Better Living through Chemistry

Plastic, nylon, and glass—you won't find these on the periodic table. Yet these substances are a part of our daily lives. Substances like plastic are called **synthetic** materials, because humans synthesize (make) them. Materials scientists and chemical engineers figure out how to combine and rearrange **atoms** of substances to create a new substance that is stronger, cheaper, safer, or otherwise more useful.

But you can't make something from nothing. Where do these scientists and engineers get their ingredients? Earth's natural resources provide the raw materials for everything you see around you, from cell phones to medicines to rockets.

Starting Your Day

Let's start right at the beginning of the day. Your phone alarm wails, and you silence it, then rub your sleepy eyes. What's the phone made of?

The screen is made of glass that is mostly silicon and oxygen. Humans first made glass by heating crushed sand or a mineral called quartz with other substances. These natural resources are still used as the source for some modern kinds of glass.

The circuitry of the phone relies on several metals, including copper, gallium, gold, indium, magnesium, palladium, platinum, silver, tin, and tungsten. These elements are extracted from rocks and ores. Then they are processed before ending up in your phone.

Petroleum Products

You crawl out of bed and make your way to the bathroom. There on the shelves are dozens of products to help you get ready for your day. What are they made of?

Shampoo, hand lotion, mouthwash, nail polish, sunscreen, perfume, and mascara all have something in common—they include ingredients made from **petroleum**. The bottles holding these substances are typically made of plastic, which is also made from petroleum. Hairbrushes, combs, toothbrushes, hair dryers, shower curtains, and even the toilet seat are typically made of plastic. That's right, petroleum again!

What is petroleum? It's not an element, so it's not in the periodic table. The raw material for petroleum came from dead plants and animals. Their remains were buried hundreds of millions of years ago. Instead of decaying, these remains changed into petroleum, which is made mostly of carbon and hydrogen. It is also called **crude oil**.

This natural resource is mined or collected. A refinery separates the crude oil into different **products**. Each product is a different combination of carbon and hydrogen. Most of the refined products are used for fuel, including gasoline that powers cars, trucks, and buses. Other refinery products include lubricating oils, waxes, and raw materials for plastics and medicines.

Crude oil is extracted from the ground using special machinery.

When materials scientists and chemical engineers figured out how to create plastics from petroleum, they changed the way we live. Instead of packaging shampoo in a glass bottle, how about using plastic? If it slips out of your wet hand in the shower, there won't be any broken glass to cut your feet. Plastic means that food can easily be packaged for eating on the go, using plastic utensils. Plastic means that hospitals can store new or sterilized equipment in sealed packages, reducing the risk of infection.

Medications

It's allergy season, so you take a pill to help keep your sinuses clear. What are the ingredients in this synthetic substance? Many medications are **compounds** built from different amounts of the elements carbon, hydrogen, and oxygen, with a few other atoms mixed in. Biochemical engineers figure out how to use **chemical reactions** to create these new substances. Medical researchers test new substances and help the engineers decide what to create next.

Getting Dressed

You put on your clothes for the day. Your T-shirt is 100 percent cotton. But your other clothes are made with petroleum-based materials, such as nylon and polyester. Rayon is a synthetic, too, made from the cellulose of plants. Not only shirts, blouses, pants, and skirts have synthetic fabrics, but also sweaters, windbreakers, rain coats, sneakers, sandals, flip-flops, and tote bags. Then there are nylon umbrellas, nylon zippers, and plastic hangers. It's hard to believe that all these products are made from materials that come from the ground. But that is true for all petroleum-based products.

The Kitchen

You go into the kitchen for breakfast. You find yourself surrounded by more petroleum products: nonstick pans, plastic bottles, drinking straws, plastic-foam egg cartons, trash bags, microwave dishes, milk jugs, waxed paper, and lunch boxes. Even tablecloths, refrigerator shelves, mops, sponges, and dish scrubbers may be petroleum-based products. The windows in the kitchen are made of glass, as is the glass you fill with juice. The stainless-steel spoon you use to eat your cereal? It's a manufactured metal, combining raw iron, carbon, and chromium.

At least your food doesn't contain synthetic materials, right? Not so fast. Many prepared foods contain synthesized preservatives, colorings, and flavors. Vitamins are added to other foods. Folic acid is an important B vitamin. It is available naturally in some foods, but people often consume less than the recommended amount. Without enough folic acid, pregnant women are much more likely to have a child with birth defects. Now the United States Food and Drug Administration requires food manufacturers to put extra folic acid into breads, cereals, flours, pasta, and other grain products. This added synthetic vitamin helps prevent many birth defects.

Heading to School

You reach for your sunglasses. Oh yes, those are likely to be plastic, too. If you are not bicycling or walking, you are probably going to school in a vehicle. The car or bus is powered by petroleum-based fuel (unless you're in an electric vehicle charged by solar panels). You may be riding on asphalt streets. Asphalt is made with tar, which is another petroleum product.

Phew! You made it to school after a busy morning. Now you look around the classroom. What synthetic materials are here?

Synthetic materials are a part of your daily life.