



## WHAT'S IN IT? HOW IS IT MADE?

### *Teacher Information Sheet*

This *Teacher Information Sheet* is intended to show the connection between the products you and your students use every day and raw materials taken from the Earth. Mining, quarrying, and oil-and-gas production not only provide the ingredients to make nearly everything we use in our daily lives, but also are the source of most of the energy needed to process those raw materials into finished products.

#### **Introduction**

We are now in our third generation of people who are largely disconnected from the land around them. The original settlers who came to this country felled the trees, cleared the land, tilled the soil, and quarried rock. Settlements sprang up around deposits of iron, zinc, and copper, which provided employment and raw materials for the miners, blacksmiths, and workers in the rolling, stamping, and slitting mills that made products from these metals. Your ancestors five generations back likely made their own candles and clothes, used coal or wood for heat, and dug their own wells for water. These days, however, few of us are directly engaged in mining or manufacturing, let alone making our own clothes and shoveling coal into a furnace. Whenever we need something, we simply go out and buy it. When we want heat, we turn up the thermostat.

What we've gained in convenience we've lost in knowledge. Should you doubt this, ask any ten of your friends what raw materials are used to make glass, or a dinner plate, or a computer, and you will see what we mean. No longer are we close to the Earth in anything but the literal sense. For this reason we ask nearly every visitor to the Sterling Hill Mining Museum the following question: Can you name any product you've used in the last two weeks, a product manufactured by man, that did not somehow involve mining in its production? The goal is not to glorify mining, but merely to explore how much mining affects our daily lives. Like it or not, the answer to that question is: *almost nothing*.

Below we list broad categories of products that we use in our daily lives, and explain how mining is necessary to bring those products to you. In later documents we will address the environmental consequences of mining and the steps we might take to reduce our demand for raw materials taken from the Earth.

#### **Metal Products**

With very few exceptions, wherever metal is part of a product we use, or was part of the machinery used to manufacture that product, the metal came from a mine. Our houses contain copper pipes and wire, iron nails and screws, aluminum window frames, and tungsten in our light bulbs. Our cars contain zinc (in carburetors, fuel pumps, and tires), iron (as steel, for the frame and body), copper (wires), lead (in the battery), mercury (the reflective part of the mirrors),

chromium (as plating on door handles, hubcaps, mirrors, etc), and strontium (the flares in the trunk). The light from many of our televisions and computer monitors comes from compounds of metals that some people have never heard of, but nevertheless use every day. Our streets are lit at night by sodium and mercury vapor lamps. We wear jewelry composed of gold, silver, platinum, copper, or brass (an alloy of copper and zinc). Some of us have gold-capped teeth and mercury-based fillings in our mouths, or even artificial knee and hip joints made of titanium. Metals are such a pervasive part of our daily lives that it is hard to imagine what life would be like without them—we would, after all, have to go back to the Stone Age. Nevertheless, many people seem not to realize the connection between metals and mining.

### **Plastic Products**

The raw material for nearly all plastics is oil, natural gas, or coal. In an average home you're likely to find many products made from plastic: drinking glasses and coffee cups, dinner plates, the containers for a variety of household products (milk, shampoo, glues, pills, detergents, leftover food), and trash and garbage cans merely begin the list. The bodies of radios, lightweight camera housings, computer monitors, and televisions likewise are made from plastic. The list of plastic products used in our daily lives seems almost endless, yet nearly all began either with an oil or gas well, or a coal mine. PVC pipe, for example (the pipe commonly used in our homes for drain lines) is made from natural gas and rock salt (halite).

### **Ceramic Products**

Dinner plates, flower pots, coffee cups, electrical insulators, false teeth, spark plugs, wall tile, crockery—these are only a few of the things that are made from ceramic materials. The base material for most types of ceramics is either clay (from a clay pit) or ground-up silicate minerals such as plagioclase and orthoclase feldspar, wollastonite, tremolite, anthophyllite, and talc, all of which come from mines. New uses are being discovered for ceramics every year, but most are not well known to the general public; possible exceptions are the several new types of ceramic magnets that are now in widespread use to affix objects to our refrigerators. Meanwhile, it is a sobering thought that the finest Staffordshire china and the most beautiful Ming vases are products of kaolin clay pits.

### **Glass Products**

Glass, whether used for windows, drinking glasses, eyeglasses, bottles, or TV and computer monitor screens, is *totally* a product of mining. The soda-lime glass most widely used for commercial products contains silica (either from a sand pit or a sandstone quarry), trona (from a trona mine), limestone (from a limestone quarry), and feldspar (from mines, again). The feldspar provides the alumina to strengthen the glass. Decorative glassware sold as “lead crystal” owes its heaviness and sparkle to lead, another mining product. Moreover, the pigments for colored glass typically are mining products as well, as anyone who has studied the manufacture of stained-glass windows in churches can attest. Iron, cobalt, manganese, or gold produce green, blue, violet, and red glass, respectively. All four of these metals, plus more, come from mines; there is no other commercial source.

### **Wood, Paper, and Cardboard Products**

The raw material for anything made of wood, paper, or cardboard is trees. Certainly we don't mine trees, nor in centuries past did we plant them—we simply harvested what Mother Nature

had provided us. Nevertheless, mining plays a large role in the manufacture of the wood, paper, and cardboard products that we use every day.

First, one has to cut the trees down. The blade of the saw or the head of the axe came from an iron mine. If a chain saw was used, it too has a metal blade, its plastic housing is a petrochemical product from oil wells, and it runs on gasoline and oil, two more petrochemical products. Then, in order to make things like wood studs and plywood for houses, wood veneer for furniture, or toothpicks for our meals, the wood has to be sawn to size (metal blades) or peeled into thin sheets for plywood and veneers (metal blades again). The adhesives used for these latter two products are petrochemicals made from oil. Wood treated for outdoor use employs a host of preservatives, all of which contain components from the mining industry: creosote, for example, is derived from coal, and the chromium and arsenic used in pressure-treated wood are products of mines as well.

To manufacture paper and cardboard one has first to mash the wood to separate it into fibers. This involves heavy machinery, the metal for which came from mines. Fibers for the print industry are then soaked in sulfuric acid to bleach them (the sulfur is extracted from the caprock of subsurface salt domes), and additional chemical baths are necessary if one wishes to neutralize the acid to make archival-quality paper. The shiny, heavy paper used in oversized “coffee table” books owes its shininess and heaviness to clay, which is added to fill the pores in the paper so the print will make a clean impression—that is, inks do not bleed into clay-impregnated paper, so the print is crisper and the photographs more detailed.

### **Textiles**

Textiles, which go into our clothes, drapes, bed linens, tablecloths, and blankets, can be divided into two groups: natural and synthetic. Both involve mining in their manufacture.

Let’s consider natural textiles first. The principal ones are cotton and wool. Even if we discount the metal tractors that are used to prepare the cotton fields and plant the seed, and the phosphate rock in the fertilizer, and the petrochemical products in the insecticides—that is, even if we pretend that a truckload of freshly picked cotton owes nothing to mining—we can’t go from raw cotton to a cotton shirt without involving mining-related products every step of the way. The cotton has first to be cleaned and spun into thread. The thread has to be woven into cloth, and the cloth then has to be dyed, cut, and finally sewn into garments. Every one of these processes involves metal machinery and the gasoline (from oil) or electricity (from coal or uranium) to power it. Even if you make your own clothes, what do you think your sewing machine and needles are made of? Similar arguments can be made for woolen clothes, starting with the metal shears that are used to shear the sheep.

Synthetic fabrics, meanwhile, are even more directly a product of mining. Nylon, rayon, and polyester are all made from either oil or coal.

### **Agricultural and Horticultural Products**

Almost all nations produce a significant part of their food supply through agriculture. Think of all the food plants we grow in the United States: corn, wheat, oats, barley, lettuce, broccoli, tomatoes, various types of beans, potatoes, carrots, garlic, radishes, peanuts, and dozens upon

dozens more. Other agricultural plants are grown for their fibers (cotton and hemp for string, twine, and rope), for flavorings (mint, wintergreen, plus nearly all spices), or for their medicinal value. Agriculture on a commercial scale, however, depends heavily on mining for its success.

Here's why. First the farmer must prepare the soil by tilling it. This involves metal machinery, and all of that metal came from mines. Then the seed must be planted, which typically involves more metal machinery. A tractor, for example, contains components from more than a dozen different kinds of mines, runs on diesel fuel (a product of oil wells), and is lubricated with oil and grease (oil wells again). If the crops require fertilizer, chances are good that the phosphate content of that fertilizer came from a phosphate-rock quarry. Many crops also require water beyond that supplied through normal rainfall, and the metal pipes and sprinkler heads for delivering that water all come from mines. Then the crops must be harvested, cleaned, and packaged, all processes that require more machinery. Nearly every step of a commercial agricultural operation involves components and materials that come from mines. Similar considerations apply to most steps of commercial horticultural facilities such as greenhouses and tree farms.

Even a typical household garden involves numerous mine-related products and materials. The blades for shovels and trowels, the nozzles and couplings for hoses, and the hinges on your garden gate are made of metals from mines. The plastic for the garden hose comes from oil wells. Insecticides likewise can be traced back to oil wells—the active ingredients in most insecticides are petrochemical products made from oil. The fertilizer probably contains rock from a phosphate quarry, and the plastic, ceramic, or metal bowl in which you carry your produce from the garden to the kitchen is a product of mining as well.

### **Animal Products**

Our society uses animals in many ways—meat and milk for nourishment, fur for clothing, hides for leather, and bones for fertilizer, to name a few. The importance of mining in this context is not so much to provide the raw materials, but to process them into something we can use. Even something as simple as converting a wild deer into venison involves mining on several levels. If you are a hunter, unless you plan on strangling the deer yourself, you will need the products of mining to bring it down. Consider, for example, the lead slug of the bullet, the brass casing, and the sulfur and saltpeter in the gunpowder, not to mention the metal parts of the rifle itself. If you use a bow, the materials for the fiberglass of the bow, and the metal tip of the arrow, came from mines. You will use a metal car that runs on gasoline to transport your deer, a metal knife to skin the carcass and cut the meat, and a metal pan to cook it in.

### **Food**

Most of us don't think that the products of mining go into the food we eat, but some do. Clay, for example, is a component of some soft ice creams and candies. Clay is composed of particles so very small that we can't distinguish them by touch, so a bit of watery clay in our mouths gives a sensation of creaminess (without the calories). That, plus the fact that clays provide bulk and weight at very little cost, are the reasons that clays (called "extenders" in the food industry) find their way into various foods. In our bodies they are inert; we don't metabolize them, but just pass them through.

More familiar examples of mining-related products are fortified foods. Some brands of cereal, for example, contain iron—literally. If you were to take such a cereal, put some in a glass of cold water, mash it into a watery pulp, and then stir a magnet through it, you'd find tiny particles of iron adhering to the magnet when you draw it out. There is nothing wrong with this. Your body needs iron, and this is one way of supplying it.

Even something as commonplace as a steak involves mining to bring it to your grocery store. To get steaks from a steer one needs various knives and saws to cut through meat and bone. The metal for the knife and saw blades comes from mines. Probably, when you bought your steak, it was sitting in a styrofoam tray and wrapped in transparent plastic. Both of these are petrochemical products, from oil wells.

### **Pharmaceuticals**

A trip to your bathroom can be an instructive exercise on the importance of mining in your life. The main ingredient in numerous medicated powders is a mineral called *talc*; it is for this mineral that *talcum powder* was named. The active ingredient in ointments for diaper rash, anti-itch lotions, and sunscreen lotions is zinc, while that for dandruff shampoos is either zinc or selenium. Antiperspirants contain zirconium. The fluorine in sodium monofluorophosphate (“fluoride”), the anticavity agent in toothpaste, comes from the mineral *fluorite*, and the main ingredient in many toothpastes is finely ground chalk (a rock). Vaseline (petroleum jelly) and the waxes in lipsticks are petrochemicals from oil wells. The list becomes much longer when prescription drugs are included.

### **Fuels and Electricity**

Cars, trucks, trains, buses, airplanes—all are fueled and lubricated by products distilled from petroleum that came from oil wells. Fuel oil, natural gas, and propane are used to heat our homes. About 60% of this nation's electricity is generated by burning coal, a rock abundant in this country, and the balance is generated mostly by nuclear power plants, which use uranium from mines. Even hydroelectric power involves mining in large and necessary ways: for the concrete, rock, and steel in dams, the metal to make the turbines to generate electricity, and the copper wires to transmit that electricity elsewhere. Using wood as a fuel involves mining as well, for one has to cut the tree down somehow, and then size the logs into convenient lengths for burning. Even if you simply gather small branches to burn in your house, you likely burn them in a stone or brick fireplace, or a wood stove made from steel. And remember, if you took away the products of mining from a typical house, there would be no house at all: no foundation, walls, or roof, no brick facing or aluminum siding, no water or drain pipes, no electric wiring, no bathroom fixtures, no windows, no paved or gravel driveway.

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