ACS Chemistry for Life®

Celebrating Chemistry

NATIONAL CHEMISTRY WEEK AMERICAN CHEMICAL SOCIETY

The Healing Power of Chemistry

The Healing Power of Chemistry: How Your Body Is Its Own Bodyguard

Have you ever noticed how you get a tear in your eye when a speck of dust gets in it? Or have you ever suddenly sneezed when you stepped outside? These are just two parts of your body's amazing defense systems that work every day to protect you. But there are even more cool things to learn about how your body takes care of itself!

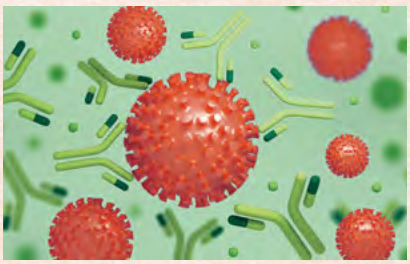
There are **germs** everywhere, and your skin is the biggest protection against them, as well as injuries (read more on page 11). For your body to take care of you, it uses three types of **immunity**: the kind your body knows how to do on its own, the kind your body learns as it fights with germs, and the kind that you received from your mom before birth (or perhaps through blood transfusions for certain diseases). All of these are necessary to keep you healthy.

Immunity your body knows

Almost everyone is born with one or more kinds of innate immunity or defenses against things that could hurt us. Examples of these defenses include our skin; tears (to get rid of dust/bugs/germs); mucus (like snot to trap germs/dust, which we sneeze and cough up, or swallow and excrete); saliva (to break down **pathogens**, or disease-causing germs); and stomach **acid** (to kill foreign particles that we've swallowed). When you get a fever, it's your body's way of fighting the **infection**, because by raising our body's temperature, we make it difficult for pathogens to multiply. More examples include the way that blood clots work to stop bleeding, and how scabs form over wounds as they heal. These are all ways your body works naturally to protect you!

Immunity your body learns

Adaptive immunity is when your body learns to fight a certain germ … and "remembers" it for later! When you first get infected with a germ, your body makes Y-shaped proteins called **antibodies** to fight back. These tiny proteins recognize the germ that caused the disease, so that the next time this germ attacks you, you'll be able to fight it off without becoming sick. **Vaccines** work in a similar way, by mildly infecting you so that your body can identify and fight off the same infections later. This is like a "Wanted" sign that helps people identify a certain suspect. A vaccination (or previous infection) helps warn your immune system when an old enemy returns!



Immunity from others

Passive immunity is immunity to infection from antibodies that were *not* produced in your body. This protects you only for a short term (not for life). For example, antibodies passing on to a baby from the mother will go away a few months after birth as the baby develops their own immunity.

About the cover:

About 5 weeks after breaking his arm, the little mole is at the doctor's office to see how he's healing. On the computer screen, you can see an X-ray of the healing bone called the *radius.* The bone was held in place by a soft fiberglass cast. Notice how a little bump (called a *callus*) has formed as the bone has healed.

On the doctor's shelves, you can find:

- *milk of magnesia*: a liquid medication (activity on page 9) for heartburn, upset stomach, and constipation
- *hydrogen peroxide*: a chemical disinfectant commonly used for cleaning wounds
- *bandages*: used to cover cuts and speed up the body's ability to heal wounds (find out more about bandages on page 4, and how to make your own on page 5)
- *pain relief medication* (*analgesics*): treat pains from injuries, twisted ankles, and headaches
- all the cool "Doctor" books: *Dr. Grey*, *Dr. Who*, *Dr. Sleep*, *Dr. Strange*, and *Dr. Dolittle*

On the counter, you can also find:

- *otoscope*: used to check ears for signs of hearing loss, earaches, and infections, or to find out if an ear canal needs cleaning
- *sphygmomanometer* (or blood pressure cuff): used to measure how well a heart is pumping blood throughout the body
- *digital thermometer*: tells whether you have fever as your body is busy fighting germs (read more on page 3)
- older editions of *Celebrating Chemistry*: did you notice our recent algae edition?

Given the incredible things our body does for us, it deserves the same love and attention from us. Promise yourself to eat nutritious food with lots of whole grains, fruits, and vegetables. Maintain good hygiene by washing hands and brushing your teeth regularly, getting enough sleep, showering daily, etc. Enjoy learning about "The Healing Power of Chemistry"!

Beat Bad Bacteria with Antibiotics

By Keith Michael Krise

Have you ever taken medicine for a nose or ear infection, or a long-lasting cough? If so, you've met up with some *bad* bacteria!

Your doctor might explain that your illness was caused by a germ called a **bacterium** (when more than one, they're called bacteria). A bacterium is a small, usually single-celled organism you can only see under a microscope.

So would it surprise you to know that some bacteria can actually be good? You or someone in your family has probably eaten some! There's good bacteria in foods like yogurt, kimchi, idli, sauerkraut, and in drinks like kombucha, kefir, and buttermilk. These good bacteria are called **probiotics** (which means "for life" in Greek). They're good for your body because they help you digest food and have good "gut health."

When you are sick with a bacterial infection, your doctor will have you take medicines for a certain number of days to feel better. These medicines may be grape- or bubble gum-flavored liquids, or regular pills. They're called **antibiotics** (which means "against life" in Greek).

People have been using antibiotics for at least a couple thousand years as medicines! Believe it or not, ancient Egyptians knew how to fight bacteria, even though they could never actually see them. In fact, they would put moldy bread on cuts and surgical wounds to help them heal! They knew that doing this strange thing helped the patients fight off infections, but they didn't know exactly how or why.

It wasn't until much later, in 1928, when Scottish scientist Alexander Fleming figured it out by chance. He discovered the secret was actually something *made by* the mold, an antibiotic called penicillin**.** Fleming made his discovery after he left a plate of bacteria in a sink with dirty dishes. He noticed that when the mold called *Penicillium notatum* grew on the plate, it killed all the bacteria around it.

How do antibiotics work?

Antibiotics work in many ways with our body to cure an infection. These medicines work by killing the bacteria (which is what the word bactericidal means) or by slowing/stopping their growth (bacteriostatic). These medicines contain chemicals that target and kill only bacterial cells, but leave human cells alone.

All antibiotics chemically target some important function or structure in the bacteria that keeps them alive and growing. One way is to interfere with how the bacteria make their own cell walls. Penicillin, for example, works by making the bacterial cells weak and easy to break. Some other antibiotics keep bacteria from growing and spreading by stopping them from making certain important proteins. As these antibiotics slow the spread of infection, our own immune system has the time it needs to attack the remaining bacteria and help us get better.

When is it safe to take antibiotics?

Antibiotics must be taken *only* with a doctor's prescription. Take them exactly as the doctor says. Continue taking them for the whole time, even if you start to feel better in a couple of days. If you stop early, the stronger bacteria "learn" to adapt and survive antibiotics. The next time the bacteria are exposed to the same antibiotic, fewer or none of them will be killed—causing **antibiotic resistance**. If that happens, the antibiotic will eventually stop being able to fight off the bacteria, and can no longer be used as medicine.

Though antibiotics fight against bacteria, they cannot cure you of a *viral* infection like the flu, COVID-19, or diseases caused by other **microorganisms**. Biologists, chemists, and other scientists are doing their part by looking for new disease-fighting medicines to stop bacterial infections … and you can do your part by being responsible in how you use antibiotics!

Keith Michael Krise *is Associate Professor of Chemistry and Biochemistry, at Gannon University, in Erie, Pennsylvania.*

Milli's Safety Tips: Safety First!

ALWAYS:

- Ask an adult for permission to do the activity and for help when necessary.
- Read all directions and safety recommendations before starting the activity.
- Wear appropriate personal protective equipment (safety glasses, at a minimum), including during preparation and clean up.
- Tie back long hair and secure loose clothing, such as long sleeves and drawstrings.
- Do not eat or drink food when conducting the activity.
- Clean up and dispose of materials properly when you are finished with the activity.
- Thoroughly wash hands after conducting the activity.

Bandages for Faster Healing

By Oksana Love

Introduction

Have you ever fallen and scraped your elbow or knee so badly that it bled? If so, you or an adult probably cleaned the wound, stopped the bleeding, and then placed a bandage over it. Try this activity to compare how two different types of bandages work with your body!

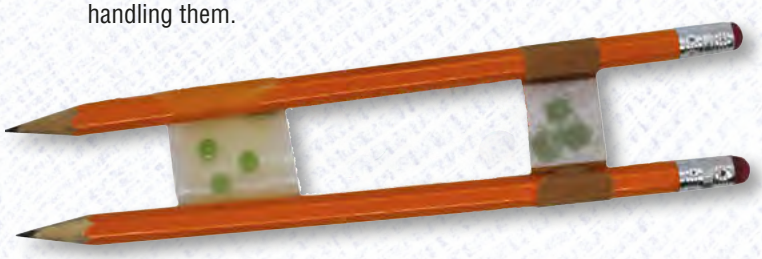
Materials

- Regular bandage made of flexible fabric or plastic
- Hydrocolloid bandage
- Food coloring (any color)
- 5 mL (1 tsp) water in a small cup
- Eyedropper or cotton swab
- 2 tall pencils at least 8 inches long
- Paper towels

Note: Hydrocolloid and regular bandages (of any brand) work well for this activity. The dot-sized, "pimple patch" bandages are not recommended, due to difficulty in handling them.

Question to Investigate

Which type of bandage, regular or hydrocolloid, absorbs water (or fluid from the body) better?



Procedure

1. Add and mix 1 drop of food coloring to 5 mL of water in the cup.
2. Remove the outside wrappers from both the regular bandage (RB) and the hydrocolloid bandage (HB).
3. Peel away only part of the paper that covers the HB and stick a pencil to one side of it. Now place a second pencil parallel to the first on the other side of the bandage with at least an inch between the pencils, as shown.
4. For the RB, peel away the paper to expose both the sticky ends and stick them to the pencils, leaving the gauze exposed. The sticky pad of HB and the gauze portion of the RB should both be facing up.
5. Look closely at the surface of each bandage. Answer Question 1 in the chart.
6. Using either a dropper or cotton swab, add one drop of water unto the wound-covering area of each bandage. If using a cotton swab, dip one end in water and squeeze the tip to release a small amount of water onto each bandage. Then answer Question 2.
7. Wait at least one hour. Observe the bandages, feel their texture, and answer questions 3 and 4.

Comparing regular and hydrocolloid bandages			
		Regular bandage	Hydrocolloid bandage
Questions to answer immediately			
1	What does the wound-covering part of the bandage look and feel like?		
2	Does the bandage absorb the water immediately? (Yes/No)		
Questions to answer after one hour			
3	What evidence do you notice that shows the bandage absorbed the water?		
4	Touch the front and back of the bandages. How do they feel?		

How does it work?

Regular bandages have a small rectangular piece of cotton gauze that quickly absorbs the fluid that comes from a wound as it heals. Once the fluid is absorbed, holes in the sticky portion of the bandage allow it to evaporate quickly. Keeping wounds clean and dry prevents infection and aids healing.

Hydrocolloid bandages have two layers. The outer layer is waterproof and keeps the wound clean. The inner layer contains gel-like hydrocolloid material. This gel slowly absorbs liquid from the wound and creates an environment that supports healing.

Hydrocolloid bandage makers claim that wounds covered with these bandages heal faster than wounds covered by a regular bandage or a scab (which is your body's own "bandage"). But they tend to be more expensive than regular bandages. Which of these bandages have you used before?

Oksana Love *is an Assistant Professor of Chemistry at the University of North Carolina Asheville.*

Build a Better Bandage

By Sherri Rukes

Introduction

What do you think makes one bandage work better than other kinds? Your task is to become a "bandage engineer" and design a bandage that has what it takes to absorb fluid and stay in place while the body heals (if there were a real cut or injury).

SAFETY SUGGESTIONS

- Do not test your bandages on any person or animal. The tape you are experimenting with in this activity is NOT intended for use on skin. You will use either wax paper, foil, or metal as a testing surface (instead of your actual skin) in this activity.
- Use caution when handling scissors.

Question to Investigate

Which combination of padding and tape makes the best bandage?

Materials

- 3 kinds of tape, such as masking, packaging, clear, cloth, electrical, washi tape
- 3 kinds of padding, such as a small piece of cloth, cotton ball, paper towel, Kleenex, gauze, felt, notebook paper
- 1 testing surface, such as wax paper, aluminum foil, or a metal cookie sheet
- Scissors
- Eyedropper
- Water
- Paper towels

Procedure

Sticky Test

1. In the chart below, list the 3 types of tape and the 3 types of padding you gathered.
2. Make 9 bandages by combining each type of tape with each type of padding.
3. To test how the bandage might stick to skin, attach one of the bandages firmly onto the testing surface (wax paper, foil, or metal). Now pull it off. Add a score of 1 to 5 based on the instructions under "How to Rate Your Bandages." Repeat this for each of the bandages.
4. Next, try removing the padding from each bandage. Record how easy or difficult it is to remove the padding. Score them from 1 to 5 in the chart.

Absorbency Test

5. Choose the two best combinations of tape and padding from the Sticky Test and name them Sample A and B.
6. Build three new pairs of Sample A and Sample B bandages so that one pair (A & B) is sized for each of the wounds listed in Step 7.
7. Use an eyedropper to add the suggested drops of water to the padding of each pair of bandages as described in the box below. The drops of water represent the typical amount of fluid from each type of wound.

Vaccine in arm	1 drop
Cut on fingertip	15 drops
Scraped knee	40 drops

8. Now stick the wet bandages onto the testing surface, and remove them like you did in the Sticky Test. Which combination of padding and tape makes the best wet bandage? Why?

Sticky Test				
		Types of padding		
Types of tape	On a scale of 1-5*, how well does tape stick to:			
	the surface?			
	the padding?			
	the surface?			
	the padding?			
	the surface?			
	the padding?			

*** How to Rate Your Bandages**

- 1 = doesn't stick much
- 2 = sticks a little
- 3 = sticks but comes off
- 4 = sticks but leaves marks when removed
- 5 = very sticky, hard to remove

How does it work?

Cotton gauze is commonly used as padding for bandages because it absorbs fluid that oozes from wounds, and then allows it to evaporate. The sticky part of most bandages is made of either fabric or plastic tape. It must stick to the skin and padding, but not to the wound. The bandage also needs to be easy to remove, so that it can be changed daily. Bandages need to be sticky on the skin, but must peel off without leaving a sticky residue. How do you think the design of bandages might change in the future?

Sherri Rukes *is a chemistry teacher at Libertyville High School in Libertyville, Illinois.*

START

1

Who takes care of your teeth and fills cavities?

2

You just put on sunscreen for skin protection!

3

Who prepares prescribed by

20 Finish!

Go online: www.acs.org/celebratingchemistry to read our digital articles!

All these professionals study chemistry to help you heal!

D SCIENTIST

E VETERINARIAN

F DENTIST

G PARAMEDIC

C PHARMACIST

B PHYSICIAN

A NURSE

19

Who works in the laboratory to find new cures for diseases?

18

You drank orange juice for a healthy dose of vitamin C.

17 Fun Fact

Ancient Egyptians used honey, grease, and lint to make bandages for wounds.

16

You discovered a new medicine for humans, made from plants. Move forward 2 squares!

15

Who gives you a yearly physical exam and prescribes medication when you're sick?

14

Oh no, you met up with a nasty germ! If you got vaccinated on square 5, you're safe! If not, too bad—now you're sick! Go back 4 squares.

medications
a doctor?

4

Can you name 3 food sources of probiotics (p. 3)? If so, jump ahead 1 square!

5

Get vaccinated to keep from getting sick for the rest of the game!

6

Eureka! You developed a new, exciting vaccine!

The Healing Power of Chemistry– The Game!

What You'll Need

- 2-4 players can play this game
- Six-sided die (or a digital simulator)
- The game board on this page
- One token per player (coins, beads, seeds, lentils, etc.)

How to Play

1. Each player picks a different small object as their token. Place all the tokens on the square labeled START on the left top corner.
2. Each person rolls the die, and the person with the highest number goes first. Then moving clockwise, each player rolls the die and plays their turn.
3. When players roll the die, they move forward the number of spaces on the die.
4. When a player lands on a square, they follow any instructions on it and stay, move forward or backward.
5. If a player lands on a square with a read the description on the square. Look to the left center of the page and match the description to the correct professional. Fill the letter on
6. Complete all actions for each player before proceeding to the next player.
7. The first player to reach FINISH! wins.

7

Who takes care of you in the hospital or when you get hurt at school?

8

Can you name one of your skin's layers (p. 11)? If so, move forward 2 squares!

9

Congratulations – you discovered a new antibiotic to cure a disease!

10

Who helps your pets when they're sick or need a checkup?

11

Ouch, you hurt your ankle! Use a chemical ice pack. Skip your next turn.

12

Who takes care of you in the ambulance if you need to be taken to the hospital?

13

You made a fantastic bandage – move forward 2 squares!

Why Wild Animals Don't Need a Vet!

By Cheryl Trusty

Have you ever seen a dog or cat nibble grass from the lawn? Many household pets, as well as birds, bees, lizards, elephants, and chimpanzees in the wild, sometimes eat things that cure their illnesses, heal their injuries, prevent diseases, kill parasites, or aid digestion. This process of animals healing themselves is called zoopharmacognosy. This long word comes from three Greek words: *zoo* (meaning animals) + *pharma* (drug) + *cognosy* (knowledge).

Animals are nature's pharmacists. Apes rub their fur with millipedes that contain insect-killing chemicals to keep insects away. Some birds do the same thing but use ants instead. Chimpanzees and their cousins, bonobos, swallow certain leaves whole to kill off worms and other parasites in their stomachs. Some chimps rub crushed insects on their own wounds, as well as those of their friends and family, to speed up wound healing. African elephants chew the bark of the fever tree to help ease arthritis pain.

How do scientists know that animals use certain plants/insects as medicine, instead of just as regular food? To find the answer, scientists observe these animals secretly to see how and when they use the plants or insects. They can tell that an animal is using a plant or insect as a medicine if:

1. The animal does not eat this plant as part of its regular diet;
2. The plant being eaten provides little or no nutritional value;
3. The animal mostly eats the plant (or rubs it on itself) during the season when other animals are catching infections; and
4. The only animals in the group that are eating the plants are those that are or can be infected with a disease.

Why should we care about how animals take care of themselves? One reason is that humans can get some of the same diseases as other animals. That's why, by observing how animals use plants and insects as medicine, scientists can get ideas for ways to develop medicines for humans. How cool is that?

Chimpanzees often help each other by grooming and removing harmful parasites. *Photo by researcher Tobias Deschner.*

For example, scientists have seen that when certain bears come out of hibernation, they rub a special kind of root on their fur, which helps them better digest food and ease the pain of arthritis. In fact, this root has also been used in indigenous North American, Central American, and South American cultures as medicine. Another example is that leaves eaten by Tanzanian chimps contain an antibiotic which is now being studied as a powerful drug for curing cancer!

Animals in the wild are often good at taking care of themselves and protecting their families from diseases—so they don't need a veterinarian to be healthy! But animals in confinement (in zoos, for example) don't have access to the plants or insects they need to self-medicate, so they often need a vet to treat them for different diseases. Studying animals and how they medicate themselves in the wild can help us get clues to finding effective medicines and cures for diseases affecting humans as well as household pets.

Nature's amazing "medicine cabinet" shrinks a little bit every day, as deforestation and climate change continue to change animal habitats and feeding patterns. As a result, animals in the wild are finding it harder and harder to survive—and may eventually become extinct if we don't do our part to conserve the environment. Of course, we humans also benefit from caring about and protecting our environment!

***Cheryl Trusty** is a retired research analytical chemist for special EPA projects.*

Cloudy with a Chance of Clear Color

By Faith Yarberry and Giovana Stanford

Introduction

Stomachaches are no fun! There is a medicine, patented over 150 years ago and still used today, that reduces stomach acid so that you feel better. This cloudy-looking liquid, called milk of magnesia, is also a key ingredient in this colorful science activity.

Question to Investigate

How does milk of magnesia reduce stomach acid and make us feel better?

Additional Safety Requirements

- Water temperature must not exceed 104°F (40°C)

Materials

- ¼ cup (60 mL) milk of magnesia (unflavored)
- ½ cup (120 mL) distilled white vinegar
- ¼ cup (60 mL) warm tap water
- 1 or 2 leaves from a head of red cabbage
- 1 quart-size (about 1 liter) resealable or Ziploc plastic bag, storage or freezer type
- 1 tall cup for indicator
- 4 tall clear plastic cups, marked A, B, C, and D
- Spoon to stir (optional)
- Tablespoon and teaspoon
- Paper towels

Procedure

Part 1: Tear cabbage leaves and freeze

1. Tear two whole cabbage leaves into small pieces (0.5 inch/1 cm each), enough for about 1 cupful (240 mL).
2. Place them in a quart-size resealable plastic bag.
3. Seal the bag and place it in the freezer for at least one hour (or for a few hours or days).

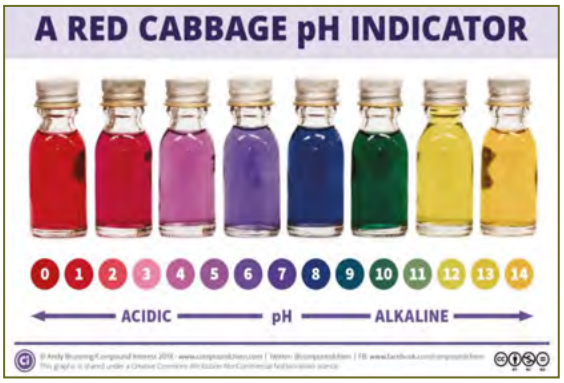
Part 2: Make cabbage juice indicator

1. After at least one hour, open the zip-closing plastic bag with the red cabbage pieces and pour in ¼ cup (60 mL) of warm tap water.
2. Squeeze as much air as possible from the bag (without spilling any liquid) as you completely seal it.
3. Squish the bag and its contents with your hands for a few minutes until the water becomes a dark purple color.
4. Carefully open the bag, tilt, and pour only the "juice" into a tall clear plastic cup, while holding back the cabbage pieces in the bag.

Part 3: Mix it up

1. Shake the bottle of milk of magnesia well. Measure and pour 1 tablespoon (tbsp) of milk of magnesia and 1 teaspoon of cabbage juice to each cup.
2. Swirl each cup or stir with a spoon to mix the two liquids.
3. Add the number of tablespoons of vinegar to each cup as described in the chart and record your observations.
4. Compare the final color in each cup to the pH chart on this page and write the corresponding numeral in the chart.

Cup	Amount of vinegar	Color after adding vinegar	Color after stirring	Cloudy or clear?	≈ pH	Acidic, Basic, or Neutral? (Circle one)
A	1 Tbsp					A B N
B	2 Tbsp					A B N
C	3 Tbsp					A B N
D	4 Tbsp					A B N



How does it work?

The main ingredient in milk of magnesia is magnesium hydroxide. The liquid looks cloudy because only a small amount of the magnesium hydroxide dissolves in water. The rest stays suspended in the liquid, while some sinks to the bottom of the bottle. When you mix vinegar (an acid), with magnesium hydroxide (a **base**), a **chemical reaction** happens. The acid and base cancel each other out. The red cabbage juice you added to the mixture changes color during the reaction, letting you know when the vinegar is "used up." Once all the magnesium hydroxide is used up, the mixture turns clear and remains clear.

How does milk of magnesia help your body? You need acid in your stomach to help you digest your food. However, if the contents of your stomach are too acidic, you may get a stomachache. Milk of magnesia uses up the extra acid and speeds up your digestion so that you feel like yourself again!

Watch a video of how to do this activity at https://www.acs.org/NCWedures

Faith Yarberry *is a Senior Lecturer in Chemistry at the University of Central Arkansas.*
Giovana Stanford *is an undergraduate student researcher at the University of Central Arkansas.*

The Adventures of Meg A. Mole, Future Chemist

Dr. Gregory Naumiec

To celebrate this year's National Chemistry Week theme, "The Healing Power of Chemistry," I traveled to Conway, Arkansas, to meet **Dr. Gregory Naumiec**. Dr. Naumiec is an Associate Professor at the University of Central Arkansas, where he researches new drug treatments for tropical diseases.

Dr. Naumiec told me that in his lab, he and his students are working to "make new, safe, and affordable medicines for what are called neglected tropical diseases. These diseases affect the lives of nearly two billion people worldwide, and the poorest people are the most affected."

The doctor explained to me that there are about 20 neglected tropical diseases, including Chagas disease, leishmaniasis, snail fever, sleeping sickness, and others. These diseases are caused by viruses, bacteria, toxins, parasites, and fungi, and they're common in poor tropical regions around the world. Neglected tropical diseases make hundreds of thousands of people very sick every year, but the people are usually too poor to afford the medicines, if they can even find them at all.

When I walked into his laboratory, I got to see Dr. Naumiec and his team working to combine different chemicals to make their medications. He explained, "While working our chemistry, we wear lab coats, gloves, and safety goggles. We work in our chemical fume hood, which keep us safe from smelly chemicals and harmful fumes."

I could tell how much Dr. Naumiec cares about his students. "I love getting to teach them chemistry," he said. "Being able to help train the next generation of doctors, pharmacists, and scientists is a great feeling. What I love most is when I meet a student who tells me they're afraid of chemistry and that they won't do well in my class. But over a few weeks or months, I sometimes see the same student become more and more confident, and do better on tests. By the end, they may even tell me that Chemistry was their favorite class!"

Growing up, Dr. Naumiec's favorite subjects were history and chemistry. After taking chemistry in 11th grade, he decided he wanted to become a chemist. But why? He explained, "I immediately fell in love with chemistry, especially when we did our first experiment — making cheese! Not only were we learning and doing chemistry, but it was also fun! That whole year, we did amazing experiments, and ended up creating a potato cannon! Taking that class got me started on my journey to becoming a chemistry professor."

I asked Dr. Naumiec what he likes most his career. "To me," he said, "the best thing about being a scientist is making something that no one has ever made before. A lot of the medications that my lab makes have never been made by anyone else in the world, which is really cool! Hopefully, one of our medicines will someday help fight neglected tropical diseases. Snail fever, for example, affects children more than adults. So, making a new low-cost, safe, and effective medicine for it could help millions of children worldwide."

I really enjoyed my visit with Dr. Naumiec. It was exciting to see how his laboratory is working to discover new medicines. They're helping children and adults all over the world feel "The Healing Power of Chemistry"!

Personal Profile

Favorite color? Orange

Favorite movie? Jurassic Park (I still love dinosaurs after all these years)

About your family? I have a loving wife, Erin, and the most amazing daughter, Amelia (she's 10 years old!)

Accomplishment you are most proud of? Being named Professor of the Year for the Central Arkansas local ACS chapter. It was a great honor being nominated by my students for that award!

Word Search

Try to find the words listed below – they can be horizontal, vertical or diagonal, and read forward or backward!

Z	J	P	E	N	I	C	I	L	L	I	N	E	S	L	M
Q	O	I	C	A	R	H	Z	R	L	L	H	C	R	E	I
X	E	O	I	P	H	A	R	M	A	C	I	S	T	C	L
V	P	L	P	M	B	A	L	R	R	E	D	C	B	A	K
A	I	D	A	H	R	A	N	E	G	Y	A	I	E	N	O
C	D	E	U	X	A	C	N	G	C	I	H	E	W	T	F
C	E	N	X	T	A	R	L	D	R	D	Y	N	D	I	M
I	R	T	A	C	F	G	M	E	A	V	W	T	O	B	A
N	M	I	G	I	N	E	T	A	R	G	E	I	O	I	G
E	I	S	K	I	E	C	L	Q	C	L	E	S	F	O	N
O	S	T	L	C	A	M	I	N	G	O	X	T	I	T	E
R	T	A	E	B	L	E	X	R	A	Y	G	C	V	I	S
C	E	N	D	I	N	F	E	C	T	I	O	N	D	C	I
H	R	O	M	R	N	E	C	Z	E	M	A	E	O	A	A
M	O	E	P	A	T	H	O	G	E	N	H	Y	L	S	L
G	X	R	V	I	S	K	L	I	M	M	U	N	I	T	Y

ANTIBIOTIC
BANDAGE
DENTIST
EPIDERMIS
ECZEMA
GERM
GOOD BACTERIA
HEALING
IMMUNITY
INFECTION
MILK OF MAGNESIA
PATHOGEN
PENICILLIN
PHARMACIST
SCIENTIST
VACCINE
X-RAY
ZOOPHARMACOGNOSY

For answers to the word search, please visit **www.acs.org/celebratingchemistry**.

Good Health Begins with Your Skin

By Lori R. Stepan

Which do you think is the largest organ in the human body? Ask your family and friends to see if they know the answer.

You may be surprised to learn that the answer is … your skin! The average adult has 22 square feet of skin on their body, slightly larger than the area of your twin-sized bed! All this skin weighs about 8 pounds.

Your skin is made up of three layers: epidermis, dermis, and hypodermis, as shown in the picture. Why should you care about your skin? Your skin protects you from injuries and helps keep out infections and diseases. It controls your body temperature (through sweat), oozes out oil, and prevents the loss of moisture. Your skin also helps your body produce vitamin D, which is important for healthy bones, teeth, muscles, and more.

In order for your skin to keep you healthy, you must also keep your skin healthy. Above all, moisturizing is vital! If your skin gets too dry, it can easily become cracked, reducing the effectiveness of our largest barrier to infection.

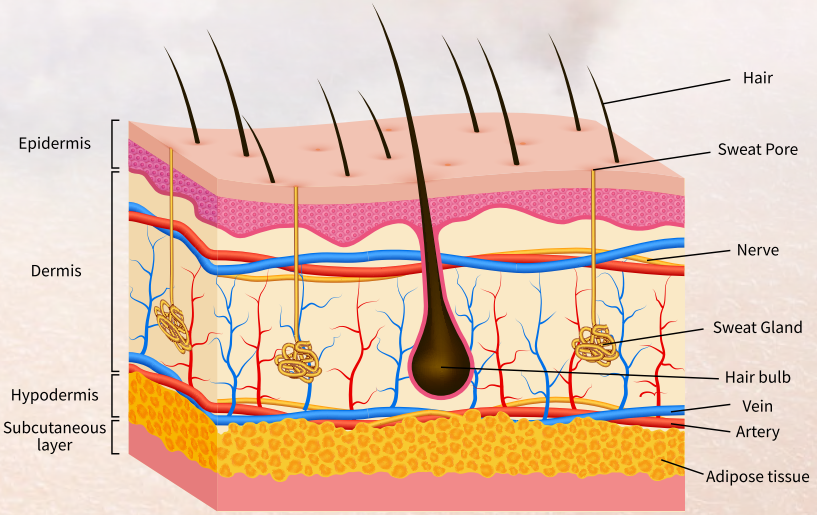
Chemistry can help with dry skin! Most moisturizing skincare products are designed to penetrate only the top layer, the epidermis, and they soften dry skin. Many body lotions contain chemicals that are already part of the skin's natural moisturizing system.

Some kids and adults may have a skin condition called eczema that is linked to an overactive immune system. Eczema can cause inflammation that weakens the skin's immunity. The symptoms of eczema include dry, red, really itchy skin, swelling and cracking of skin, and patches of thickened skin. Prescription ointments can help. They contain chemicals that repair the skin barrier, such as those that add moisture back to the skin, those that add back oils to lubricate and soften the skin, and those that prevent water loss from the skin.

Another thing you can do to keep your skin healthy is to rub sunscreen on it for protection from ultraviolet (UV) radiation when you go out in the sun! When you are exposed to too much UV radiation, it can lead to skin cancer. But once again, chemistry comes to the rescue! Many sunscreens contain zinc oxide (which scientists abbreviate as ZnO) or titanium dioxide (TiO_2). These wonderful compounds block UV rays from penetrating your epidermis and causing sunburn damage.

Be sure to take care of your skin today, with the help of chemistry!

SKIN ANATOMY



Did you know that your skin can heal itself?

Ever wonder what your body does when you get a cut on your skin? If a cut is deep enough, it can make you bleed. In a few seconds, the blood vessels in the area start to shrink to reduce blood flow and stop the bleeding.

Red blood cells, along with other proteins come together to form a kind of screen or shield that stops the wound from bleeding and protects it from getting infected. These blood cells, proteins, and **enzymes** in the blood slowly make the blood thicker and turn it into a gel (or a clot). This forms a scab that acts as a solid "fence" protecting the fragile wound from the external environment.

Next, new blood vessels form in and around the wound. They can supply oxygen and nutrition needed to speed up the healing process. Eventually, the wound heals and the skin, with some minor discoloration, is back to normal.

So the next time you get a cut, remember the wonderful things your skin is doing to heal itself as you put on that bandage!

Lori R. Stepan *is Associate Teaching Professor of Chemistry at Penn State University in University Park, Pennsylvania.*

Words to Know

Acid – a substance, such as vinegar, that has a pH of less than 7.

Antibiotic – a medicine that fights and kills bacteria to help you feel better. Antibiotics cure bacterial infections, but not other kinds of diseases.

Antibiotic resistance – when bacteria can no longer be killed by a certain antibiotic.

Antibodies – proteins made by your body's immune system that latch onto germs and keep them from making you sick.

Bacterium – a single-celled organism. There are bad bacteria that cause diseases, but also good bacteria that help you digest food.

Base – a substance, such as milk of magnesia, with a pH greater than 7.

Chemical reaction – the process where atoms are rearranged between two or more substances to result in different substances.

Enzyme – usually a protein that living things make to stay healthy. Enzymes speed up reactions in the body.

Germs and pathogens – any disease-causing microorganisms that attack living beings (examples are viruses and bad bacteria).

Infection – a disease caused by germs.

Immunity – the ability of your body to resist diseases, infections, cuts, germs, etc.

Microorganisms – tiny living things made of just one cell, or a colony of cells. These little creatures live on, in, and all around us!

Probiotics – a good kind of bacteria that lives in certain foods, which people and animals eat for good "gut health."

pH indicator – a chemical that changes color to show whether a substance is an acid or base.

Vaccine – an injection, pill, or spray that teaches our body to recognize and fight off infectious germs.

About *Celebrating Chemistry*

Celebrating Chemistry is a publication of the ACS Office of Science Outreach in conjunction with the Committee on Community Activities (CCA). The Office of Science Outreach is part of the ACS Division of Education. The National Chemistry Week (NCW) edition of *Celebrating Chemistry* is published annually and is available free of charge online or in print through your local NCW Coordinator. Visit **www.acs.org/ncw** to learn more.

About the American Chemical Society

The American Chemical Society (ACS) is one of the world's largest scientific organizations. ACS members are chemists, chemical engineers, and other professionals who work in chemistry or chemistry-related jobs. The ACS has more than 173,000 individuals in our global community across 140 countries. Members of the ACS share ideas with each other and learn about important discoveries in chemistry during scientific meetings held several times a year, through the ACS website, and through the many peer-reviewed scientific journals the ACS publishes. ACS members carry out many programs that help the public learn about chemistry. One of these programs is National Chemistry Week, held annually during the third week of October. ACS members celebrate by holding events in schools, shopping malls, science museums, libraries, and even virtually online! Activities at these events include carrying out chemistry investigations and participating in contests and games. If you'd like more information about these programs, please contact us at **outreach@acs.org.**

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ACKNOWLEDGMENTS

The articles and activities used in this publication were written by theme team members of the ACS Committee on Community Activities under the leadership of **Lori Stepan**. Meg A. Mole's interview was written by **Kara KasaKaitas**. The translation for *Celebrando la Química* was done by **ACSI Translations**. Front cover illustration concept is by **Faith Yarberry**. Center spread illustration concept is by **Dave Heroux**.

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