ANIMAL ANATOMY

In “Wild Patients” (p. 8), you read that veterinarians who treat exotic pets must understand the anatomy of the animals they care for. The diagram below shows the digestive system of a rabbit. Use the information to answer the questions that follow.

QUESTIONS

1. Rabbits practice *coprophagy*—they eat their own droppings. Why might they do this?

2. Birds also have a caecum, but its size and function vary among species. How do you think the caecum of a bird that eats plants would compare with that of a bird species that eats mainly fish? Support your answer with evidence from the diagram.

3. How is a rabbit’s digestive system similar to that of a human? Explain your answer.

4. Imagine you are a veterinarian. You suspect a rabbit has developed a disease that affects its small intestine. What symptoms might you expect the animal to show?
BIRD DIGESTIVE SYSTEM

MOUTH: Birds don’t have teeth to grind food into smaller pieces. Their digestive systems must be able to process food whole.

ESOPHAGUS: Food travels from the throat into the rest of the digestive system through this tube.

CROP: Excess pieces of food can be temporarily stored in this pouch before moving deeper into the digestive system.

PROVENTRICULUS: This stomach-like gland produces acids (chemicals that dissolve other materials) and enzymes (large biological molecules that perform functions in the body) to help break down food.

LIVER: This organ produces bile—a fluid that mixes with partially digested food in the small intestine and helps break down fat in foods.

GIZZARD: The gizzard’s muscular walls grind up food particles into smaller pieces. Some birds swallow stones, which are stored in the gizzard, to help grind food.

SMALL INTESTINE: The lining of the small intestine absorbs nutrients from broken-down food particles into the bloodstream. The body uses these nutrients for energy, growth, and other necessary functions.

PANCREAS: The pancreas produces many enzymes, which speed up the chemical reactions that help break down food. They mix with partially digested food in the small intestine.

CLOACA: Liquid waste, which would become urine in mammals, is mixed with solid waste in the large intestine and released through the cloaca.

CAECUM: This sac helps a bird break down cellulose—the main substance that makes up plant cells.
INSIDE VIEW

In “Wild Patients” (p. 8), you read about veterinarians who treat unusual pets. Among the tools these doctors use to diagnose animals are X-rays. These energy waves can be used to create images of parts inside an animal. The images are possible because X-rays interact differently with different types of matter that make up a body. The table below describes these interactions. Study the table, and then answer the questions that follow.

<table>
<thead>
<tr>
<th>INTERACTION</th>
<th>WHAT HAPPENS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorption</td>
<td>Dense materials, like teeth and bones, absorb X-rays. These hard parts of the body appear white on an X-ray image. When materials aren’t very dense, X-rays pass through them. These materials appear dark on an X-ray.</td>
</tr>
<tr>
<td>Scattering</td>
<td>Every material is made up of atoms. These smallest units of an element contain negatively charged electrons. When X-rays hit electrons in an atom, they scatter in different directions. The pattern that is formed by the scattered X-rays depends on the type and arrangement of atoms in the material. Scientists use images of scattered X-rays to determine a substance’s molecular structure—the configuration of atoms in a molecule.</td>
</tr>
<tr>
<td>Fluorescence</td>
<td>Some atoms fluoresce, or give off light, when an X-ray hits them. Electrons follow orbits, or paths, around an atom’s nucleus, or center. The farther an electron is from the nucleus, the more energy it has. Energy from the X-ray causes an electron to jump to a higher orbit. The electron eventually falls back down to its original orbit, releasing excess energy in the form of light. The amount of energy released depends on the element.</td>
</tr>
</tbody>
</table>

QUESTIONS

1. Soft tissue in the body looks dark on an X-ray image. What does that indicate about how soft tissue interacts with X-rays?

2. Do you think X-ray images can be used to identify tumors—growths of abnormal cells in the body? Why or why not?

3. What characteristic determines how much energy an electron has in an atom?

4. Use your own words to explain how exposure to X-rays can cause a material to give off energy.

5. Which of the interactions listed could be used to determine what makes up a chemical compound? Use details from the chart to explain why.
BRAND-NEW BODY PARTS

In “Wild Patients” (p. 8), you learned about some of the treatments veterinarians use to keep animals healthy. Sometimes scientists go to extreme lengths to help animals that have been injured. For example, they may give an animal a high-tech prosthetic—an artificial body part to repair or replace a damaged or missing one. Read the table below to learn how prosthetics are helping some injured animals lead normal lives. Then complete the rest of the skills sheet.

ANIMALS WITH PROSTHESECS

<table>
<thead>
<tr>
<th>ANIMAL</th>
<th>PROSTHETIC DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goose</td>
<td>In 2015, someone dropped off a goose that was missing most of its bill at a rescue center in Brazil. The bird was so injured that it couldn’t eat on its own. To save the bird, a dentist used a 3-D printer—a device that creates solid objects by building up layers of material—to make the goose a prosthetic bill out of a plastic. The prosthetic was attached to what was left of the bird’s bill. The first beak turned out to be too heavy for the bird to easily open and close it. So the dentist created a new one that was one-third the weight, and the bird survived.</td>
</tr>
<tr>
<td>Tortoise</td>
<td>Freddy the tortoise was brought to a rescue center after roughly 85 percent of its shell was destroyed in a fire. Without a shell, the tortoise was at serious risk for infections and damage to its body. Scientists studied a similar turtle’s shell to come up with a design. Then they used a 3-D printer to create a new shell out of plastic. Artists painted the white plastic with natural colors so Freddy would blend into the environment.</td>
</tr>
<tr>
<td>Dolphin</td>
<td>Winter the bottlenose dolphin lost her tail after it became entangled in a rope. The dolphin learned to swim using her flippers and a side-to-side motion. But scientists were concerned that she would eventually develop problems with her spine because dolphins’ bodies don’t normally move that way. A scientist who creates prosthetics for humans designed a flexible tail made from silicone, a type of polymer—a large molecule made up of repeating units—for Winter. To attach the new tail to her body, the scientists created a gel sleeve. The sleeve was designed to mimic blubber—the fat of sea animals—to protect Winter’s sensitive skin while keeping the tail in place.</td>
</tr>
</tbody>
</table>

DIRECTIONS Use what you know to design a solution to the following problem: Alligators rely on their tails, which make up roughly half the length of their bodies, to propel themselves through the water. Suppose an alligator was injured and lost its tail.

Define the Problem: List at least three criteria or constraints that a prosthetic for an alligator needs to meet.

Design It: Draw a model of your design below. Be sure to label and explain the different parts of your design.

Brainstorm Ideas: Come up with several ideas for an alligator’s prosthetic. Think about how you might design a prosthetic to replace it. What materials would you use? How would you attach it?
INTO THE WILD

In “Wild Patients” (p. 8), you read that some people keep exotic animals as pets. When these pets become too big or are no longer wanted, people might release them into the wild. The animals are not usually native to the area and can become invasive species—harming other wildlife and the environment. Read the following passage to learn about the negative impact of exotic pets released into the wild. Then use complete sentences to answer the questions that follow.

PET INVASION

Owning an exotic pet—like a snake, pig, or tropical fish—might seem like an exciting idea. But living with these unusual pets can pose problems. The animals may grow too large, get too costly to care for, or become unmanageable. When that happens, some owners release their exotic pets into the wild. In addition to being illegal, this act can harm the environment.

Many ecosystems—biological communities of interacting organisms and their physical environments—in the U.S. are overrun by invasive species. Many of these non-native animals were first imported into the U.S. as pets. For example, Burmese pythons from Asia are wreaking havoc in Florida’s Everglades National Park. Scientists believe the problem started when overwhelmed owners released the snakes—which can grow to more than 6 meters (20 feet) long—into the wild. Now the snakes are breeding in the park and threatening native wildlife.

Lionfish are another invasive species currently hunting U.S. wildlife. This fish is native to the South Pacific and Indian oceans. Aquarium owners who grew tired of caring for their lionfish dumped them along the Atlantic Coast in the 1990s. Because lionfish have no known predators in the Atlantic and reproduce quickly, they soon spread widely, gobbling up millions of native fish.

Even harmless-looking goldfish can be a menace to ecosystems where they don’t belong. Goldfish up to 20 centimeters (8 inches) long have been found in Lake Tahoe, on the border between California and Nevada. Researchers believe that their waste may cause excess algae to grow in the mountain lake. These algae blooms cloud the typically clear water, harming native species.

QUESTIONS

1. Describe what an invasive species is in your own words.

2. Why can non-native species become a threat when introduced into new ecosystems?

3. What evidence in the passage supports the idea that lionfish will be a long-term problem along the Atlantic Coast?

4. Choose one of the exotic pets discussed in the article “Wild Patients.” What might cause owners of this animal to release it into the wild? What do you think the consequences of this action would be for the animal and the environment?

5. How do you think officials could help prevent the release of exotic pets into the wild? Describe at least two possible solutions.
POISONOUS PAINT

In “Standing Guard” (p. 12), you read about China’s terra-cotta warriors. Many of the brightly colored pigments ancient artists used to paint the statues are toxic to humans. Lead (Pb) is one hazardous ingredient commonly used in paints from ancient times until the 1970s, when it was outlawed in the U.S. Breathing in or ingesting this element can cause serious health problems. The diagram below shows how lead poisoning can affect the body. Use the information, along with that from the article, to answer the questions that follow.

HOW DOES LEAD HARM THE BODY?

No amount of lead exposure is considered safe. Ingesting lead can severely affect children’s mental and physical development. Children younger than 6 are particularly vulnerable to lead’s toxic effects because their brains are growing rapidly. Lead is also dangerous because it accumulates in growing bones, making it difficult or impossible to remove from the body. As lead levels increase, so do the severity and range of problems.

QUESTIONS

1. Why are children particularly at risk for lead poisoning?

2. Why might archaeologists unearthing the terra-cotta soldiers be at risk of lead exposure? Use information from the article to support your answer.

3. Do you think spraying the warriors with polyethylene glycol will increase or decrease the risk of lead exposure for the people who work with them?

4. Many famous painters in history, including Michelangelo and Vincent van Gogh, had serious health problems. Their symptoms included fatigue, painful stomach aches, and unusual behavior. Scientists now believe many of these artists suffered from lead poisoning. Describe two pieces of evidence that help support this theory.

5. How might scientists be able to confirm that certain people from the past had lead poisoning by studying their remains?
WHAT WILL SURVIVE?

In “Standing Guard” (p. 12), you learned how the paint on terra-cotta soldiers deteriorated when it was exposed to air after being buried underground for 2,200 years. Environmental changes can affect materials in different ways. In this activity, you'll predict and make observations regarding how certain objects withstand the test of time.

**STEP 1: MAKE PREDICTIONS**

1. **Organic materials**, such as wood, paper, and cotton clothing, come from animal or plant sources. On a separate piece of paper, list three other organic objects in your classroom.

2. **Inorganic materials**, such as metal, glass, and plastic, are substances that come from nonliving sources. List three inorganic objects in your classroom.

3. How do you think the make up of different materials affects how each decays? Do you think organic or inorganic materials will break down faster? Explain your answer.

4. How do you think the conditions in an object’s environment affect how fast its materials break down?

**STEP 2: PLAN AN EXPERIMENT**

Design an experiment that will compare how organic and inorganic materials break down in different environments. Describe the steps of your experiment. Think about what materials you will need. What factors will you change and control during the experiment? What data will you collect?

**STEP 3: CONDUCT YOUR EXPERIMENT**

Gather the necessary materials and carry out your experiment. Record the data you collect.

**STEP 4: DRAW CONCLUSIONS**

When your experiment is complete, summarize what you discovered in the space below. Support your conclusions with evidence from your experiment.

**TAKE IT FURTHER:**

Use the observations from your experiment to explain why you think the terra-cotta warriors, in general, are relatively well preserved after 2,200 years.
THE DIRT ON CLAY

In “Standing Guard” (p. 12), you learned how artists created an army of clay warriors 2,200 years ago. The warriors are made of terra-cotta—clay heated to high temperatures to remove moisture, allowing it to harden. Use the table below to compare clay with other types of sediment—particles of rock or soil. Then answer the questions that follow.

### TYPES OF SEDIMENT

<table>
<thead>
<tr>
<th>TYPE</th>
<th>PARTICLE SIZE (DIAMETER)</th>
<th>CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>2 millimeters or larger</td>
<td>Gravel includes sediment with a particle size that can range from pebbles to large boulders.</td>
</tr>
<tr>
<td>Sand</td>
<td>0.06-2 mm</td>
<td>Sand particles are called grains. There are large spaces between the particles. Water flows easily around the particles, so sand doesn’t absorb moisture well. Its particles don’t easily stick together.</td>
</tr>
<tr>
<td>Silt</td>
<td>0.002-0.06 mm</td>
<td>Silt particles are finer than those of sand, but silt still feels slightly gritty if you run it through your fingers. Silt is easily carried by wind and water. Areas that have been flooded are often covered by a layer of silt.</td>
</tr>
<tr>
<td>Clay</td>
<td>0.002 mm or smaller</td>
<td>Clay has little space between its particles, making it very dense. It easily absorbs water, and its particles stick together. But when clay is dry, it becomes almost as hard as concrete.</td>
</tr>
</tbody>
</table>

### QUESTIONS

1. Which main feature is used to categorize different types of sediment?

2. Which type of sediment do you think would be best for growing plants? Use evidence from the chart to support your answer.

3. Sand and gravel are not commonly found in floodplains. Why might that be?

4. Explain why potters must heat clay to finish a piece of pottery.

5. What characteristics make clay an ideal material to create objects like the terra-cotta warriors?
HIDDEN MASTERPIECE?

In “Standing Guard” (p. 12), you learned how scientists used detective work to discover the original appearance of ancient terra-cotta statues. In the following passage, you’ll learn about technology being used to uncover a masterpiece that was thought to have been destroyed. Read the passage, and then use complete sentences to answer the questions that follow.

ART SLEUTH

For nearly five centuries, people thought a mural created by the famous artist Leonardo da Vinci, The Battle of Anghiari, was destroyed during a 1563 makeover of the building in Florence, Italy, where it was painted. It turns out that the architect in charge of the building’s renovation might have secretly saved Da Vinci’s masterpiece.

Scans revealed a gap—not found anywhere else in the building—behind a wall covered by another artist’s painting. Maurizio Seracini, an engineer from the University of California, San Diego, believes that the gap conceals a secondary wall containing Da Vinci’s lost mural. Seracini hopes to use high-tech tools to “see” through the outer wall and reveal what lies behind it.

Paint pigments get their colors from different chemical elements. For instance, the white paint Da Vinci used contained lead (Pb), and his bright-red paint contained mercury (Hg). Seracini can detect these elements with a beam of neutrons, or uncharged particles, that penetrates the outer wall.

If Da Vinci’s mural is there, then the atoms in the paint will absorb the neutrons, break down, and give off gamma rays—a type of high-energy electromagnetic radiation. Because different chemical elements emit gamma rays of different energy, Seracini would learn which elements and paints are hidden behind the wall.

So far, Seracini has tested the new technology on mock walls, with promising results. The final step is to build a portable machine and take it to Florence to examine the real thing.

QUESTIONS

1. What evidence suggests that Da Vinci’s mural may still be intact?

2. In your own words, explain what happens when a neutron hits an atom.

3. What does it indicate if one material gives off gamma rays with a different energy than another material when exposed to a beam of neutrons?

4. Why do you think Seracini has tested his scanning technology on a mock wall before he attempts to use it on the real thing?

5. How might the technology described in the passage be helpful to archaeologists studying the terra-cotta warriors?
CHANGING HABITAT

In “Teens vs. Climate Change” (p. 14), you learned how Earth’s changing climate affects the places many kids call home. In the following passage, you’ll learn more about how warming temperatures could also affect an organism critical to a healthy environment—the bee. Read the passage and then answer the questions that follow.

BAD NEWS FOR BEES

Many of the foods we eat wouldn’t exist if it weren’t for bees. These hardworking insects pollinate nearly all fruits and vegetables by carrying a yellow powder produced by flowers, called pollen, from plant to plant. Now many scientists fear that climate change is putting bees—and our food supply—at risk.

One concern is that warming temperatures could disrupt the life cycles of bees and the plants they pollinate. Bees feed on a sweet fluid, called nectar, produced by flowers. They have evolved to know when flowers will begin to bloom based on longer daylight hours in the spring. In some areas, however, snow is melting earlier in the year—triggering plants to flower earlier than usual. Scientists don’t know yet if bee populations will be able to adapt to this change. If the bees don’t emerge to feed on the pollinating plants’ nectar in time, they might not be able to gather enough food to survive.

Some studies indicate that bumblebees may already be feeling the effects of warmer temperatures. Changing climate has already shifted the southern part of the insects’ range in North America and Europe northward, shrinking their habitat.

QUESTIONS

1. Which of the following statements is BEST supported by evidence in the passage?
   A. Bees rely on daylight changes to know when flowers will bloom.
   B. Bees are becoming active earlier in the year.
   C. Warming weather is causing more flowers to bloom.
   D. Climate change is causing bee populations to die off.

2. According to the information in the passage, which of the following statements is NOT true?
   A. Most fruits are pollinated by bees.
   B. Bees are most active in the winter.
   C. Bees need nectar to survive.
   D. Melting snow is triggering plants to flower earlier than usual.

3. How would the disappearance of bees affect the food supply? Support your answer with evidence from the passage.

4. What is one way bees could survive if flowers were to begin to emerge earlier in the year?

5. How does the passage support the argument made in the lawsuit described in “Teens vs. Climate Change”?
UNDERGROUND CARBON

In “Teens vs. Climate Change” (p. 14), you read that warmer temperatures have been causing permafrost—a layer of soil that normally remains frozen all year round—in Alaska to thaw. The diagram below shows how thawing permafrost could have further effects on the environment. Use the information in the diagram to answer the questions that follow.

LEAKING PERMAFROST

One quarter of land in the Northern Hemisphere is covered by permafrost. Almost twice as much carbon is stored there as is currently found in Earth’s atmosphere. If climate change causes this layer to thaw, it could release more heat-trapping greenhouse gases, raising temperatures on Earth even more.

1. Warmer global temperatures heat up Earth’s surface.
2. As the ground heats up, permafrost begins to thaw. Organic matter frozen in the soil breaks down into carbon dioxide (CO₂) and methane (CH₄).
3. Carbon dioxide and methane are released into the atmosphere.
4. These greenhouse gases trap heat from the sun in Earth’s atmosphere. That causes global temperatures to rise even more.

QUESTIONS

1. Explain how thawing permafrost could cause even more permafrost to thaw.

2. Some scientists have called thawing permafrost a “time bomb.” Cite two pieces of evidence to explain why that might be.

3. Refer to the “What Will Survive?” skills sheet. Based on the information found there, what do you think the organic matter frozen in permafrost is made of?

4. The warming effects caused by greenhouse gases released from melting permafrost happen slowly. Based on what you learned in “Teens vs. Climate Change,” what are some of the more immediate effects of melting permafrost?

5. Which of the answers you gave for Question 4 do you think is a bigger concern? Explain.
TAKE A STAND

In “Teens vs. Climate Change” (p. 14), you learned that a group of kids are suing the U.S. government to force it to take action against climate change. You also read that the U.S. has announced that it is pulling out of an international climate agreement that aims to reduce the emissions of greenhouse gases.

Do you think the U.S. government should or should not take stronger action to curb the production of greenhouse gases? Use this skills sheet to compose a letter to a politician to tell him or her what you think. Gather evidence from the article and your own research to support your opinion. Use your answers to write your letter on a separate sheet of paper.

Date __________________________

Dear ____________________________________________________________ (choose a local, state, or national politician),

Your Statement (State your opinion about whether the U.S. should or should not act to try to reduce climate change.)

________________________________________________________________________________________________________________________________
________________________________________________________________________________________________________________________________
________________________________________________________________________________________________________________________________

Give Supporting Reasons (Provide at least two arguments that support your opinion. Use facts from the article and/or your own research.)

________________________________________________________________________________________________________________________________
________________________________________________________________________________________________________________________________
________________________________________________________________________________________________________________________________
________________________________________________________________________________________________________________________________

Call to Action (What specific actions do you think should be taken?)

________________________________________________________________________________________________________________________________
________________________________________________________________________________________________________________________________
________________________________________________________________________________________________________________________________
________________________________________________________________________________________________________________________________

Write a Conclusion (Conclude with a few sentences that reinforce your main points.)

________________________________________________________________________________________________________________________________
________________________________________________________________________________________________________________________________
________________________________________________________________________________________________________________________________
________________________________________________________________________________________________________________________________

Sincerely, __________________________________________________________________________________________ (your name)
RISING WATERS

In “Teens vs. Climate Change” (p. 14), you learned that warming temperatures are causing ice on Earth to melt. The effect of melting ice on sea levels depends on where the ice is located. Glaciers are sheets of ice that lie on land. Icebergs are large pieces of ice that float in the ocean. In this activity, you’ll design an experiment to model how different types of melting ice will affect sea levels.

PREDICT: Which will cause sea levels to change more: melting ice that was floating in the water or melting ice that covered land?

MATERIALS: glass or clear plastic bowl, roughly 15 centimeters (6 inches) in diameter • warm water • ice cubes • clay • heavy glass • marker • ruler

MODEL A MELTING GLACIER: Design an experiment that represents how melting glaciers affect sea levels. You can use some or all of the given materials. Your experiment should include measurements to determine how the water level changes after the ice melts. Write a procedure below. Then carry out the experiment.

MODEL A MELTING ICEBERG: How can you modify your experiment’s setup to see how melting icebergs affect sea levels? Write a new procedure below. Then carry out the experiment. (Remember: To make a fair comparison between the two experiments, they should be as similar as possible.)

CONCLUSIONS

1. In which setup did the water level change more? By how much?

2. Why do you think the different kinds of melting ice caused the results they did? Explain your answer.

3. What type of ice will have a larger effect on sea levels if it melts? Support your answer with evidence from your experiments.
HAZARDOUS STRUCTURES

In “Colossal Construction” (p. 20), you learned how engineers worked to protect organisms living near the construction site of a new bridge on the Hudson River. Read the table below to learn how different types of infrastructure—the physical structures humans rely on for power, transportation, and other needs—can harm wildlife. Then follow the directions to complete the activity below.

Infrastructure Hazards

<table>
<thead>
<tr>
<th>Structures</th>
<th>Wildlife Dangers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Turbines</td>
<td>Wind turbines’ spinning blades harness the power of wind to generate electricity. Turbines provide a valuable source of clean, renewable energy. But they can also pose a danger to flying animals that collide with turbine blades. Most birds killed by turbines are migratory songbirds. These birds typically fly at night at relatively high altitudes. When weather conditions are poor, however, the birds fly at lower heights and more often come into contact with turbine blades. Wind turbines also affect migrating bats that fly at night.</td>
</tr>
<tr>
<td>Tall Buildings</td>
<td>Scientists estimate that hundreds of millions of birds in the U.S. die each year by crashing into glass windows. Many of these collisions occur at night. Scientists believe migrating birds mistake artificial lights in the buildings for stars and the moon, which birds use to navigate. The lights draw in birds that then collide with the buildings. Sometimes, the birds become disoriented and circle the buildings until they become too exhausted to fly.</td>
</tr>
<tr>
<td>Roads</td>
<td>Roads are essential for people and goods to travel from place to place. But these paved pathways often cause many problems for wildlife. Highways can block animals from moving from one habitat to another to find food or mates. Traffic on roads also produces noise pollution that scientists believe may affect animal behavior. Animals rely on sound to detect predators or to communicate with one another. Wildlife can also be struck and killed by vehicles.</td>
</tr>
</tbody>
</table>

DIRECTIONS

Choose one type of infrastructure described in the table above. Brainstorm two different solutions that could be used to reduce the risks the infrastructure poses for wildlife. Consider what you learned about some of the protective measures engineers took when building the Governor Mario M. Cuomo Bridge.

On a separate piece of paper, describe or model your solutions, and explain how they would help minimize the danger to wildlife while still allowing people to benefit from the structures.
In “Colossal Construction” (p. 20), you learned about a new bridge being built across the Hudson River. In the following passage, you’ll learn how the river came to be contaminated with toxic chemicals and what is being done to clean them up. Read the passage, and then answer the questions that follow.

**POLLUTED BY PCBs**

The Hudson River is one of the most important river habitats in the U.S. But a nearly 320 kilometer (200 mile)-long stretch of the waterway was once so polluted that it was long classified as a hazardous Superfund site. The government requires that these sites be cleaned to protect human health and the environment.

The river was contaminated by polychlorinated biphenyls (PCBs). These stable, human-made chemicals don’t react easily with other substances and are resistant to extreme temperatures. They were commonly used in manufacturing, including in electrical equipment and plastics. But PCBs were banned in 1979 because they were found to cause cancer and other serious health problems. The chemicals also can build up in organisms’ bodies.

Two General Electric plants were responsible for most of the Hudson’s PCB pollution. It’s estimated that the plants alone released 1.3 million pounds of PCBs in the years before the ban. Starting in 2002, scientists began a cleanup effort by taking samples of the river bottom to see where PCBs were concentrated. Then they dredged certain areas to remove polluted sediment. The cleanup cost more than $1.5 billion. During the project, 2.1 million cubic meters (2.7 million cubic yards) of contaminated material was removed, processed, and disposed of in a special facility.

Despite those efforts, toxic sediments remain in parts of the river, and PCB levels in fish remain high. Some environmental groups and officials are calling for a more thorough cleanup.

**QUESTIONS**

1. Which of the following is NOT true about PCBs?
   A. It is illegal to use them today.
   B. High temperatures don’t break them down.
   C. They occur naturally in the environment.
   D. The chemicals were useful in different areas of manufacturing.

2. PCBs can last a long time in the environment. Use evidence from the passage to explain why.

3. Before deciding where to build the new bridge across the Hudson, officials tested the PCB levels in the sediment at the building site. Why do you think it might be important to know the PCB levels before beginning construction?

4. The U.S. Environmental Protection Agency (EPA) will not require General Electric to continue to work to remove PCBs from the river. However, the EPA will continue to monitor PCB levels every five years. Why do you think some people are against this decision?

5. What factors do you think the EPA considered when making its decision about further PCB cleanup in the Hudson? Support your answer with evidence from the passage and article.
Name: _____________________________

UNDER CONSTRUCTION

In “Colossal Construction” (p. 20), you learned about some of the challenges engineers faced in the designing and construction of a new bridge across the Hudson River in New York. In this activity, you’ll test your engineering skills by trying to design the strongest bridge possible while working within a set of specific building criteria and constraints.

BUILDING OBJECTIVE:
Using the building materials listed below, build a bridge that can support the greatest weight without collapsing. You will test its strength by measuring the number of pennies the bridge can hold. The bridge must meet the following criteria and operate under certain constraints:
- It needs to extend across a 30.5 centimeter (12 inch) gap between two desks.
- It must have a roadway that can hold a plastic cup.
- You may use only the building materials given to you.

MATERIALS: scissors • 2 desks • ruler • plastic cup • 300 pennies • scale
Building materials: 25 drinking straws, 50 toothpicks, plastic tape, glue

1. DESIGN: Brainstorm what type of structure will be the strongest. Draw models of your bridge designs.

2. BUILD: Select your best design and use the given materials to build it.

3. TEST: Place two desks 30.5 cm (12 in.) apart. Place your bridge across the gap and place the plastic cup in the middle of your bridge’s roadway. Predict how many pennies the bridge will hold. Then gradually fill the cup with pennies until the bridge starts to collapse. Measure how much the cup weighed when the bridge toppled.

4. REFINE: Which areas of your bridge began to fail first? Use your observations to improve your design. Rebuild or alter your bridge based on your new design. Test the bridge. Did the adjustments make it stronger?

CONCLUSIONS
1. Compare your results with the results of your classmates. Which bridge design was the strongest? What characteristics do you think made the bridge strong?

2. What criteria and constraints might need to be taken into account when building a bridge in real life?
name: ________________________________

tracking salt

in “colossal construction” (p. 20), you learned that part of the hudson river is a tidal estuary—an area where a river’s fresh water mixes with salt water from the ocean. the river’s salinity—the amount of salt in a body of water—is highest closest to where the river empties into the ocean. researchers determine an estuary’s boundary between salt water and fresh water by finding the salt front—a location in the river where the salinity reaches 100 milligrams of salt per liter of water.

knowing the location of the salt front helps determine where different organisms may be living. its location changes throughout the year depending on tides and weather conditions. the table below shows the location of the salt front in the hudson river at the beginning of each month for a year. its location is shown in hudson river miles (hrm), or the number of miles upstream from where the mouth of the river meets the atlantic ocean. use the data along with information from the article to complete the skills sheet.

<table>
<thead>
<tr>
<th>date</th>
<th>salt front location in hrm</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/1/15</td>
<td>66.8</td>
</tr>
<tr>
<td>11/1/15</td>
<td>59.6</td>
</tr>
<tr>
<td>12/1/15</td>
<td>59.4</td>
</tr>
<tr>
<td>1/1/16</td>
<td>36.2</td>
</tr>
<tr>
<td>2/1/16</td>
<td>57.9</td>
</tr>
<tr>
<td>3/1/16</td>
<td>64.3</td>
</tr>
<tr>
<td>4/1/16</td>
<td>45.3</td>
</tr>
<tr>
<td>5/1/16</td>
<td>57.9</td>
</tr>
<tr>
<td>6/1/16</td>
<td>62.2</td>
</tr>
<tr>
<td>7/1/16</td>
<td>45.1</td>
</tr>
<tr>
<td>8/1/16</td>
<td>68.8</td>
</tr>
<tr>
<td>9/1/16</td>
<td>70.1</td>
</tr>
</tbody>
</table>

source: u.s. geological survey

analyze it

1. in which month was the salt front located farthest upstream? farthest downstream?

2. between which two months was the change in the location of the salt front the greatest?

3. how do you think heavy rains upstream would affect the location of the salt front in the river? explain your answer.

4. how would you expect the salinity of the water at the governor mario m. cuomo bridge, located at roughly 25 hrm, to compare with the water near cold spring, new york, which is located at roughly 55 hrm? provide evidence to support your answer.

5. some fish, such as sturgeon, live in the ocean as adults but spawn and reproduce in fresh water. use the data in your graph and the article to explain why these organisms may be affected by the building of the governor mario m. cuomo bridge.

graph it plot the data in the table in a line graph. don’t forget to label the x- and y-axes and give your graph a title.
Name: _________________________________

SCIENCE NEWS

DIRECTIONS: Read the “Science News” section on pages 2–7.
Then test your knowledge, filling in the letters next to the correct answers.

1. The Cassini spacecraft was launched in ______.
   A 1982
   B 1997
   C 2004
   D 2015

2. NASA programmed Cassini to crash into _____ in September 2017.
   A Mars
   B Saturn
   C Titan
   D Venus

3. A ________ is an organelle that supplies energy to a cell.
   A nucleus
   B membrane
   C Golgi apparatus
   D mitochondrion

4. The ________ forms the outer covering of a cell.
   A organelle
   B cell membrane
   C cytoplasm
   D lysosome

5. Dinosaurs came to rule Earth after a mass extinction about ______ years ago.
   A 20 million
   B 200 million
   C 2 billion
   D 500,000

6. Scientists believe that dinosaurs may have survived ______ that wiped out many other species.
   A volcanic eruptions
   B asteroid impacts
   C diseases
   D droughts

7. Engineers outfitted the Bloodhound with a ________, in hopes that it will reach speeds of 320 kilometers (200 miles) per hour.
   A rocket engine
   B combustion engine
   C electric battery
   D jet engine

8. A(n) ________ was recently spotted near the Statue of Liberty in New York Harbor.
   A humpback whale
   B blue whale
   C elephant seal
   D narwhal

9. ________ are sometimes used to detect underwater noise.
   A Scubaphones
   B Sonar
   C Hydrophones
   D Hyroscopes

10. A university in Spain recently installed a giant ________ on the side of a building.
    A color wheel
    B periodic table
    C dictionary
    D cell diagram
NAME: ____________________________________________

WILD PATIENTS PAGE 8

DIRECTIONS: Match each item in the left column below with its definition in the right column.

____ 1. exotic pet a. a metal that is toxic to living things
____ 2. seizure b. an abnormal growth of cells
____ 3. lead c. adapted to living with humans
____ 4. abscess d. muscle spasms throughout the body caused by unusual brain activity
____ 5. sterilization surgery e. an organism that eats mainly insects
____ 6. anesthetic f. a drug used to induce sleep and prevent pain
____ 7. tumor g. a procedure to remove the reproductive organs
____ 8. domesticated h. an element needed for healthy bones
____ 9. calcium i. an animal not typically kept as a pet
____ 10. insectivore j. a pus-filled sac

STANDING GUARD PAGE 12

DIRECTIONS: Answer the following questions in complete sentences.

1. Describe how artists created paints to color the terra-cotta soldiers. __________________________________________
   ____________________________________________________________________________________________
   ____________________________________________________________________________________________

2. Explain why the paint disappeared when the terra-cotta soldiers were unearthed. ______________________________
   ____________________________________________________________________________________________
   ____________________________________________________________________________________________

3. Why do researchers now spray the soldiers with polyethylene glycol when they are uncovered? _________________
   ____________________________________________________________________________________________
   ____________________________________________________________________________________________

4. Name one color used on the terra-cotta soldiers and describe how it was made in ancient times. _________________
   ____________________________________________________________________________________________
   ____________________________________________________________________________________________

5. How did burying the soldiers help preserve them? Use evidence from the text to support your answer. ____________
   ____________________________________________________________________________________________
   ____________________________________________________________________________________________
   ____________________________________________________________________________________________
   ____________________________________________________________________________________________
NAME: __________________________________________________________________

TEENS VS. CLIMATE CHANGE PAGE 14
DIRECTIONS: Read each statement and decide whether it is true (T) or false (F). Write your response in the space provided.

_____ 1. Some islands along the U.S. coastline could disappear within the next 35 years due to rising sea levels.
_____ 2. Scientists believe warmer temperatures are decreasing the number of severe rainstorms in areas like the Gulf Coast.
_____ 3. Warmer temperatures will most likely improve the daily lives of people who live in cold regions like Alaska.
_____ 4. There have been other periods during the last 650,000 years when the carbon dioxide levels in the atmosphere have been as high as they are today.
_____ 5. Only a small majority of scientific publications agree that climate change is likely caused by human activities.

COLOSSAL CONSTRUCTION PAGE 20
DIRECTIONS: Choose words or phrases from the box below to correctly fill in the blanks in the following sentences. Each word or phrase should be used only once.

<table>
<thead>
<tr>
<th>bedrock</th>
<th>dredge</th>
<th>noise</th>
<th>sediment</th>
<th>tidal estuary</th>
</tr>
</thead>
<tbody>
<tr>
<td>civil engineer</td>
<td>friction</td>
<td>ramps</td>
<td>swim bladder</td>
<td>turbidity</td>
</tr>
<tr>
<td>double</td>
<td>half</td>
<td>salt</td>
<td>tension</td>
<td></td>
</tr>
</tbody>
</table>

1. The rate of accidents on the Tappan Zee Bridge is _____________ that of most highways in New York.

2. A _____________ is someone who designs, builds, and supervises construction projects.

3. Weight on the new bridge is supported by the _____________ of cables that are strung from the road deck to the towers.

4. Some of the bridge’s steel supports sit on sediment instead of deeper, solid _____________.

5. _____________ between the soil and the surface of the steel piles helps steady the supports.

6. The lower part of the Hudson River is a _____________, where fresh water meets salt water from the ocean.

7. Before beginning construction, workers had to ____________ the river to make it deep enough for equipment-carrying barges.

8. High _____________ in the water can harm fish by clogging their gills with particles.

9. Fish move gas in and out of a ____________ to travel up and down in the water.

10. A bubble curtain helped prevent ____________ from the construction from escaping into the river.
DIRECTIONS: Use the clues below to fill in the crossword puzzle. All answers can be found in this issue.

ACROSS
2. a long deposit of sand that’s usually found near the coast (two words)
5. a solid layer of underground rock
10. a type of baked clay
11. a sudden attack of muscle spasms caused by unusual brain activity
12. the resistant force between solid surfaces that prevents objects from sliding against each other

DOWN
1. a substance that absorbs or reflects different hues of light
3. animals that primarily eat insects
4. a layer of permanently frozen soil
6. a substance made from tree sap used as a protective coating
7. removal of the reproductive organs
8. a small parrot native to the Australian outback
9. cloudiness caused by stirring particles in a fluid