How is plastic made and identified?

How many times a day do you use something made from plastic? I can guarantee that it's more than you think. Plastic has been a part of our lives for over 100 years, and its use continues to grow. In 2002, about 107 billion pounds of plastic were produced in North America. Recently, claims have been made about certain types of plastic being unsafe. Are we getting more than just storage when it comes to using plastic?

The process of making plastic is a complicated one. It begins with carbon from petroleum, natural gas, coal, or biological sources. The elements can be combined in various combinations in order to achieve a desired property and characteristic. The final product can be hard like the siding on your house or soft and flexible like shrink wrap.

Have you ever noticed the number with the arrows surrounding it on your plastic bottles? Many people use these numbers to determine how the product is to be recycled. These numbers are called the plastic packaging resin identification codes. They indicate the type of plastic that the item was made from and are used to help consumers know whether and how the item is to be recycled. According to the American Chemistry Council, the resin identification numbers are as follows:

- No. 1: Polyethylene Terephthalate (PET, PETE)
- No. 2: High-Density Polyethylene (HDPE)
- No. 3: Polyvinyl Chloride (PVC, vinyl)
- No. 4: Low-Density Polyethylene (LDPE)
- No. 5: Polypropylene (PP)
- No. 6: Polystyrene (PS)
- No. 7: Other: when package is made with a resin other than the six listed above, or is made of more than one resin and used in a multi-layer combination

Before a product made of plastic is allowed to hold any of your food, it needs to be tested for its intended purpose. For example, the plastic that is approved for use in your microwave has been approved for that purpose, while the plastic that carries your water was approved for that use, as well. The U.S. Food and Drug Administration (FDA) admits that something will always "leach out of the container and into the food," so they try to determine the amount that someone will ingest over a lifetime versus the levels of a given substance that

are known to be toxic. Their goal is to make sure that during our lifetime the amount that we consume will not pose any risk to our health. But what if their estimate of how much we consume is incorrect? What if the product containing plastic is not used according to the directions? These questions could be lifesaving ones. The first step is to know what kind of plastic is in your cabinets.

What is polyethylene terephthalate (PET, PETE)?

Polyethylene terephthalate (PET) is clear, tough, and shatterproof. It provides a barrier to oxygen, water, and carbon dioxide and is identified with the number 1. PET's ability to contain carbon dioxide (carbonation) makes it ideal for use in carbonated soft drink bottles. Take a look at the bottom of your soft drink bottle and you will most likely find a number 1 there. PET is also used to make bottles for water, juice, sports drinks, beer, mouthwash, catsup, and salad dressing. You can also find it on your food jars for peanut butter, jam, jelly, and pickles as well as in microwavable food trays.

According to the American Chemistry Council, PET has been approved as safe by the FDA and the International Life Sciences Institute (ILSI). In 1994, ILSI stated that "PET polymer has a long history of safe consumer use, which is supported by human experience and numerous toxicity studies." The American Chemistry Council cautions that products made with PET be used only as indicated by the manufacturer. For example, the microwavable trays are only to be used one time and not to store or prepare foods other than those for which they are intended.

Recent studies have shown that reusing bottles made of PET can in fact be dangerous. PET was found to break down over time and leach into the beverage when the bottles were reused. The toxin DEHA also appeared in the water sample from reused water bottles. DEHA has been shown to cause liver problems, possible reproductive difficulties, and is suspected to cause cancer in humans. Therefore, it's best to recycle these bottles without reusing them.

What is high-density polyethylene (HDPE)?

High-density polyethylene (HDPE) is used to make many types of bottles. HDPE has good barrier properties; it's well suited for packaging products with a short shelf life and has good chemical resistance. It is identified with the number 2. HDPE is used in milk, juice, and water bottles along with household items such as shampoo, conditioner, detergent, cleaners, motor oil, and antifreeze. It can also be found in pipe, tiles, plastic film and sheeting, buckets, crates, and recycling bins.

What is polyvinyl chloride (PVC, vinyl)?

Polyvinyl chloride (PVC or vinyl) can be manufactured to be either rigid or flexible and is identified with the number 3. When flexible, PVC is used for medical bags, shower curtains, shrink wrap, and deli and meat wrap. The rigid PVC comprises 70% of all manufactured PVC. This is used to make construction materials such as pipe, siding, window frames, railing, fencing, and decking. PVC has been said to have had a major impact on improving life around the world.

However, there are claims that PVC poses serious environmental health threats. According to the Center for Health, Environment, and Justice, the production of PVC requires chemicals like the "highly polluting chlorine," the "cancer-causing" vinyl chloride monomer (VCM), and ethylene dichloride (EDC). They also claim that PVC plastic requires large amounts of toxic additives to make it stable and usable. These additives are released during use and disposal, resulting in "elevated human exposures to phthalates, lead, cadmium, tin, and other toxic chemicals." In 2000, the Environmental Protection Agency (EPA) proposed national standards to limit air toxic emissions from polyvinyl chloride production plants.

The FDA acknowledges that the building block of PVC, vinyl chloride, is a human carcinogen. They conclude that the amount contained in the PVC food packaging is within safe limits. In 2002, the FDA recommended that a specific compound used as a plasticizer in PVC either be labeled or removed from the medical bags in which it was being used. This compound, DEHP, had shown some toxic and carcinogenic effects in lab animals, but the effects on humans were unknown. The invasive medical procedures in which this was being used may have exposed people to DEHP levels that would exceed the amount determined to be safe in humans.

What is low-density polyethylene (LDPE)?

Low-density polyethylene (LDPE) is used for its toughness, flexibility, and relative transparency. LDPE is used to make bottles that require extra flexibility. To take advantage of its strength and toughness, it is used to produce grocery bags and garbage bags, squeezable bottles, shrink wrap, stretch films, and coating for milk cartons. It can also be found in toys, container lids, and packaging. It is identified as number 4.

What is polypropylene (PP)?

Polypropylene (PP) is known for its high melting point, which makes it ideal for holding hot liquids that cool in the bottles (for example, ketchup and syrup). It can be manufactured to be flexible or rigid. PP is used to make containers for yogurt, margarine, takeout meals, and deli foods. It is also use for medicine bottles, bottle caps, and some household items. It is identified as number 5.

What is polystyrene (PS)?

Polystyrene (PS) can be rigid or foamed. It is most commonly used for protective packaging (for example, foam packaging for furniture, electronics, and other delicate items), food serving packaging (for example, cups, plates, bowls, cutlery, meat and poultry trays, and rigid food containers), bottles, and food containers. It is identified as number 6.

What is bisphenol A?

Bisphenol A (BPA) is a widely produced chemical used primarily for the production of polycarbonate plastics and epoxy resins. More than 6 billion pounds of BPA are produced and used each year for this purpose. The use of this chemical is so profound that it was detected in the urine in 93% of the population over 6 years of age.

Polycarbonate plastics are typically hard and clear and are marked with the resin identification code number 7. As mentioned previously, the number 7 is considered the "other" category and includes chemicals other than bisphenol A, as well. Nalgene water bottles were made with BPA until recently. They are being voluntarily pulled from the shelves and replaced by bottles that are BPA-free made with a relatively new plastic called Tritan copolyester. Other sources of polycarbonate are food and drink packaging, including infant bottles, toddler sipping cups, tableware, and food containers. Epoxy resins are used to line metal products such as canned foods, bottle tops, and water supply pipes.

The health risks of BPA have been receiving considerable attention. It has long been known that previous studies done on lab animals showed that BPA can cause genetic damage. BPA was approved for use with humans because the amount given to the animals was not comparable to what humans consume. For example, the intake of BPA is expressed in milligrams (mg) per kilogram (kg) of body weight (bw) per day. The highest estimated daily intake (exposure) for humans is

- less than 0.0147 mg/kg bw/day for children;
- less than 0.0015 mg/kg bw/day for adults; and
- 0.0100 mg/kg bw/day for workers exposed to this chemical.

Studies done on laboratory rodents have shown that high doses of BPA during pregnancy and lactation can reduce survival, birth weight, and growth of offspring early in life, and delay the onset of puberty. The doses given were significantly higher than the estimated human exposures:

- Delayed puberty: greater than 50 mg/kg bw/day
- Growth retardation: greater than 300 mg/kg bw/day
- Survival: greater than 500 mg/kg bw/day

BPA has also been linked to cancer, diabetes, and obesity in animals. The American Chemistry Council states that "consumers would have to eat more than 500 pounds of food and beverages in contact with polycarbonate plastic or epoxy resins every day of their lives to exceed exposure levels determined to be safe by the European Food Safety Authority and the U.S. Environmental Protection Agency." There is no way to know for sure if humans would have the same reaction that the animals have had, but there is enough evidence to be concerned and warrant further studies.

The highest estimated intakes of bisphenol A occur in infants and children. Their intake is greatest because pound for pound they eat, drink, and breathe more than adults. BPA is found in the plastic baby bottles and the linings of cans of powdered and liquid formula. Their exposure is also increased by the objects that they put in their mouth. It's important to note that bisphenol A has been detected in the blood of pregnant women and in the breast milk of lactating women.

One thing that many people seem to agree on is that high temperatures can cause BPA to leach into the food or beverage. In one study, boiling water was placed in hard plastic water bottles. The rate of release of BPA with the boiling water was compared with room-temperature water. With room-temperature water, BPA was released at a rate of 0.2 to 0.8 nanograms per hour. The BPA was released 15 to 55 times faster with the boiling water, with a rate of 8 to 32 nanograms per hour. The concern about this has led Canadian retailers to pull all baby bottles made with BPA from the shelves. In the United States, many manufacturers and retailers are beginning to do the same.

What should I do when using plastics?

Plastic is a part of our lives and will not be leaving anytime soon. Professor Fredrick S. vom Saal, a professor of biology at the University of Missouri, recommends using plastic items made with number 2 (high-density polyethylene) or 5 (polypropylene). When using the other plastics, follow these guidelines:

- **Recycle, do not reuse**: Use the product only for what it was intended for. Do not reuse bottles or microwave trays if they were not made to be reused.
- **Keep the heat away from BPA**: Do not warm bottles made with BPA in the stove or microwave, don't put boiling water in them, and do not place them in the dishwasher.

The key to using plastic safely is to use it as it is recommended.

Where can I find more information on plastics?

Environmental Protection Agency
http://www.epa.gov/NCEA/iris/subst/0356.htm

National Institute of Environmental Health Sciences
http://www.niehs.nih.gov/news/releases/2007/bisphenol.cfm

American Chemistry Council
http://www.americanchemistry.com/s_plastics/index.asp

Plastic Alternative Links:

http://www.reusablebags.com/

BPA free bottles and sippy cups
http://www.newbornfree.com/