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NATIONAL CHEMISTRY WEEK AMERICAN CHEMICAL SOCIETY

FABULOUS FIBERS

THE CHEMISTRY OF FABRICS

NATIONAL CHEMISTRY WEEK

Fabulous Fibers: The Chemistry of Fabrics!

By Sara M. Delgado Rivera

What does chemistry have to do with fabric? The answer is more than lab coats!

Think about the fabric that makes your shirt. Notice the strings that are woven or knitted together to make the fabric. These strings are called yarns. Each yarn is made of many fibers twisted together. Each fiber is made of very long molecules called **polymers** … and that means chemistry is involved! Like string and fibers, polymers have a very long and narrow shape that makes them flexible. Not all polymers can become fibers, but all fibers are made of polymers.

Fibers from Nature

For thousands of years, people have been collecting and using fibers from plants and animals to make clothes and other textiles. Even today, people collect fibers by shearing wool off animals, unraveling cocoons, and pulling soft fibers out of plants. These fibers and the polymers that make them are fully formed in nature. So, the fabrics made with these fibers are called **natural fabrics**. Cotton, linen, silk, wool, cashmere, and burlap are all examples of natural fabrics.

Fibers Invented by People

Nearly 100 years ago, chemists invented new polymers that could be formed into fibers, yarns, and fabrics. These fiber inventions started with natural resources, such as petroleum, and were changed using processes called **chemical synthesis**. This chemistry know-how allowed people to build polymers that can be pulled into extremely long fibers. Fabrics made from these fibers are called **synthetic fabrics**. Nylon, polyester, and acrylic are all synthetic fabrics.

Explore the Chemistry of Fabrics!

Inventions and discoveries continue to be made in the fields of textile chemistry and engineering, including ways that use fewer natural resources and create less waste. As you read the articles in this magazine, you will learn about fabrics that protect people and make life more comfortable and convenient for them. You will even find out how forensic scientists test fibers to help solve crimes. The activities will have you testing your own clothes (without harming them), inspecting a nature-inspired invention that you might find in your own home, and coloring yarn. Celebrate the chemistry of fabrics as you investigate, explore, and make your own discoveries about fabulous fibers!

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Investigate a Nature-inspired Invention: Hook-and-Loop Tape

By Keith Michael Krise

Engineer George de Mestral was walking his dogs in the meadows of the Swiss Alps. When they returned home, he noticed that burr seed pods were stuck on his dogs' fur! He even found some stuck to his own clothes. De Mestral was curious: Why did the burr seed pods stick to fur and fabric? The answer he found inspired him to invent a special new material … one that you may use every day!

Materials

- 2 Burr seed pods (or do an image search for "burdock seed pod")
- Magnifier
- Item that has hook-and-loop tape (Velcro) on it

Procedures

1. Hold a burr seed pod in your hand and feel its texture with your fingers. Then use a magnifier to look closely at the seed pod.
2. Use a magnifier to look at both sides of the hook-and-loop tape.
3. Press the hook-and-loop tape together. Pull the pieces apart slightly and use a magnifier to look at the place where the two are being pulled apart.
4. Next, listen to the sound as you pull the hook and loop sides apart.
5. Press the hook side against your sock and listen as you pull it off. Press the hook side on a couple of different fabric surfaces and listen as you pull the hooks off.
   - Which makes the loudest sound?
   - What does the hook side stick to the best?
   - Why does the hook side stick to the loop side so well?

How does it work?

When de Mestral looked at the burrs under a magnifying glass, he saw that they had tiny hooks that got caught on the yarns of his clothes and on the dogs' fur. This observation gave him the inspiration to develop the product that holds shoes on feet, bibs on babies, and rocks in pockets. Velcro, also commonly known as hook-and-loop tape, works so well because the hooks on one side of the tape grab onto some of the many loops on the other side. The hooks are designed to be more rigid and thicker than the loops. When pulled, the flexible loops can detach from the hooks. Some loops are torn in the process, but there are many loops, so this fabric fastener is reusable many times!

Fun facts about Velcro

- George de Mestral patented his nature-inspired fabric in 1955, calling it Velcro.
- Velcro is a combination of the French words "velours" and "crochet," which translates to "velvet hook."
- Astronauts use hook-and-loop tape to secure important scientific equipment (and their dishes) in zero-gravity space.
- Hook-and-loop tape is made with nylon and polyester. The hooks and loops are nylon and the tape that they are attached to is polyester.

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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 this activity.
- Clean up and dispose of materials properly when you are finished with the activity.
- Thoroughly wash hands after conducting the activity.

How to Sweat … and Not Stay Wet

By Neal M. Abrams

We sweat. We get caught in a rainstorm. We spill our water during lunch. There are many times we get wet, stay wet, and feel uncomfortable for a long time afterward. If this ever happens to you, the kind of fabric in the clothes you're wearing can make a big difference!

Suppose you want to wear something completely waterproof. It would keep water *off* you, but it will keep water *in*, too. You see, water is always evaporating off our skin. Wearing a truly waterproof fabric would make you feel sweaty and gross. Read about the relationship each of the three fabrics listed in this article has with water. What you'll learn will help you decide what to wear if you plan to run a lot during recess, or if the forecast calls for rain … or if you decide to play catch with water balloons.

Cotton

Cotton is soft, feels comfortable, and stretches. These properties make cotton a top pick for towels, jeans, and shirts. Cotton holds onto water because it is very **hydrophilic** ("water-loving"). It can pull a little bit of sweat from your body (a process called "**wicking**") to keep you feeling dry and comfortable. However, cotton doesn't dry very quickly. If you got caught in a rainstorm, you would not feel good at all. Imagine wearing wet jeans! There are times when the water-absorbing property of cotton is not so great. Cotton can be woven, like in jeans, or knit like in T-shirts. Knit fabrics tend to stretch better than those that are woven.

Wool

Wool is both water repellant and very absorbent. How can this be? It has to do with the unique structure of the wool fiber. It has an inner core that is hydrophilic and attracts water, like cotton. However, the inner core is covered with overlapping scales. These scales have a waxy coating, called lanolin, which is **hydrophobic** ("water-fearing"). Due to this amazing structure, wool can absorb up to 20% of its weight in water before it starts to feel damp! Wool does something else amazing. As the fibers absorb moisture, a little bit of heat is released. The wool holds the water, preventing evaporation (which is a cooling process). These two processes keep people feeling warm, even when a little wet. Another reason wool keeps people warm is that it contains many tiny air pockets. This structure provides a layer of insulation, holding a person's own body heat on the inside while keeping the cold air outside. These properties explain why many hats, scarves, sweaters, coats, and even socks are made of wool.

Quick-dry Athletic Wear

Athletic wear is made of polyester or nylon combined with a little Spandex (a synthetic fiber known for its stretchiness). Polyester and nylon dry quickly because their molecular structures are much less hydrophilic than cotton. They also tend to be wrinkle-, shrink-, and stain-resistant. Adding Spandex fibers allows the fabric to stretch as the wearer moves. This is because the polymers in Spandex coil and uncoil like a spring, giving it a unique stretchy property. The special weave and blend of fabrics cause liquid water to bead up, yet water vapor can easily move through the spaces between the yarns. Quick-dry athletic wear is a great solution for people who exercise outside. These fabrics will get wet eventually, but the water will evaporate more quickly than it does from cotton or wool. As the water evaporates, it takes a little heat from its surroundings, meaning a person wearing the shirt or shorts will feel a little cooler. Feeling cooler could be especially welcome in hot weather.

Thanks to nature and chemistry, we have fabulous fabrics that help us feel dry and comfortable, even soon after getting wet.

Neal M. Abrams, Ph.D. *is an Associate Professor of Chemistry at the SUNY College of Environmental Science and Forestry in Syracuse, NY.*

Put Your Fabric to the Test

By Regina M. Malczewski

When you dry yourself off after a swim, try to stay dry on a rainy day, or put on a T-shirt, you choose the best fabric for the job. Perhaps you need a fabric that is very absorbent. Maybe you want to wear a T-shirt that will dry quickly because you'll be running in gym class.

In this activity, you will add water to the fabrics used to make umbrellas, towels, and T-shirts. You will discover a key property that makes these fabrics so useful.

Materials

- Small towel
- Umbrella
- T-shirt (cotton/polyester blend)
- T-shirt (100% cotton)
- T-shirt (100% polyester)
- Cotton swab
- Small cup of water

Procedures

Prepare for the activity

1. Place your cotton swab in a small cup of room-temperature water.
2. Turn your three T-shirts inside out and place them aside.
3. Fold the small towel in half and lay it flat on the table.
4. Lay the closed umbrella on a table. Pull out a bit of the fabric and arrange it so that a small section is flat against the table.

Test the towel and umbrella

1. Hold the cotton swab over the flat fabric section of the umbrella. Then squeeze the cotton swab to release one big drop of water onto the umbrella fabric.
2. Dip the cotton swab back in the water for a moment and then squeeze it over the towel to release one big drop onto the fabric.
3. Record your observations in the chart below. Use a check mark to show whether each material absorbs (soaks up) or repels water.

Test the T-shirts

1. Dip the cotton swab back in the water and squeeze it so that a big drop of water lands on one of the shirts. Watch the water closely to examine how quickly the water goes into the fabric.
2. Repeat Step 1 for the other two shirts, and try to make the water drop land in the roughly same place on each shirt.
3. Allow some time for the water to evaporate from all three shirts. As you wait, record your observations in the chart below.

Item		Hydrophilic (Absorbs water)	Hydrophobic (Repels water)	Evidence
Umbrella			✓	water beads up and slides off
Towel				
T-shirts	Cotton			
	Polyester			
	Cotton/Polyester Blend			

How does it work?

Different fabrics have different properties. People use these properties to choose which fabrics to use in different situations.

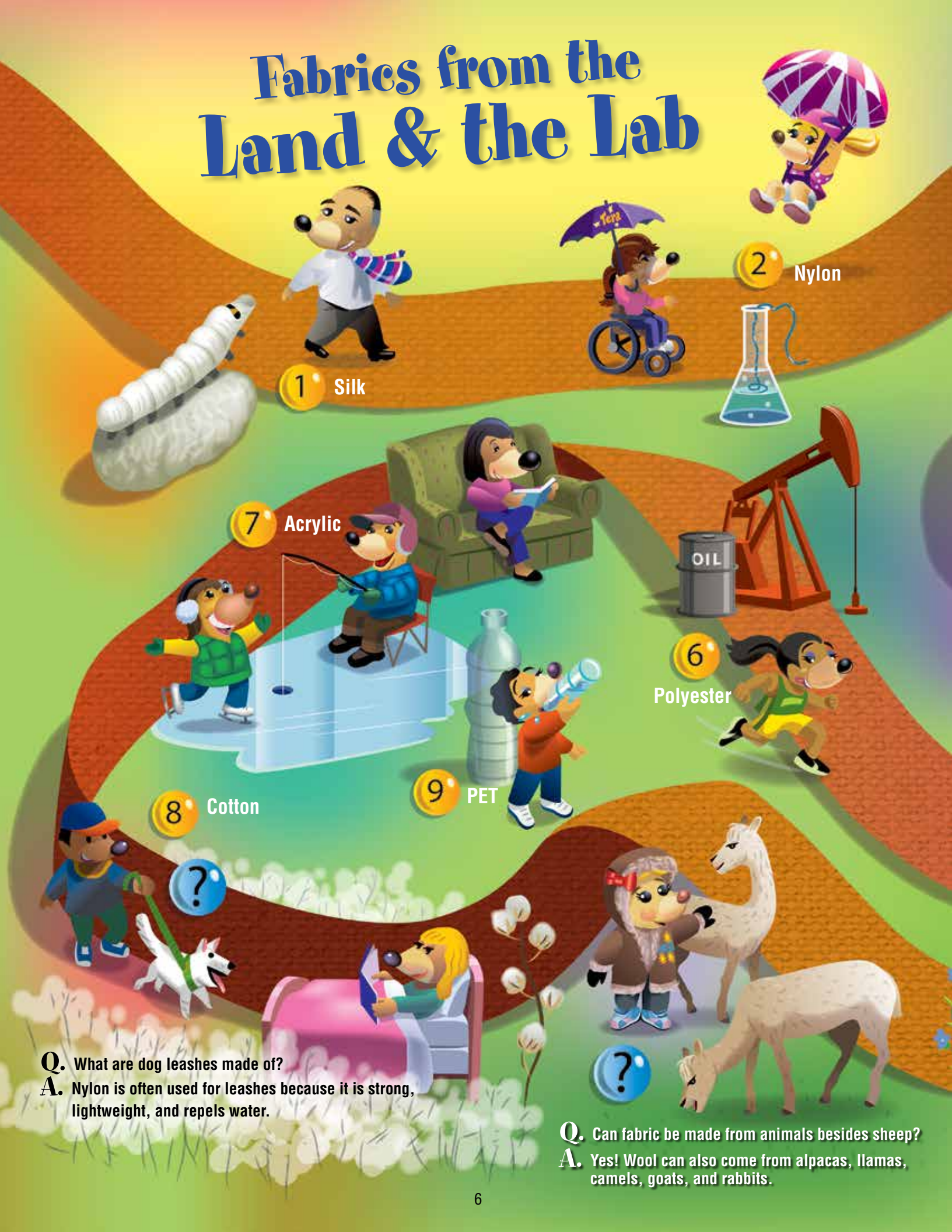
We use towels to absorb water, so cotton is a good fabric choice. Water is very attracted to cotton. There is also some clever engineering on the towel: it has thousands of tiny loops on its surface. These cotton loops provide many places for water to stick — so that drops of water disappear into the towel instantly. A fabric that quickly absorbs water is called **hydrophilic** (which literally means "water-loving"). Hydrophilic fabrics such as cotton are soft, have good airflow, and are easy to wash. This is why bed sheets, blankets, socks, and T-shirts are often made with cotton. Drops of sweat are absorbed by the fabric, keeping us feeling dry and comfortable.

We use umbrellas to keep water off of us, so nylon is a good fabric choice. Water molecules are not attracted to nylon, but they are very attracted to each other. So, the water sticks together on the umbrella in the shape of little domes. Due to the smooth surface of the umbrella, there is no place for water to stick, so the drop can easily slide off the surface of the umbrella. A fabric that repels water is called **hydrophobic** (literally, "water-fearing"). Hydrophobic fabrics are often high-strength, anti-bacterial, and dry quickly. Parachutes, dog leashes, and climbing ropes are often made of nylon.

Polyester fabrics are also hydrophobic. It may seem surprising that many clothes, sheets, and blankets are made of polyester. It does not have good airflow and does not absorb water readily. However, water evaporates from it quickly. This is why polyester is used in swimsuits and athletic wear. Polyester is strong, wrinkle-resistant, and cheaper to make than cotton fabric. Many products are a blend of both cotton and polyester, and the resulting fabric has a combination of these great properties.

Regina M. Malczewski, Ph.D. *is a retired research specialist who worked at Dow Corning in Midland, MI.*

Fabrics from the Land & the Lab



Q. What are dog leashes made of?
A. Nylon is often used for leashes because it is strong, lightweight, and repels water.

Q. Can fabric be made from animals besides sheep?
A. Yes! Wool can also come from alpacas, llamas, camels, goats, and rabbits.

Q. What are shoelaces made of?
A. Usually, a blend of nylon, cotton, and polyester.

The moles along the path are using different types of fabric. Guess which items are made of the fiber featured in each section. The column to the right reveals the answers!

1 Neckties

Some ties are made from silk — a strong, smooth, shiny, expensive fabric … made from insect cocoons!

2 Umbrellas and Parachutes

These items are often made from nylon, a strong lightweight fabric made from coal, air, and water. Nylon is strong, lightweight, and water-resistant!

3 Climbing Rope

Climbing ropes, once made of jute, are now made of nylon. Many other ropes are still made from the strong, flexible fibers that grow inside jute plants.

4 Dancing Outfits

Many dress clothes contain rayon, which is made from a polymer harvested from trees and bamboo.

5 Winter Clothing

Sweaters, coats, scarves, mittens, and hats are often made with wool, a breathable yet insulating fiber from sheep.

6 Athletic Wear

Polyester is a durable, easy-care fabric made from petroleum. It's used in athletic wear, fleece outerwear, cushion filling, pillow stuffing, blankets, and more.

7 Upholstery Fabric & Winter Clothing

Acrylic is a durable, easy-care fabric that's used to make coats, sweaters, mittens, and hats. It's also blended with polyester to make the fabric on sofas and the fur on stuffed animals.

8 Bed Sheets and Pajamas

To keep you comfy in bed, sheets and PJs are often made from cotton, a soft, absorbent, and breathable fabric made from fibers in cotton plants.

9 Fleece Pullover and Shoes

Used plastic bottles that are labeled PET, PETE, or have the number "1" in the recycling symbol can be recycled to become polyester fibers and fabric.

10 Tablecloths

Some fancy tablecloths are made from linen, a soft fabric made with fibers from the fast-growing flax plant.

Marvelous Masks

By Lori R. Stepan

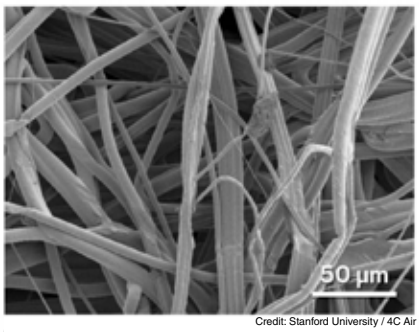
Achoo! Imagine sneezing without catching it with a tissue, shirtsleeve, or mask. Drops of your saliva shoot out of your nose and mouth into the air. The drops eventually fall and land all over different surfaces and onto the floor. Some saliva remains in the air. A friend may even breathe in some of these tiny drops without realizing it. Gross!

As disgusting as sneezes may be, they serve an important purpose: to get whatever is irritating your nose, out! Breathing in pollen, dust, or pepper could make you sneeze. Having disease-causing viruses and bacteria in your nose could also make you sneeze. If you are carrying these, anyone who breathes in bits of your sneeze or who touches a place where parts of your sneeze landed (and then touches their eyes, nose, or mouth) may get sick. No wonder we were trained when we were little to cover our coughs and sneezes! Unfortunately, saliva and mucus also come out of our noses and mouths when we talk, sing, and even breathe.

So how can we stay healthy? And how can we keep people around us healthy?

The power of masking

Many people choose to wear a fabric mask over their nose and mouth to prevent the spread of disease. Masks keep irritants (such as pollen) and germs (such as viruses and bacteria) from getting into our noses and mouths in the first place. They also keep our saliva and mucus contained so that the germs they may carry will not spread to other people.

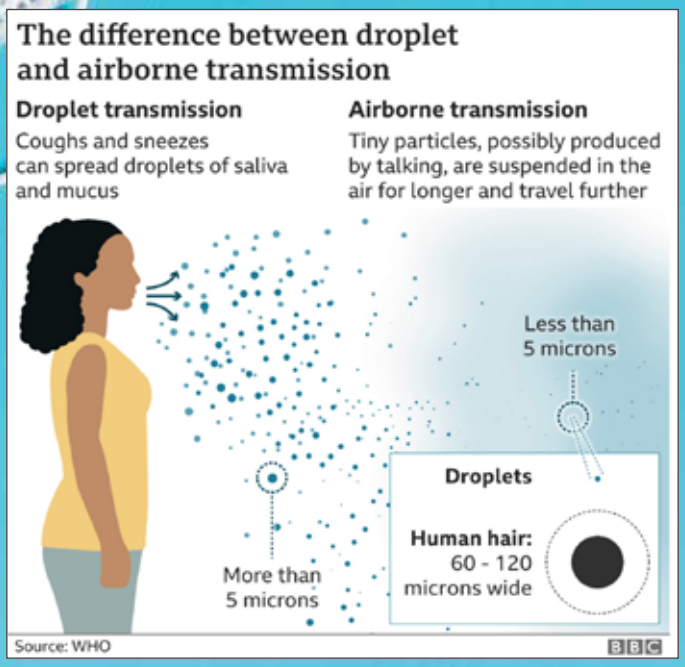


Credit: Stanford University / 4C Air

N95 masks are made of layers of very thin plastic fibers.

Masks are simple forms of protection that are easy to use and inexpensive. They come in different colors, styles, and sizes, too. And many masks can be cleaned and reused. With all of these choices, how do you know if your mask is up to the task?

The way a mask is made affects how well it does its job. The tighter the fit, the better the mask. Particles and droplets should not be able to enter or escape around the edges of the mask. Tightly-woven fabric, where the fibers are very close together, increases a mask's effectiveness.



The Yuck Stops Here!

N95 masks are great at stopping sneezed droplets, blocking 95% of any droplet that's 0.3 microns or bigger

For example, the tight-fitting N95 mask effectively traps droplets and particles within its many layers of very thin nonwoven plastic fibers. These polypropylene fibers form a sort of net that catches droplets and stops them from passing through. In fact, these amazing masks block 95% of particles that are 0.3 microns or larger. To see how small this is, check out the picture above!

When a person wearing a mask sneezes, the droplets and particles are trapped inside the mask, protecting other people nearby. At the same time, when others sneeze, their saliva and mucus are trapped on the outside of the mask, protecting the person wearing the mask. This is why it's so important for health care workers to wear N95 masks: so they don't make the people they're people helping sicker, and also stay healthy themselves.

Other materials that masks are commonly made of include disposable paper, synthetic fabrics such as polyester and rayon, natural materials such as silk and cotton, and combinations of these and other fabrics. Researchers have found that many types of fabric masks that people wear block between 7% and 98% of droplets. One-layer masks block the fewest droplets. Layering fabrics together improves the particle-blocking power of a mask. Including different kinds of fabric in the layers improves the mask even more!

Masks really are marvelous, because they literally provide us with layers of protection from disease!

Lori R. Stepan, Ph.D. *is an Associate Teaching Professor of Chemistry at Penn State University in State College, PA.*

Chemistry Cracks the Case: Focus on Fiber

By Ashten Yarberry, Kathryn Orton, and **Faith Yarberry**

Fibers, yarns, and even pieces of fabric found at a crime scene are examples of evidence used to solve crimes. Forensic scientists conduct tests on fibers collected from a crime scene. This article explains two types of tests.

The first way to identify the type of fabric is to burn it. This test clearly shows whether the fabric is made of natural or synthetic fibers. If the fabric burns easily and gives off a smell like burning paper, it is likely made of cotton. This makes sense because paper and cotton are both made of **cellulose**. The smoke from cotton is either gray or white, and the ash left after burning is soft, fine, and crumbly. If the fabric shrinks away from the flame, however, it is made of synthetic fibers. If it also has a sweet chemical smell, the fiber is likely polyester. The smoke and fumes from polyester are harmful to breathe in, so all burn tests are conducted in a well-ventilated area. Rather than leaving ash, burnt polyester leaves behind a dark, round bead.

Forensic scientists are careful to not use the burning test too often, for a few reasons. First, burning destroys the evidence! Second, the same material can burn with different results depending on the amount of each substance in the fabric. Finally, fabric coatings can cause errors because the coating burns first.

A second way to gather information about fibers from a crime scene is to use a **polarized light microscope**. A forensic scientist can use this piece of scientific equipment to conduct a few different tests to identify the type of fiber:

1. Separating the **polarized light** that reflects off the fabric to see its blend of different colors.
2. Finding the material's **refractive index**, which measures how it bends light.
3. Looking at the **shape and texture** of the fiber. For example, silk tends to be less rough than wool. Looking closely at the condition of the fiber, forensic scientists can also tell whether the clothing is new or has been worn and washed often.

In court cases, attorneys have fibers analyzed to show who might have been at the crime scene. Often, more than one scientist needs to analyze a piece of evidence. Using a polarized light microscope is a great way to analyze fibers because the evidence doesn't get destroyed during the test.

Fiber analysis alone cannot answer the question of "whodunnit?" Unlike fingerprints or DNA, fiber analysis does not point to one specific person. Instead, it can be used to identify a group of people as possible suspects, or to rule out other suspects. However, fiber analysis conducted by forensic scientists, along with other key evidence, helps investigators crack the case.

Ashten Yarberry, Esq., *is a Staff Attorney at Legal Aid of Northwest Texas, in Fort Worth, TX.* ***Kathryn Orton, M.S.,*** *is a Forensic Scientist II at the Texas State Crime Lab, in Tyler, TX.* ***Faith Yarberry, Ph.D.*** *is a Senior Lecturer at the University of Central Arkansas, in Conway, AR.*

The Adventures of Meg A. Mole, Future Chemist

Personal Profile

Favorite color? Magenta

Favorite pastime/hobby? One thing I really like to do for fun is design interior spaces (Fun fact: I also considered being an interior designer when I grew up)!

Dr. Tova Williams

In honor of this year's National Chemistry Week theme, *"Fabulous Fibers: The Chemistry of Fabrics,"* I traveled to Raleigh, North Carolina to meet Dr. Tova Williams.

Dr. Williams is an Assistant Research Professor in Textile Engineering, Chemistry and Science at North Carolina State University. She told me, "I'm passionate about advancing science within the area of dye/color chemistry. I design and develop environmentally-friendly dyes and dyeing processes using a variety of tools, including algae and fungus as sources of bio-color." In addition, she explained that she enjoys "teaching and communicating technical concepts to diverse audiences and inspiring the next generation of scientists." I could not wait to learn more about her work with dyes and colors!

So where does Dr. Williams work? "I do most of my work in a laboratory (and with chemicals), but I also often work with a computer to plan experiments and help me design dyes I want to create," she said. I really was excited to see the many colors of dyes she works with, and the amazing things she's able to create using them. She explained further, "I create dyes for different fibers such as textile and hair fibers, and I find ways to make the dyes less toxic." Not only are the colors beautiful, but she also understands how important it is for them to be safer for everyone.

Growing up, Dr. Williams' favorite subjects were Chemistry, Geometry, Calculus, and World History. "I was definitely interested in science when I was growing up," she recalled, "and my interests changed many times. At one point I actually wanted to be a marine biologist! I decided to be a chemist instead, because I fell in love with the science after taking my first class and later found out I could be a dye/color chemist and create less toxic hair dyes." She also got to participate in summer camps and do fun experiments.

I asked Dr. Williams what she liked the most about her job. "Every day is different," she shared, "and I get to not only shape science, but also the next generation of scientists, my community, and the world."

Take a look at all of the wonderful fabrics you see around you. From clothes, to curtains, and even towels, the excitement of chemistry helps chemists like Dr. Williams create many different colors to make fabrics beautiful. These chemists continue to look for ways to make fabric dyes even safer!

Dyeing to Color Fabric

By David S. Heroux

Introduction

Think about your favorite shirt. What color is it — and how did it become that color?

The dye manufacturer tested different types of fabrics to see how the color would look on each. The manufacturer then tested the fabric samples to make sure that the color would stay the same, even after you washed and wore your shirt many times. A lot of work and science goes into giving your favorite shirt its awesome color!

Procedures

Get ready for the activity

1. Cover the work area with cardboard or a paper or plastic bag.
2. Cover your clothing with an art smock and wear disposable gloves.
3. Cut an index card in half and label the two pieces **Cotton** and **Polyester**.
4. Use a hole punch to make a hole at one end of each label. Cut one 12-inch (30 cm) length of cotton string or yarn. Push one end of it through the hole on the "Cotton" label and make a knot.
5. Cut and label the polyester string or yarn in the same way.

Prepare the dye bath

1. Empty one packet of Kool-Aid drink mix into a cup or bowl and set it on your covered work surface.
2. Add ¼ cup (60 mL) of water to the mix and stir with a fork until the powder dissolves.

Dye the fibers

1. Place both pieces of string or yarn in the dye bath, letting the ends with the labels hang over the edge of the cup or bowl so they stay dry.
2. Push any floating parts of string or yarn down into the dye with a fork.
3. Wait 10 minutes.
4. Place a paper towel on a plate.
5. Use a fork to carefully remove both samples from the dye bath and place them on the paper towel to dry. What do you observe?

Try this!

Ask someone in your home to cut a piece of either the cotton or polyester string or yarn without telling you which one it is. Then place this unknown sample in the dye bath. Compare the results to your labeled samples. Can you identify whether the unknown sample is made of cotton or polyester?

BE SAFE!

- Wear safety glasses or goggles to protect your eyes.
- Use cool tap water. There is no need for hot water.
- Cover your clothes and wear disposable gloves. The drink mix will stain fabric and skin.
- Wash your hands after doing the activity and cleaning up.

Materials

- Kool-Aid drink mix packet, any flavor or color, unsweetened
- Water
- Cup or bowl for dye
- Fork
- Measuring cup, ¼ cup (60 mL)
- Plate
- Paper Towel
- White cotton string or yarn
- White polyester string or yarn
- Scissors
- Hole punch
- Index card
- Pen
- Cardboard, paper bag, or plastic bag large enough to cover and protect your work surface

Notes

- Kool-Aid's Blue Raspberry Lemonade, Orange, and Tropical Punch flavors work well.
- Nylon or acrylic may be substituted for polyester.
- Wool may be substituted for cotton.

Here's the Chemistry!

There are molecules in powdered drink mix that give it its color. These molecules absorb and reflect light in a special way that our eyes see as color. These molecules are very attracted to water and dissolve very quickly.

The combination of dye molecules in powdered drink mix sticks best to fibers that are also very attracted to water. The main molecule in cotton, also known as the polymer cellulose, is very attracted to water. That's why the dye sticks well to the cotton, making it brighter or darker in color.

The combination of dye molecules in the drink mix are barely attracted to polyester. So even though the cotton and polyester were in the dye bath for the same amount of time, the dye stuck only a little bit. This is why the polyester fiber you soaked in the dye is lighter or duller in color.

Chemistry is the science that puts and keeps the color in your clothing … just the way you like it!

David S. Heroux, Ph.D. *is a Professor of Chemistry at Saint Michaels College in Colchester, VT.*

Words to Know

Cellulose—a polymer made by plants

Chemical reaction—the process of rearranging atoms within molecules to form different molecules

Chemical synthesis—the process of using one or more chemical reactions to create a desired molecule

Fabric—cloth made by weaving or knitting yarns together

Fiber—a long thin structure made of polymers that can be twisted with other fibers to make yarn

Hydrophilic—the property of being very attracted to water

Hydrophobic—the property of not being attracted to water

Natural fiber—A fiber that is fully formed in nature by plants, animals, or minerals

Polymer—a long thin molecule made of repeating groups of atoms

Synthetic fiber—A fiber that is made by humans using chemical synthesis

Wicking— A property of a fabric that pulls water from a surface and holds it

Yarn—A group of fibers twisted together that can be woven or knitted to become fabric

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 over 151,000 members in more than 130 countries around the world. 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.**

About Celebrating Chemistry

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Want to learn more about Avi and the other moles?
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