater animals maintain water balance in their bodies with **Art in Motion: Excretion in Aquatic Animals.**



The bodies of freshwater animals, such as fishes, contain a higher concentration of salt than the water they live in.

So water moves into their bodies by osmosis, mostly across the gills. Salt diffuses out. If they didn't excrete water, they'd look like water balloons with eyes!

So they excrete water through kidneys that produce lots of watery urine. They don't drink, and they actively pump salt in across their gills.

The bodies of saltwater animals, such as fishes, contain a lower concentration of salt than the water they live in.

So they lose water through osmosis, and salt diffuses in. If they didn't conserve water and eliminate salt, they'd shrivel up like dead leaves.

So they conserve water by producing very little concentrated urine. They drink, and they actively pump salt out across their gills.

VISUAL ANALOGY

EXCRETION IN AQUATIC ANIMALS

FIGURE 27–15 All animals must rid their bodies of ammonia while maintaining appropriate water balance. Freshwater and saltwater animals face very different challenges in this respect.
Interpret Visuals ***What are two ways freshwater fishes avoid looking like "water balloons with eyes"?***

Freshwater Animals Many freshwater invertebrates lose ammonia to their environment by simple diffusion across their skin. Many freshwater fishes and amphibians eliminate ammonia by diffusion across the same gill membranes they use for respiration.

The situation is more complex for some freshwater invertebrates and most freshwater fishes. The concentration of water in their freshwater environments is higher than the concentration of water in their body fluids. So water moves passively into their bodies by osmosis, and salt leaves by diffusion. To help maintain water balance, flatworms have specialized cells called flame cells that remove excess water from body fluids. That water travels through excretory tubules and leaves through pores in the skin. Amphibians and freshwater fishes typically excrete excess water in very dilute urine. Freshwater fishes also pump salt actively inward across their gills.

Saltwater Animals Marine invertebrates and vertebrates typically release ammonia by diffusion across their body surfaces or gill membranes. Many marine invertebrates have body fluids with water concentrations similar to that of the seawater around them. For that reason, these animals have less of a problem with water balance than do freshwater invertebrates. Marine fishes, however, tend to lose water to their surroundings because their bodies are less salty than the water they live in. These animals actively excrete salt across their gills. Their kidneys also produce small quantities of very concentrated urine to conserve water.

796 BIOLOGY.com Search Lesson 27.4 GO • Art in Motion

UbD Check for Understanding

HAND SIGNALS

Ask students the following questions, and have them show a thumbs-up sign if they think they can answer the question correctly, a thumbs-down sign if they definitely can't, or a waving-hand sign if they're not sure.

- What is the purpose of excretion?
- What can most aquatic animals do to eliminate ammonia from their bodies?
- How do mammals and reptiles differ in the way they excrete nitrogenous wastes?

ADJUST INSTRUCTION

For any question that received a thumbs-down or waving-hand sign, ask students to find where the topic is discussed in the text and write a one- or two-sentence answer to the question. Ask volunteers to read their answers to the class.

Answers

FIGURE 27–15 Their kidneys produce lots of watery urine, and they don't drink.

Excretion in Terrestrial Animals

How do land animals remove wastes while conserving water?

Land animals also face challenges. In dry environments, they can lose large amounts of water from respiratory membranes that must be kept moist. In addition, they must eliminate nitrogenous wastes in ways that require disposing of water—even though they may not be able to drink water. **Figure 27–16** shows the excretory systems of some terrestrial animals.

Terrestrial Invertebrates **Some terrestrial invertebrates, including annelids and mollusks, produce urine in nephridia.** **Nephridia** (singular: nephridium) are tubelike excretory structures that filter body fluid. Typically, body fluid enters the nephridia through openings called nephrostomes and becomes more concentrated as it moves along the tubes. Urine leaves the body through excretory pores. **Other terrestrial invertebrates, such as insects and arachnids, convert ammonia into uric acid.** Nitrogenous wastes, such as uric acid, are absorbed from body fluids by structures called **Malpighian tubules,** which concentrate the wastes and add them to digestive wastes traveling through the gut. As water is absorbed from these wastes, they form crystals that form a thick paste, which leaves the body through the anus. This paste contains little water, so this process minimizes water loss.

Terrestrial Vertebrates In terrestrial vertebrates, excretion is carried out mostly by the kidneys. **Mammals and land amphibians convert ammonia into urea, which is excreted in urine. In most reptiles and birds, ammonia is converted into uric acid.** Reptiles and birds pass uric acid through ducts into a cavity that also receives digestive wastes from the gut. The walls of this cavity absorb most of the water from the wastes, causing the uric acid to separate out as white crystals. The result is a thick, milky-white paste that you would recognize as "bird droppings."

Quick Lab GUIDED INQUIRY

Water and Nitrogen Excretion

1. Label one test tube Urea and the other Uric Acid. Place 2 grams of urea in the one labeled Urea. Place 2 grams of uric acid in the one labeled Uric Acid.
2. Add 15 mL of water to each test tube. Stopper and shake the test tubes for 3 minutes.
3. Observe each test tube. Record your observations.

Analyze and Conclude

1. Observe Which substance—urea or uric acid—is less soluble in water? Explain.

2. Infer Reptiles excrete nitrogenous wastes in the form of uric acid. How does this adaptation help reptiles survive on land?

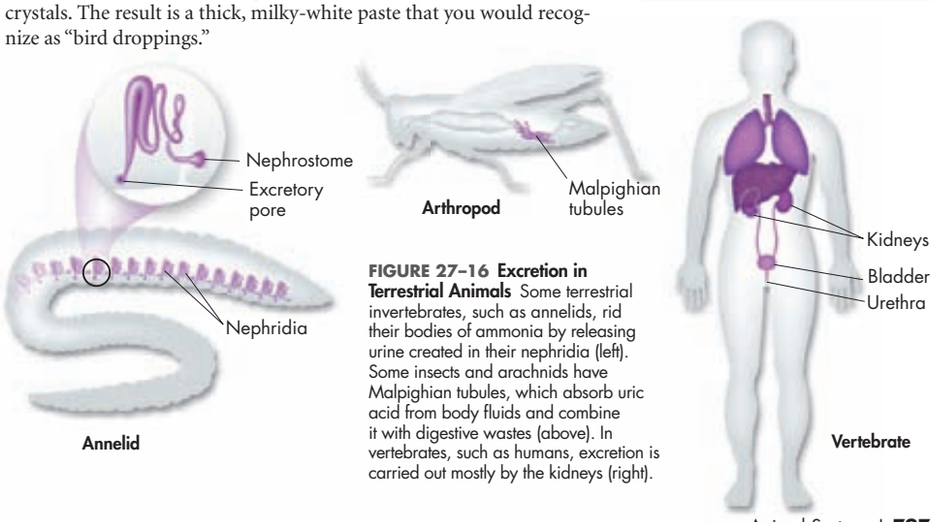


FIGURE 27–16 Excretion in Terrestrial Animals Some terrestrial invertebrates, such as annelids, rid their bodies of ammonia by releasing urine created in their nephridia (left). Some insects and arachnids have Malpighian tubules, which absorb uric acid from body fluids and combine it with digestive wastes (above). In vertebrates, such as humans, excretion is carried out mostly by the kidneys (right).

Lead a Discussion

Use **Figure 27–16** to discuss excretion in terrestrial animals. Point out that the three systems shown in the figure are representative examples, and that other land invertebrates and vertebrates have similar, if not identical, systems. In discussing each example, call on students to read aloud related material in the text.

DIFFERENTIATED INSTRUCTION

ELL English Language Learners Have English language learners work with native English speakers to practice the pronunciation and develop understanding of challenging terms related to excretion, including *nephridia, nitrogenous wastes,* and *Malpighian tubules.*

ELL Focus on ELL: Extend Language

INTERMEDIATE, ADVANCED, AND ADVANCED HIGH SPEAKERS Have students fill in a **Vocabulary Word Map** for the term *excretion.* First, ask them to write *excretion* in the top rectangle. As they read the lesson, have them think of words and concepts that relate to excretion and write them in the rectangles below. Accept short phrases from intermediate speakers. Encourage advanced speakers to write complete sentences. Require advanced high speakers to use complex sentences that show they fully understand the lesson concepts. Then, lead a discussion about students' maps and how they relate to the lesson material.

Study Wkbks A/B, Appendix S32, Vocabulary Word Map. **Transparencies,** GO17.

Quick Lab

PURPOSE Students will be able to infer how a nitrogenous waste's solubility affects excretion.

MATERIALS 2 test tubes, 2 stoppers, test-tube rack, graduated cylinder, balance, urea, uric acid, glass-marking pencil

SAFETY Read safety information for urea and uric acid before doing the lab. Make sure students wear goggles, a lab apron, and heat-resistant gloves. Caution them to handle glassware carefully and not to touch any broken glass. Have students wash their hands when finished.

PLANNING Before the lab, discuss why terrestrial animals must conserve water. Review solubility with students, and explain that some substances dissolve easily in water, while others do not.

ANALYZE AND CONCLUDE

1. Uric acid is less soluble. The solution of urea appears to be clear, whereas the uric acid produced solid crystals in the water.
2. Sample answer: To live successfully on land, reptiles must conserve water. Because uric acid crystallizes as a solid precipitate in water, it does not carry water with it when it is excreted from the body.

Assess and Remediate

EVALUATE UNDERSTANDING

Play a game in which you give students the answers to questions about animal excretion and students respond with the right questions. Students can play the game in teams or as individuals. Then, have students complete the 27.4 Assessment.

REMEDIATION SUGGESTION

L1 **Struggling Students** If your students have trouble answering **Question 3b,** ask them to think about which of the two compounds are soluble in water. Point out that the insoluble compound uric acid does not take water with it when it is eliminated from the body. Therefore, excreting uric acid rather than urea conserves water.

BIOLOGY.com Students can check their understanding of lesson concepts with the **Self-Test** assessment. They can then take an online version of the **Lesson Assessment.**

Adaptations to Extreme Environments The kidneys of most terrestrial vertebrates are remarkable organs, but the way they operate results in some limitations. Most vertebrate kidneys, for example, cannot excrete concentrated salt. That's why most vertebrates cannot survive by drinking seawater. All that extra salt would overwhelm the kidneys, and the animal would die of dehydration. Some marine reptiles and birds, such as the petrel in **Figure 27–17,** have evolved specialized glands in their heads that excrete very concentrated salt solutions. Another remarkable excretory adaptation is found in the kangaroo rats of the American southwest. The kidneys of these desert rodents produce urine that is 25 times more concentrated than their blood! In addition, their intestines are so good at absorbing water that their feces are almost dry.

FIGURE 27–17 Excretion Adaptations Some terrestrial animals that spend a large amount of time in salt water, such as this petrel, have special adaptations to rid themselves of excess salt. This bird, which hunts for fish in the ocean, has special glands in its nostrils that separate salt from the water it swallows and excrete the salt as a thick, sticky fluid.

27.4 Assessment

Review Key Concepts

1. a. Review Why does the metabolic waste ammonia pose a problem for all animals?

b. Explain How do insects, reptiles, and birds eliminate ammonia? How do mammals and some amphibians eliminate it?

c. Apply Concepts How do kidneys help maintain homeostasis while processing nitrogenous wastes?

2. a. Review In general, how do aquatic animals address the ammonia problem?

b. Compare and Contrast How do the differing water balance needs of freshwater animals and saltwater animals explain the difference in their excretion of nitrogenous wastes?

3. a. Review In what form do (a) annelids and mollusks, (b) insects and arachnids, (c) mammals and land amphibians, and (d) reptiles and birds excrete nitrogenous wastes?

b. Relate Cause and Effect Explain how differing water balance needs relate to an animal's conversion of ammonia to either urea or uric acid.

BUILD VOCABULARY

4. The Greek word *ouron,* meaning "urine," has led to the root *uro-*, of *urea* and *uric* (acid). Why is it appropriate that these two words are each formed from a root word meaning "urine"?

BIOLOGY.com Search Lesson 27.4 GO • Self-Test • Lesson Assessment

Assessment Answers

1a. Ammonia is poisonous.

1b. Insects convert ammonia into uric acid. Some insects have Malpighian tubules, which absorb uric acid from body fluids and combine it with digestive wastes. In most reptiles and birds, ammonia is converted to uric acid, which is separated out from other wastes as white crystals. Mammals and land amphibians convert ammonia into urea, which is excreted as urine.

1c. Kidneys separate nitrogenous wastes and excess water from blood. This helps maintain the proper balance of water in blood and body tissues.

2a. In general, aquatic animals can allow ammonia to diffuse out of their bodies into surrounding water, which dilutes the ammonia and carries it away.

2b. For freshwater animals, the concentration of water in their environments is higher than the concentration in their body fluids. As a result, they excrete water through kidneys that produce lots of watery urine. The bodies of saltwater animals contain a lower concentration of salt than the water they live in. So, they conserve water by producing very little concentrated urine.

3a. (a) urine, (b) in crystals that form a thick paste, (c) urine, (d) thick, milky white paste

3b. Sample answer: Animals that need to conserve water convert ammonia into uric acid, which is less soluble in water. Animals that do not have as great a need to conserve water convert ammonia into urea, which is highly soluble in water.

BUILD VOCABULARY

4. Sample answer: Both urea and uric acid are nitrogenous compounds that animals excrete. Urea is one component of urine.

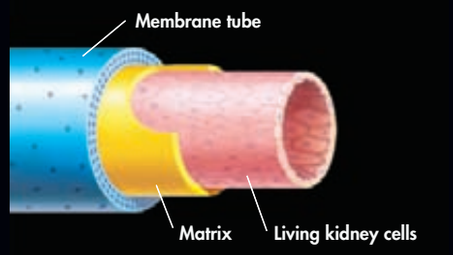
Technology & BIOLOGY

Bioartificial Kidneys

Hundreds of thousands of people suffer from kidney failure. Kidneys eliminate wastes from blood while retaining vital compounds, so if your kidneys fail, you can die, poisoned by your own nitrogenous wastes. Because kidney function is so important, researchers are always working on better replacements for it.

Today's techniques save lives but are far from ideal. Techniques such as artificial kidney dialysis pass a patient's blood through a system of extremely fine tubes that retain blood cells and vital proteins while filtering out wastes, which are discarded. But important compounds are also filtered out, and they must be given back to the patient intravenously.

A technique invented by Dr. H. David Humes at the University of Michigan could eliminate this drawback. It combines the technique above with the latest in biotechnology to produce what is called a renal tubule assist device, or RAD. Tiny tubes (blue in the figure to the right) are lined with a matrix (shown in yellow) on which living cells can grow. The matrix-covered tubes are then "seeded" with cells from kidneys that were donated for transplant but could not be used. When properly cared for, these kidney cells grow one layer thick (shown in pink) to cover the matrix.



During treatment, the fluid that would normally be discarded is passed through the inside of these tubes, while the patient's blood passes by on the other side. The living kidney cells then act on the waste fluid, returning valuable compounds like glucose to the blood, and adding the important compounds made in healthy kidneys. Researchers hope that this technique can someday improve the lives of the many people whose kidneys fail.


Dr. H. David Humes

WRITING **If possible, interview someone who has undergone kidney dialysis, asking about five questions you have about the experience. Transcribe your interview, and include a short introduction to the topic. Alternately, read about the experience of kidney dialysis, and write a one-page summary.**

Quick Facts

KIDNEY DISEASE AND TREATMENT

Kidney disease is a serious problem for millions of Americans. Here are some facts about kidney disease and treatment.

- According to the Centers for Disease Control and Prevention (CDC), an estimated 26 million adult Americans have chronic kidney disease, whether they know it or not.
- The main causes of kidney disease are diabetes, hypertension, and heredity.
- There are two main forms of kidney dialysis. In hemodialysis, a patient's blood is drawn from the body and filtered through a dialysis machine. In peritoneal dialysis, a fluid is put into the abdomen that captures waste products; after a few hours the fluid and wastes are drained away.

Teach

Lead a Discussion

Make sure students understand the advantage that bioartificial kidneys have over artificial kidney dialysis.

Ask How does artificial kidney dialysis help a person who has kidney failure? *(Sample answer: by performing the functions the person's kidneys would by filtering out harmful wastes from the person's blood)*

Direct students' attention to the illustration of the renal tubule assist device.

Ask Where do the living kidney cells in the RAD come from? *(from kidneys that were donated for transplants but couldn't be used)*

Ask What do those cells do that an artificial dialysis machine can't do? *(Sample answer: The cells filter the waste fluid from kidney dialysis and separate the valuable compounds from wastes that need to be discarded. The cells return the valuable compounds back to the person's blood.)*

DIFFERENTIATED INSTRUCTION

L3 **Advanced Students** Ask students to use online or library resources to find out more about kidney disease. Have them investigate causes of kidney disease as well as more about what treatments are available, including kidney transplants and different kinds of kidney dialysis. Students should prepare a written report of what they find, with reliable sources cited for all facts included.

Answers

WRITING Tell students that not all people want to talk about their illnesses, but they might have a relative or family friend who will. Alternatively, students might contact a treatment facility in the area and set up an interview with one of the nurses or technicians who help carry out artificial kidney dialysis. Make sure students prepare interview questions in advance. Review the questions before students ask them.

NATIONAL SCIENCE EDUCATION STANDARDS

UCP I, II, V

CONTENT C.1.a, C.5.d, E.2, G.1

INQUIRY A.2.a, A.2.b, A.2.c

CHAPTER LAB

Pre-Lab

Introduce students to the concepts they will explore in the chapter lab by assigning the Pre-Lab questions.

Lab

Tell students they will perform the chapter lab *Anatomy of a Squid* described in **Lab Manual A.**

L1 **Struggling Students** A simpler version of the chapter lab is provided in **Lab Manual B.**

SAFETY

Students should wear goggles, a lab apron, and disposable plastic gloves when dissecting the animals. Caution students to handle the scalpel, dissecting scissors, and dissecting pins with care. Make sure they wash their hands at the end of the lab.

BIOLOGY.com Look online for **Editable Lab Worksheets.**

For corresponding pre-lab in the **Foundation Edition**, see page 660.

NATIONAL SCIENCE EDUCATION STANDARDS

UCP I, V
CONTENT C.5.d
INQUIRY A.1.c

Pre-Lab Answers

BACKGROUND QUESTIONS

a. A gastrovascular cavity has a single opening through which food is ingested and wastes are expelled. A digestive tract has two openings, one for ingesting food and one for expelling wastes.

b. Sample answer: In all respiratory structures gases diffuse across a selectively permeable membrane.

c. In an open circulatory system, blood is only partially contained within a system of blood vessels as it travels through the body. In a closed circulatory system, blood circulates entirely within blood vessels.

Skills Lab

GUIDED INQUIRY

Pre-Lab: Anatomy of a Squid

Problem What structures does a squid use to obtain nutrients and eliminate wastes?

Materials squid, dissecting tray, hand lens, forceps, dissecting scissors, dissecting pins, dissecting probe

Lab Manual Chapter 27 Lab

Skills Focus Observe, Infer, Sequence, Draw Conclusions

Connect to the Big idea All animals obtain their food by eating other organisms. All animals need a way to digest the food, and most animals need a way to circulate the absorbed nutrients to all the cells in the body. Animals also need to absorb oxygen from their environment for cellular respiration. Finally, animals need to rid their bodies of wastes.

The ways that animals meet these needs vary greatly. Often, different habitats require different structures. For example, an animal that must obtain its oxygen from air will not have the same respiratory structures as an animal that must obtain its oxygen from water. In this lab, you will dissect a squid and observe parts of several body systems.

Background Questions

a. Compare and Contrast How are a gastrovascular cavity and a digestive tract different?

b. Review What process takes place in all respiratory structures?

c. Compare and Contrast What is the difference between an open and a closed circulatory system?

Pre-Lab Questions

Preview the procedure in the lab manual.

1. Interpret Visuals What structure can you use to distinguish the ventral side of a squid from the dorsal side?

2. Infer Why is it important to lift the mantle while cutting it?

3. Predict What do you expect the gills to look like, and why?

BIOLOGY.com Search Chapter 27 GO

Visit Chapter 27 online to test yourself on chapter content and to find activities to help you learn.

Untamed Science Video Trek carefully with the Untamed Science crew as they get up close and personal with bears to learn about their adaptations.

Art in Motion What happens when fresh and saltwater fishes excrete water or salt? Find out by watching this animation.

Art Review Review your knowledge of the different types of respiratory systems with this activity.

InterActive Art See how single- and double-loop circulation systems compare.

Data Analysis Investigate the relationship between body size, tracheal structure and the amount of atmospheric oxygen to understand why insects were larger in the Paleozoic than they are today.

Visual Analogy Compare the structure and function of the types of teeth with common objects.

PRE-LAB QUESTIONS

1. The siphon is located on the ventral side.

2. Sample answer: If the mantle is not lifted, the scissors may cut through the organs that lie beneath the mantle.

3. Sample answer: Because gas exchange takes place in the gills, I expect the gills to have a large surface area.