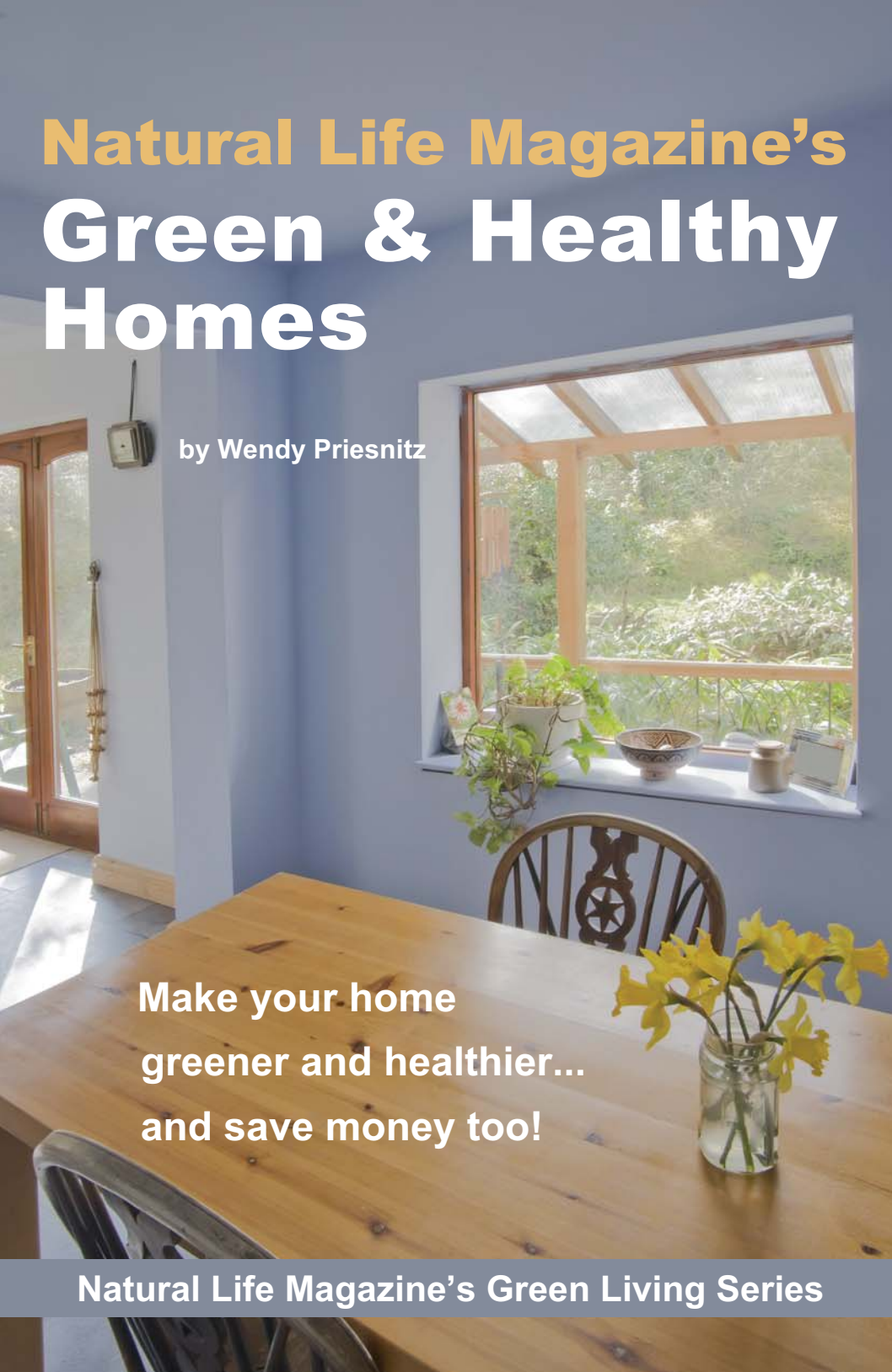
# Natural Life Magazine's Green & Healthy Homes

by Wendy Priesnitz



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Natural Life Magazine's Green Living Series

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**by Wendy Priesnitz**

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# Natural Life Magazine's Green & Healthy Homes

# Introduction

Natural Life Magazine was publishing information and inspiration about eco-conscious living long before it became trendy – when nobody had heard of organic cotton, global warming, or natural foods, and when hardly anybody rode a bike except kids. Nevertheless, back in the fall of 1976 when the first issue of *Natural Life Magazine* rolled off the press, eager readers used its pages to share their tips about environmentally sensitive living, organic gardening, natural parenting, renewable energy, and other low-impact lifestyle issues.

As a twenty-something new mother at the time, I especially loved reading the letters and articles we received from readers with many more years of experience than I had – letters that shared the many ways to use baking soda to clean your house, natural remedies for keeping bugs off your cabbages, and tips for how to keep a woodstove burning hot enough to minimize the amount of harmful emissions exiting via the chimney. And I marveled at how people could live frugally and in an eco-conscious manner while still enjoying the important things in life.

However, life was somewhat simpler in those days for those of us wanting to make greener, healthier choices in our homes. There were no genetically modified crops and seed patents, it was before personal computers and cell phones and the Internet, long before municipal recycling and composting

programs. Manufacturers weren't using as many carcinogenic and hormone-disrupting chemicals in their products – and we didn't know about the ones they *were* using, or about their dangers. Companies weren't slapping the words "natural," "green," "eco-friendly, "non-toxic," and "chemical-free" all over their products in an attempt to attract sales.

Now that more of us are looking for ways to reduce our impact on the planet, the market for healthy, eco-friendly products has been estimated to be worth over two hundred billion dollars annually in the U.S. alone. So now, the need is less for inspiration or information and more for untangling the spin. As green moves beyond niche market status and becomes the color of choice for mass merchandisers, not all products and companies are as healthy nor as environmentally responsible as they advertise themselves to be. (I have elaborated on this idea of greenwashing in Chapter 1.)

Helping readers sort through that sometimes bewildering hype has been the job of my Ask Natural Life column, which appears in each issue of *Natural Life Magazine*. Those columns have been well received by our readers, many of whom have distributed copies far and wide. And those columns are the basis for this and others in this series of books.

Neither *Natural Life Magazine* nor this book contains recommendations about what new green brands are the hottest and the most eco-chic. Instead, we explain the issues in a manner that is not influenced by any particular company, then let you decide how to make decisions to make your home greener and healthier and where to spend your money – or, in some cases, not to spend it at all.

By providing insight into some of the more common and/or controversial issues related to healthy, sustainable homes, I hope to provide you with tools that will help you live

comfortably and mindfully, within your financial and ecological means, while having a minimal effect on the planet that houses us all. Like *Natural Life Magazine,* this book is about applying good old common sense, research, and skepticism (if it sounds too green to be true, it probably is!) to empower ourselves to create a better life for ourselves, our families, and the Earth.

I feel that one of the foundations of common sense – certainly in terms of making decisions about health and environmental matters, but perhaps in other aspects of life too – is what has come to be called the Precautionary Principle.

A precautionary approach is caution taken in advance, or caution practiced in the context of uncertainty in order to anticipate harm before it occurs. Under the Precautionary Principle (which is enshrined in the law of the European Union but not in those of other countries, unfortunately), it is the responsibility of the proponent of an activity or product to establish that it will not (or is very unlikely to) result in significant harm.

The 1998 *Wingspread Statement on the Precautionary Principle*, resulting from a conference of the Science and Environmental Health Network, summarizes the principle this way: "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically."

This sense of caution is important for many reasons beyond the obvious threats of harm. Astonishingly, many of the chemicals that find their way into consumer products have not been thoroughly tested, nor have their multiple or cumulative effects been well studied. Since test subjects are often animals or men, we sometimes don't know the effects of toxins on women (and their reproductive systems) and children, whose

smaller size might make them more vulnerable to negative effects. In addition, a great deal of scientific research is funded by the corporations that manufacture or use these chemicals, rather than by a government-accredited, independent laboratory. And that casts doubt on the quality of the data. In this book, I have referred to scientific studies and reports to highlight some of the corporate irresponsibility that should invoke the Precautionary Principle. They are neither meant to create a definitive statement of all the research that has been conducted about a specific substance, nor the safety or otherwise of the substance. Also please note that, as governments are pushed to more stringent oversight, some of the toxic ingredients are being removed from the marketplace in various countries, so my statements about a specific toxin occuring in a product can become out of date. However, many of these toxins have a long life and can be persistent, remaining in the environment for many years after they have been banned.

In the face of all the bad news about climate change and health-destroying environmental pollution, many people feel a sense of urgency constrained by an overwhelming confusion about not knowing what to do or where to start to turn things around. And for some people, that is paralyzing. In fact, aside among all of the questions from readers that have formed the basis for this book, the most common question I am asked is, "Are the small changes I make sufficient to turn things around?" I believe they are, and that change begins with each one of us individuals, in our families, our homes, and our communities.

Many of you will already have planted the seeds of a sustainable future in your actions. As we live our daily lives, we can nourish those seeds so they grow into something much bigger. And because everything is interconnected, every little

thing we do to detoxify our homes is one of those seeds that will help to detoxify the planet and improve our families' health. Every choice and decision we make about how we live will either increase or decrease our individual and collective environmental footprints. And the best part is that, like those writers in the early issues of *Natural Life Magazine* in the 1970s, we can make choices that will also save us money without diminishing our quality of life!

As Margaret Mead wrote: "Never doubt that a small group of thoughtful committed citizens can change the world; indeed, it's the only thing that ever has." So let's get started on those changes.

# Chapter 1
# Beware Greenwash

*Greenwash – verb: the act of misleading consumers regarding the environmental practices of a company or the environmental benefits of a product or service.*

Increasingly, consumers are voting for environmental sustainability with their dollars. For instance, prior to the recent recession, the North American organic sector was said to be growing by twenty percent a year and the market for healthy, eco-friendly products has been estimated now to be worth over two hundred billion dollars annually in the U.S. alone. Many consumers are willing to pay significantly more for products branded "natural" and "organic," believing them to be of superior quality and safer for themselves and for the environment. Businesses, both large and small, are obliging with an ever-expanding selection of products catering to this eco-sensibility. In addition to fattening their bottom lines by providing a competitive edge with this growing number of green consumers, environmental performance has become a point of social responsibility for many corporations.

However, as green moves beyond niche market status and becomes the color of choice for mass merchandisers, not all products and companies are as environmentally responsible as they advertise themselves to be. Hence, the term "greenwashing," which was coined as far back as the 1970s by

environmental activists to describe the way corporations portrayed themselves as environmentally responsible in order to mask environmental wrongdoings. The U.S.-based watchdog group CorpWatch defines greenwash as "The phenomena of socially and environmentally destructive corporations attempting to preserve and expand their markets or power by posing as friends of the environment." Former Madison Avenue advertising executive Jerry Mander (best known for his 1977 book *Four Arguments for the Elimination of Television*) called it "ecopornography" in a 1972 article in *Communications and Arts Magazine*. The term "greenwashing" is now used to describe a wide range of attempts by businesses to attract environmentally aware consumers, including the creation of organizations, celebrity endorsements, event sponsorship, and the use of meaningless and unverifiable words like "natural," "green," "eco-friendly," "non-toxic," and "chemical-free" on labels and packaging. Even the word "organic" is meaningless unless it is backed up by certification.

The practice is widespread. In the spring of 2007, Ottawa-based TerraChoice Environmental Marketing Inc. sent research teams into six big box stores with instructions to record the details of every product-based environmental claim they observed. After recording close to two thousand environmental claims on over one thousand products, they tested the claims against current best practices in environmental marketing. The sources for these best practices include the International Organization for Standardization (ISO), the U.S. Federal Trade Commission (FTC), U.S. Environmental Protection Agency (EPA), Consumers Union and the Canadian Consumer Affairs Branch. Then, they studied the resulting list of false or misleading claims for patterns and lessons, distilling them into the "Six Sins of Greenwashing." Of the more than

one thousand products that made environmental claims, all but one committed at least one of the Six Sins.

In late 2010, the FTC announced green marketing guidelines. It warned companies against using labels that make broad claims that cannot be substantiated, like "eco-friendly." Marketers must qualify their claims on the product packaging and limit them to a specific benefit, such as how much of the product is recycled. And they must substantiate the use of environmental seals and certifications with third-party verification. It is hoped these new measures will help curb greenwashing and help consumers make good choices.

Other types of deceptions are more subtle and hard to police. For instance, one of the many new so-called "green" magazines recently raved about, in an advertorial feature (meaning advertising disguised as editorial), paper towels made from recycled paper and chlorine-free bleach. But this is an inherently non-green and unnecessary product, easily replaced by reusable cloth towels or, better yet, a piece of cloth that has outlived its original purpose as clothing or bedding.

The Organic Consumers Association (OCA) urges consumers to avoid products with unpronounceable ingredients, which seems like sound advice. Reading the fine print on labels carefully will also help you to avoid greenwashing by seeking products that are certified to meet legitimate environmental standards by an independent third party.

However, there are no perfect products and everything we do has an impact. Because the temptation to greenwash can be seen as a necessary part of an economy's adjustment to a new, more sustainable mode, one person's greenwash is another person's market-driven approach to solving global warming.

And that is the rationalization used by the increasing number of non-profit organizations partnering with corporations:

They believe that they can then have a larger impact than if they struggled along on their own.

In the U.S., the Climate Action Partnership is one example of such a partnership between conglomerates like BP America, Duke Energy, DuPont, General Electric, and PG&E with monster environmental groups like Environmental Defense and the Natural Resources Defense Council (NRDC).

In recent years, a number of Canadian conservation groups, including the World Wildlife Fund, the Canadian Parks and Wilderness Society, and the Canadian Boreal Initiative, have receiving funding from Pew Family Charitable Trusts, set up by the same family that used to control the Alberta Tar Sands giant Suncor.

In what may be the most controversial of these liaisons, one of the least green companies – The Clorox Company, which was named America's most chemically dangerous by the Public Interest Research Group – teamed up with the Sierra Club, self-described as the nation's oldest, largest and most effective environmental organization. The Sierra Club's board of directors voted to allow Clorox to use its name and logo to market a new line of non-chlorinated cleaning products called Green Works. In return, Clorox Company pays Sierra Club an undisclosed but apparently substantial fee, based partly on product sales.

No doubt these organizations need the money and these liaisons help take their messages to the masses. But they must be vigilant if the funding isn't to compromise the quality or believability of the message. The fact remains that the corporations are benefitting from branding themselves as green when they are often far from that. And that, like all greenwashing, is deceptive. So caveat emptor when you are purchasing "green" products for your home.

# Chapter 2
# Avoiding Plastic

Plastic is ubiquitous in our lives, so it makes a good place to begin as we try to understand the environmental and health impacts of the products and practices we employ in our homes.

Plastic is a problem due to the pollution that occurs during the manufacturing process, the waste created when products made from such a persistently non-biodegradable material are discarded, and the health effects from its off-gassing during use. The International Plastics Task Force, a global network of activists, ecologists, non-profit organizations, and waste management experts, says that "Plastic has become an environmental problem of global scale."

Except for a few experimental types, plastics are essentially a byproduct of petroleum refining and, of course, petroleum is a non-renewable and rapidly declining resource. The components of oil or natural gas are heated in a cracking process, yielding hydrocarbon monomers that are then chemically bonded into polymers, which are long-chain molecules. Different combinations of monomers produce polymers with different characteristics. Additionally, various chemicals such as plasticizers, antioxidants, anti-static agents, colorants, flame retardants, heat stabilizers, and barrier resins are added to give plastic products their performance properties. The manufacture of plastic and plastic products is a messy process: Among

the forty-seven chemical plants ranked highest in carcinogenic emissions by the U.S. EPA, thirty-five are involved in plastic production.

In the late 1990s, the Oakland Recycling Association commissioned an analysis of the toxic chemical burden of the plastics industry using data from the EPA, especially its Toxics Release Inventory. The resulting *Report of the Berkeley Plastics Task Force* stated that the plastics industry contributes fourteen percent of the national total of toxic releases. Although the refining process uses waste minimization methods, air emissions of toxic chemicals are still high because of inherent difficulties in handling large flows of pressurized gases.

Toxic chemicals that the study found were released in significant amounts included trichloroethane, acetone, methylene chloride, methyl ethyl ketone, styrene, toluene, benzene, and 1,1,1 trichloroethane. Other major emissions from plastic production processes include sulfur oxides, nitrous oxides, ethylene oxide, methanol, and other volatile organic compounds.

Dioxins, which are highly toxic even at low doses, are produced when plastics are manufactured or incinerated. While dioxin levels in the environment have been declining for the last thirty years, they break down so slowly that some of the dioxins from past releases will still be in the environment for many years to come.

Manufacturing polyethylene terephthalate (PET) resin generates more toxic emissions (nickel, ethylbenzene, ethylene oxide, benzene) than manufacturing glass. Producing a PET bottle generates more than one hundred times the toxic emissions to air and water than making the same size bottle out of glass, according to the Berkeley Plastics Task Force.

PVC is another type of plastic that presents notorious environmental problems. Its manufacture involves the use

of hazardous raw materials, including the basic building block of plastic, vinyl chloride monomer (VCM), which is explosive, highly toxic, and carcinogenic. PVC production facilities have a long history of generating complex and hazardous chlorinated wastes, some of which are inevitably released into the surrounding environment.

People are exposed to these chemicals not only from the manufacturing process, but by using products made from plastic, by eating food contained in plastic packaging, and even by breathing them as they off-gas in the indoor environment.

One substance of concern is Bisphenol A (BPA), an endocrine disruptor that has been widely used in polycarbonate products like food containers, water bottles, baby bottles, eyeglass lenses, nail polish, dental sealants, water pipes, and the plastic lining of food cans. Endocrine disruptors behave like the hormones estrogen and androgen, and could wreak havoc on the body's endocrine system.

The National Clearinghouse for Worker Safety and Training reported in its newsletter in 2000 that University of Missouri researchers found that extremely low amounts – one hundred thousand times smaller than once thought – of BPA causes reproductive problems in mice.

Early in 2008, researchers at the University of Cincinnati announced in the journal *Toxicology Letters* that when polycarbonate bottles were exposed to boiling water, BPA was released fifty-five times more rapidly than when exposed to cold water. That finding had huge implications, given the widespread use of this plastic for baby bottles, which are regularly boiled for sterilization purposes.

University researcher Dr. Scott Belcher stresses that it is still unclear what level of BPA is harmful to humans. But he urges consumers to think about how cumulative environmental

exposures might harm their health. Children are more at risk due to their small size.

In 2008, the Canadian government announced that it would be the first in the world to ban the importation, sale, and advertising of polycarbonate baby bottles containing BPA, and that it would officially declare it a toxic substance. The industry complained, but in 2010, Canada officially added BPA to its *Toxic Substances List*. I hope that is just a first step that will lead to a wider ban of its use.

As a result of the growing concern over BPA exposure, some manufacturers and retailers worldwide have stopped selling a variety of products for both babies and adults that contain the chemical.

Another concern is posed by plasticizers, which are commonly added to PVC as softeners. Also known as phthalates, they make hard plastics flexible and durable, and are used in everything from electrical cables, hoses, gaskets, and vinyl sheet flooring to toys, teething rings, and medical equipment.

Phthalates are so common that the majority of Americans tested by the Centers for Disease Control and Prevention were found to have metabolites of multiple phthalates in their urine. Although there is conflicting research on the dangers, some phthalates are known to be endocrine disruptors, and some studies have suggested they may even contribute to breast cancer.

About ten years ago, scientists at the Consumers Union found that some plastic deli wraps use a plasticizer known as DEHA, which has been show to be an endocrine disruptor in rats, and that it could leach from the plastic into fatty foods such as cheese and meat.

Like other toxic substances, phthalates are a greater danger to children. The use of some phthalates in children's toys is

restricted in the E.U. and California, and other jurisdictions are studying their effects. In 2004, a joint Swedish-Danish research team found a very strong link between allergies in children and the phthalates DEHP and BBzP.

A study by Finnish researchers, which was published in the *American Journal of Public Health* in 2000, showed that plastics found in flooring and indoor wall surfaces may have adverse respiratory effects on children. Many of these materials, which are PVC-based, can emit plasticizers, solvents, and alcohols. The study, involving over twenty-five hundred children, showed that the risks of respiratory symptoms typical of asthma were associated with the presence of plastics. The overall risks of asthma and pneumonia were also increased in those children exposed to plastics compared to those unexposed.

Plastic also creates massive disposal issues. Its low cost has enabled the development of enormous quantities of packaging that is designed to be discarded as soon as it is opened. Plastics account for an estimated one-quarter of all waste in landfills. The durability that makes manufacturers like using plastic means that products made from it stay in the environment a long time after they are discarded, especially if they are shielded from direct sunlight by being buried in landfills. Decomposition rates are further decreased in food containers by the antioxidants that are often added to enhance their resistance to attack by acidic contents.

Some types of plastic are accepted in municipal recycling programs. But, as the International Plastics Task Force points out, plastics do not actually recycle in the true sense of the word. Instead of being reformed back into the original products, they are reprocessed into secondary (and usually non-recyclable) products. This is due to several factors, including structural/chemical sensitivity, the extremely low cost of

virgin plastics, and poor product design. Extended producer responsibility would change that, with manufacturers legally required to ensure socially and environmentally sound product design, which would include biodegradability or producer take-back policies.

While containers are usually made from a single type and color of plastic, which makes them relatively easy to sort for "recycling," a consumer product like a cellular phone may have many small parts consisting of over a dozen different types and colors of plastics. The resources needed to separate those various components often exceed their value on the secondary products market.

In addition, a significant amount of plastic never even ends up in landfills or recycling programs, due to consumer apathy or lack of knowledge. Plastic trash has made its way to coastal ecosystems and the ocean, presenting a danger to marine and bird life. Greenpeace says that about ten percent of the one hundred million tonnes of plastic produced each year ends up in the sea, notably in a floating "island" in the north Pacific that is twice the size of Texas and swept together by ocean currents. To make matters worse, the plastics act as a sort of chemical sponge, concentrating many damaging pollutants and transferring them up the food chain.

Biodegradable plastics made with plant-based materials have been available for many years but have not replaced traditional mass market plastics. Traditional plastics are not biodegradable because their long polymer molecules are too large and too tightly bonded together to be broken apart and assimilated by organisms that aid decomposition. However, plastics based on plant polymers derived from wheat or corn starch have molecules that are readily attacked and broken down by microbes. Unfortunately, the production of these products has

proven to be just as energy consuming and chemical emitting as traditional plastic manufacturing. The scientific community might be encouraged to work harder on the problem if we would refuse to buy plastic products and avoid its use as a packaging material. So cutting back – if not eliminating the use of plastic in your home – is an excellent start towards alternatives, as well as making your family's life healthier and greener.

Here are a few suggestions to get you started reducing your plastic use, and for staying healthy when you can't avoid using it:

- Store foods, especially those with high fat content, in something other than plastic, preferably glass jars or Pyrex-like containers. Note: aluminum foil is not an environmentally perfect option; if you must use it, wash and reuse as many times as possible, then recycle it.
- Avoid microwaving foods in plastic and do not allow plastic wrap to touch food when microwaving.
- When purchasing foods wrapped in plastic, trim off a thin layer where the food comes into contact with the plastic and store the rest of the food in a non-plastic container.
- Buy cheese from a dairy and meat from a butcher, and ask them not to wrap your purchases in plastic.
- Avoid plastic bags at stores by taking reusable cloth bags.
- Buy foods like peanut butter, as well as laundry soap, shampoo, and other products in bulk, using your own containers.
- Avoid canned and take-out food.
- Make your own yogurt at home and store in glass jars.
- Buy eggs in paper cartons and return them for reuse or recycling.
- Reuse any plastic you feel you must buy.

# Chasing the Misleading Plastic Arrows

To assist in the recycling of disposable items, the plastics industry has devised a scheme to mark plastic bottles by plastic type:


**Polyethylene terephthalate**:
containers for soft drinks, water, salad dressing, juice, mouthwash, peanut butter, wine and liquor


**High-density polyethylene**:
household cleaners, milk jugs, cosmetics, grocery bags, extruded pipe, shipping containers


**Polyvinyl chloride**:
domestic and commercial shrink wrap, pipe, decking, outdoor furniture, blister packs, clam-shell packaging


**Low-density polyethylene**:
dry-cleaning bags, produce and bread bags, garbage bags, toys, squeezable bottles, shrink wrap


**Polypropylene**:
bottle caps, medicine bottles, drinking straws, yogurt containers, ketchup bottles, most Rubbermaid containers


**Polystyrene**:
packing materials, CD cases, cups, tableware, meat trays, clamshell containers for take-out food, egg cartons, toys


**Other**:
usually polycarbonate food containers like Tupperware and Nalgene bottles; most plastic baby bottles; clear plastic “sippy” cups, large water bottles, toys

Note: I think this is misleading because all plastics bear a label, not just ones that are recyclable. Numbers one and two are most commonly recycled.

Chapter 3

# Using and Abusing Water

Water is one of the world's most important resources. It is also probably the one that we most take for granted and abuse the most. Here are some of the ways we abuse it, as well as suggestions for conserving it and making it healthier.

## Bottled Water

One easy way to cut back on your family's plastic use is to eliminate bottled water. In addition to avoiding all that plastic, tap water has other advantages, from both health and environment perspectives.

According to the Earth Policy Institute, the global consumption of bottled water reached over forty billion gallons in 2004, up fifty-seven percent from the amount consumed five years earlier. A study conducted in 2001 for the World Wide Fund for Nature (WWF) confirmed the widespread belief that consumers associate bottled water with social status and healthy living. However, that association is largely a result of good marketing by the bottled water companies. There is little evidence that, except in cases of tainted water emergencies, bottled water is safer or healthier than tap water.

In fact, consumer groups have long warned about a range of microorganisms and chemicals that have been found in bottled water. In a four-year scientific study, the Natural Resources Defense Council (NRDC) tested more than one

thousand bottles of over one hundred brands of bottled water. In its 1999 report *Bottled Water, Pure Drink or Pure Hype?*, the group concluded, "While much tap water is indeed risky, having compared available data, we conclude that there is no assurance that bottled water is any safer than tap water." A third of the tested brands were found to contain contaminants such as arsenic and carcinogenic compounds in at least some samples at levels exceeding state or industry standards.

In another study, the Kansas Department of Health and Environment tested eighty samples of bottled water. All of them had detectable levels of chlorine, fluoride, and sodium. Seventy-eight of the eighty contained some nitrate (which can cause methemoglobinemia, or blue-baby syndrome, in higher doses), twelve had nitrite, fifty-three had chloroform, thirty-three contained bromodichloro-methane, twenty-five had arsenic, and fifteen tested positive for lead. Forty-six of the samples contained traces of some form of phthalate, while twelve of those exceeded federal safety levels for the chemical.

Scientists at the University of Geneva arrived at the same conclusion when they tested bottled and tap water for the 2001 WWF study. They found that in fifty percent of the cases the only difference between tap and bottled water was that the latter contained added minerals and salts, which do not actually mean the water is healthier. In 1997, the United Nations Food and Agriculture Organization concluded that bottled water does not have greater nutritional value than tap water.

The regulations in North America governing bottled water tend to be as spotty as the water quality, although activists are pushing politicians to tighten up the rules, which they say are not as stringent as those for municipal water supplies.

In Canada, Health Canada determines the classifications of bottled water under its Food and Drugs Act. This legislation

says that if bottled water is labeled as spring or mineral water, it must come from an underground source rather than a public water supply. If bottled water is not labeled as spring or mineral water, it can come from any source, including a well or a municipal water supply, and can be treated to make it fit for human consumption, using carbonation, ozonation, ultraviolet radiation, or filtration to remove harmful bacteria. It may also be distilled or deionized to remove the minerals. The source of the spring or mineral water must appear on the label. The Canadian Food Inspection Agency periodically samples and analyzes imported and domestic bottled waters, focusing primarily on testing for bacterial contamination.

In the U.S., the Food and Drug Administration (FDA) is responsible for bottled water safety, but its rules completely exempt waters that are packaged and sold within the same state, which account for between sixty and seventy percent of all bottled water sold in the country. The FDA also exempts carbonated water and seltzer, and fewer than half of the states require carbonated waters to meet their own bottled water standards. FDA rules allow bottlers to call their product "spring water" even though it may be brought to the surface using a pumped well, and it may be treated with chemicals. But the actual source of water is not always made clear – some bottled water marketing is misleading, implying the water comes from pristine sources when it does not.

According to the NRDC study, "Even when bottled waters are covered by FDA-specific bottled water standards, those rules are weaker in many ways than EPA [Environmental Protection Agency] rules that apply to big city tap water." For instance, it says, city tap water can have no confirmed E.coli or fecal coliform bacteria, but FDA bottled water rules include no such prohibition. City tap water must also meet standards for

certain chemicals like phthalates and is tested much more often than the products from bottlers.

In spite of all the testing, municipal water supplies are far from pristine, as the NRDC has found. It analyzed data compiled by the EPA on arsenic in drinking water in twenty-five states. Its most conservative estimates indicated that more than thirty-four million Americans drink tap water supplied by systems containing average levels of arsenic that pose unacceptable cancer risks. Some arsenic contamination results from leaching from old waste dumps, mines or tailings, or from past use of arsenic-containing pesticides.

However, switching to bottled water is no way to avoid arsenic; NRDC study found arsenic there too. Other potentially toxic chemicals that appear in water are added by municipal water treatment facilities. They include fluoride and chlorine, both of which are controversial, and discussed later in this chapter.

Some enlightened municipalities are using newer technologies, such as membrane filtration, ultraviolet irradiation, and ozone disinfection in an attempt to improve their water supplies without adding chlorine.

If much of the bottled water for sale comes from municipal taps (forty percent in the U.S., according to the NRDC), why buy water that you could get from your kitchen faucet? That brings us to the environmental issues involved with bottled water.

The Earth Policy Institute has estimated that bottled water is ten thousand times more environmentally damaging than tap water. First of all, there is the pollution created by the manufacture of the bottles. According to the WWF report *Bottled Water: Understanding a Social Phenomenon*, one-and-a-half million tons of plastic are expended in the bottling of

eighty-nine billion liters of water each year. Most of the bottles are made of the oil-derived PET, which, as we saw in the previous chapter, generates more than one hundred times the toxic emissions in the form of nickel, ethylbenzene, ethylene oxide, and benzene, compared to making the same amount of glass.

In addition, the energy required to manufacture and transport the bottles to market severely depletes our supplies of fossil fuels and increases greenhouse gas emissions. According to the Pacific Institute, the energy required to produce plastic water bottles for the American market alone in 2006 was equivalent to more than seventeen million barrels of oil and created two-and-a-half million tons of carbon dioxide. Tap water, on the other hand, is delivered by a mostly pre-existing infrastructure of underground pipes and plumbing.

As we saw when investigating plastics in the previous chapter, the post-market waste produced by discarded water bottles is a huge environmental problem. But there is another environmental issue. Many groups are fighting the expanding bottled water industry on the basis of threats to local wells, streams, and wetlands. Bottling companies can pump up to five hundred gallons per minute, or even more, out of each well, and many wells run continuously. There is a growing concern that taking too much water can reduce or deplete groundwater reserves and reduce the flow of streams and lakes, causing stress on ecosystems. Although groundwater systems can be recharged, it is not clear how much water can be taken without causing water tables to drop and streams and rivers to dry up.

There is also an ethical and social justice perspective to the sale and use of bottled water, in that it can be seen as part of a trend toward privatization of water distribution, which undermines the public responsibility to provide clean water to all citizens. Privatization turns a common good into a commodity,

depriving those who cannot pay and further threatening local ecosystems.

This is a major worry for the Council of Canadians, a founding partner in the Blue Planet Project, which focuses on protecting the world's water from the growing threats of trade and privatization of a public resource. In addition to pollution and depletion issues, they are concerned about mismanagement of fresh water supplies and inequitable access to water services. In a world that already has over a billion people without access to clean drinking water, the organization sees bottled water as part of the privatization slippery slope.

## Fluoride

Among the many substances in drinking water that are of concern, fluoride is perhaps the most controversial. This by-product of the phosphate fertilizer industry has been added to municipal water supplies in North America for decades.

Although there is some controversy surrounding the research about the health effects of fluoride, an increasing number of animal and human studies are indicating problems due to its use. These risks include exposure to heavy metals such as lead, arsenic, and radium that contaminate the industrial-grade chemical used.

Osteosarcoma (bone cancer) has been shown to be associated with radium in drinking water. A paper outlining the finding was published in 2006 in the journal *Cancer Causes & Control*. Harvard University researchers found that boys aged six to eight who were exposed to more fluoridated water were four times more likely to develop bone cancer than those exposed to lower amounts of fluoridated water. There is also an increased risk of bone fracture due to accumulation of ingested fluoride in the skeletal system.

Also worrisome are four studies from China, published in scientific literature from 1996 to 2007, and other human studies from Mexico, India, and Iran, that have found a strong association between water with high fluoride levels and sharply reduced IQs in children.

One of the concerns involves over-exposure to fluoride due to its prevalence in both toothpaste and drinking water. That can lead to severe dental fluorosis (or mottling of teeth), which can, in some children – especially those fed formula made with tap water – result, ironically, in the need for extensive restorative dental work. According to a 2005 report from the U.S. Centers for Disease Control, thirty-two percent of American children now have some form of dental fluorosis, with two to four percent of children having the moderate to severe form.

Fluoride can poison kidney function at high doses over a short time period. And it is a particular problem for people who already have kidney disease. Among healthy individuals, the kidneys excrete approximately half the daily fluoride intake. Among those with kidney disease, fluoride accumulates within the body with toxic results. Since one of the places where fluoride accumulates is the skeletal system, it can cause or exacerbate a bone disease common to people with kidney disease.

The impact of low doses of fluoride, given over long periods of time, has been inadequately studied, but a few studies have suggested there might be an adverse effect. A 1998 animal study, conducted by scientists at the EPA, reported that exposure to just one part per million (ppm) of fluoride caused kidney damage in rats if they drank the water for an extended period of time, while a 2005 Chinese study found an increased rate of kidney disease among humans consuming more than two ppm over a long period of time.

In the 1990s, it was discovered that the pineal gland can accumulate fluoride at a higher rate than either teeth or bone. And animal studies suggest that the accumulation of fluoride in the pineal gland can reduce its synthesis of melatonin, a hormone that helps regulate the onset of puberty.

The thyroid is another gland that seems to be affected by fluoride, particularly among those with an iodine deficiency, according to the U.S. National Research Council. In fact, until the 1970s, fluoride was used by doctors in doses as low as two mg per day as a thyroid-suppressing medication for patients with hyperthyroidism (over-active thyroid). Exposures in some communities with fluoridated water have been found to be in that range, which has led some to speculate a connection with the widespread problem of hypothyroidism (under-active thyroid) in the U.S.

In addition, the *Physicians Desk Reference* cautions that some people are allergic or hypersensitive to fluoride. The largest, government-funded, clinical trial found that one percent of individuals exposed to one mg per day of fluoride exhibited allergic/hypersensitive reactions, including skin rashes, gastric distress, and headache.

This seems like a major set of risks, even considering the possibility of controversial research, given that the main protective action from fluoride does not come from ingesting it, but from direct absorption through topical application to teeth. This means swallowing water is a far less effective way to fight cavities than brushing with fluoridated toothpaste.

At any rate, tooth decay rates have declined similarly in all western countries at least since the 1970s, irrespective of whether the country fluoridates its water, as in North America, or not, as in Europe. In the United States, despite living without fluoridated water, rural children's cavity rates equal those of

urban children, who are more likely to drink fluoridated water, according to a large national government study of over twenty-four thousand U.S. children published in 2003 in the *Journal of Rural Health*.

The risks and the lack of efficacy of fluoridating water have led an increasing number of professionals to speak out against it. In fact, a few thousand doctors, nurses, dentists, dental hygienists, pharmacists, and other professionals, including some Nobel laureates, have signed a Professionals Statement to End Fluoridation posted at www.fluoridealert.org.

One of these experts is Dr. Hardy Limeback, head of protective dentistry at the University of Toronto and a former advocate of fluoridation. In a public letter dated April, 2000, Dr. Limeback cited a large amount of research, which he said shows that the minimal benefit of fluoridation of water supplies does not outweigh the risks of long-term fluoride ingestion. He wrote, "A lifetime of excessive fluoride ingestion will undoubtedly have detrimental effects on a number of biological systems in the body and it is illogical to assume that tooth enamel is the only tissue affected by low daily doses of fluoride ingestion." Limeback also pointed to the issue of mass medication of an unapproved drug without the expressed informed consent of each individual must also be addressed, and said it creates a medico-legal and ethical dilemma.

## Chlorine

Chlorine is another controversial substance added to public water supplies. It is a very effective disinfectant that kills disease-causing bacteria (although it is ineffective against a variety of other water problems, including parasites). However, the really bad news is that chlorine reacts with other substances in water to create an estimated six hundred disinfec-

tion byproducts (DBPs), most of which aren't regulated or even studied much. We do know that one category of DBPs are trihalomethanes (THMs) such as chloroform and carbon tetrachloride, which have been linked to bladder cancer, heart disease, and asthma.

In 2002, a study published by The Environmental Working Group (EWG) and the Public Interest Research Groups linked high consumption of chlorinated water by pregnant women with miscarriage and birth defects.

In 2007, the EWG reported that water supplies in and around Washington, D.C., Philadelphia and Pittsburgh in Pennsylvania, and the Bay Area in California contained dangerous amounts of chlorine and were putting large numbers of people at risk. They also reported that over one thousand other smaller water systems across the country also tested positive for high levels.

Dr. Herbert Schwartz, a biologist/chemist at Cumberland County College in New Jersey, says, "Chlorine is so dangerous that it should be banned. Putting chlorine in the water is like starting a time bomb. Cancer, heart trouble, premature senility, both mental and physical, are conditions attributable to chlorine-treated water supplies. It is making us grow old before our time by producing symptoms of aging such as hardening of the arteries. It appears to be chlorine's excessive free radical formation that accelerates aging, increases vulnerability to genetic mutation and cancer development, causes difficulty metabolizing cholesterol, and promotes hardening of arteries."

When the EPA tightened its health standards for THMs in 1999, some utilities decided to alter their disinfection practices by switching to a new disinfectant called chloramine, which is made from chlorine and ammonia gases. Chloramines are more stable than chlorine and reduce the peak levels of at least some

toxic chlorination byproducts, particularly THMs. However they also have significant drawbacks according to EWG. They are not only toxic to kidney dialysis patients; they are also extremely toxic to fish, which die if chloraminated water is used in their tanks. And chloramines also produce a whole new complex of contaminants that are very poorly studied.

Eliminating water pollution and cleaning up our watersheds so that we won't have to dose our drinking water with chemicals is the best solution to creating safe water. Some municipalities are using alternatives to chlorine, including ozone.

In your home, there are a number of things that can be done to lessen your family's exposure to chlorine and its offspring. A carbon filter installed on your kitchen faucet will remove much of the chlorine and related compounds in your drinking water. In addition, they will dissipate from a container of drinking water that is left uncovered in the refrigerator for twenty-four hours. But there are other ways that you can get a dose of chlorine, such as when you open the door of your dishwasher after washing and toxic volatized chlorine from dish detergent and tap water is released into the air. Your bathroom is another place to minimize chlorine exposure. Since it has been estimated that you will absorb more chlorine in a ten-minute hot shower than by drinking eight glasses of water, bathroom ventilation is crucial. A showerhead that removes chlorine is also important.

## Point-of-Use Purification

Point-of-use water treatment, with a quality in-home water filtration system, seems to be the most economical and environmentally sensible way to get the healthiest water.

Chlorine and fluoride probably won't be a problem if you live in the country and get your tap water from a well, but you

need to be concerned about farm chemicals and other dangerous materials such as contaminated sludge that could be applied to fields, from antibiotics given to animals that can contaminate farm runoff, from your own septic system, and so on. Be sure your water source is a deep, drilled well, rather than a shallow, dug one. Have the water tested regularly and filter it before use.

The water treatment system you need depends on the problem you are trying to solve. So begin by having your water quality checked by the relevant local health authority or a private laboratory. Bacterial content tests are often free of charge, but you will probably have to pay to have your water tested for chemical contamination.

Different purification technologies each have strengths and weaknesses, and are more or less effective against specific kinds of impurities. Unless your water has a serious contamination problem, it is cheaper to focus on drinking and cooking water, rather than a more expensive whole-house system.

A carbon filter absorbs chlorine, radon, organic contaminants such as pesticides, volatile organic contaminants, and industrial solvents. It is also effective at improving taste and odor. Granular activated carbon filters tend to be less effective than solid block carbon filters due to channeling, where the water finds the easiest way through the filter, which is around the granules rather than through them, thereby overusing some areas of the cartridge and underutilizing others. Carbon block filters use a compressed form of carbon granules or powder. Various pore sizes and carbon compositions are available to target specific contaminants. Carbon filters are not effective in dealing with particulates and microorganisms, and may allow the growth of bacteria. Some carbon filter systems incorporate colloidal silver to control bacterial growth.

Ceramic water filters are also saturated with silver and will filter out most water-born disease agents. They can either be freestanding or installed under a sink. However, they are more expensive than simple carbon filters. And they are fragile and need to be cleaned regularly.

Some of the most effective systems combine activated carbon filtering with reverse osmosis (RO). RO uses a semi-permeable membrane filter to separate the water from contaminants. It is highly effective in removing impurities like dissolved solids, turbidity, asbestos, lead and other toxic heavy metals, radium, and dissolved organics. It will also remove chlorine and fluoride. However, the amount of wastewater may be significant. You should also note that water treated by RO lacks minerals and oxygen, and can have a flat taste. If you have a water softener, be sure to divert the softened water away from the kitchen tap that is connected to the reverse osmosis system.

Distillation units evaporate water by boiling, then they condense the vapor in an effort to separate the evaporated water from the contaminants. They are effective against dissolved solids and heavy metals, but don't remove all volatile organic compounds and gasses like radon, which may even end up concentrated due to the reduced volume of water. Like RO water, distilled water lacks minerals and oxygen.

There is a debate over the healthfulness of de-mineralized water versus filtered water with its natural trace minerals. But many experts feel it is healthiest to drink water with its natural trace minerals.

Depending on your contaminants, you might also investigate methods like ultraviolet light to kill microorganisms and pathogenic bacteria, ion exchange for heavy metal reduction, and KDF (or copper zinc alloy) for high chlorine reduction.

Whatever system you buy, make sure that the manufacturer's claims have been verified. The EPA in the U.S. has a high standard for systems that remove E. coli from water, and although there is no similar law in Canada, Health Canada recommends that any product sold should adhere to the EPA standard, and many do. Also, some standards organizations, including NSF International, CSA, and the Underwriters Laboratory (UL), all provide voluntary certification of water purification products. Some U.S. states require health department certification.

## Softening

We also treat water because it's "hard," that is it contains a lot of dissolved calcium or magnesium. Hard water causes a variety of problems in our homes. It causes scale to form on the inside of pipes, water heaters, humidifiers, kettles, dishwashers, and so on. The scale looks bad, reacts with soap to form a sticky scum and reduces its ability to lather, doesn't conduct heat well, and reduces the flow through pipes to the degree that they can become completely clogged. The U.S. Department of Energy says that just one-quarter inch of scale deposits can increase your energy bill by forty percent. And the increasingly popular tankless water heaters will stop working if too much scale forms.

There are a number of ways to soften hard water. The traditional type of water softener replaces the calcium and magnesium ions in the water with sodium ions. The water runs through a chemical matrix called zeolite. The zeolite is covered with sodium ions. As the water flows past the sodium ions, they swap places with the calcium and magnesium ions. Eventually, the zeolite contains nothing but calcium and magnesium and no sodium, and at this point it stops softening the water.

Then, it must be regenerated. Regeneration involves soaking the zeolite in a stream of sodium ions. Sodium chloride is dumped into the water softener, which mixes up a strong brine solution and flushes it through the zeolite to displace all of the calcium and magnesium and replace it with sodium. The remaining brine plus all of the calcium and magnesium is flushed out through a drain pipe. Each regeneration process uses a lot of water and ends up dumping approximately twenty-five gallons of salty water into your septic system or municipal sewer. That is neither green nor healthy, nor is the amount of sodium that the process adds to the water that will come out of your tap.

A paper by researchers at Kansas State University claims that someone who drinks two liters of softened hard water will increase their consumption of sodium by four hundred and eight mg. The American Heart Association recommends that you consume less than fifteen hundred mg of sodium per day from all sources. Ironically, a heart-healthy diet requires both calcium and magnesium, which the softening process removes. That fact has led the World Health Organization to flag water softening as a contributor to heart disease.

If you are concerned with the added sodium and reduced calcium/magnesium in your softened water, you should make sure the softener bypasses at least one faucet that is used for drinking water. Potassium chloride can also be used instead of sodium chloride, which would have the added benefit of helping to lower blood pressure, although for about four times the cost.

Distillation also removes the minerals in water and would be prohibitively expense for whole house use. There are other emerging water softening technologies that you might want to consider, including a NASA-created bacteriostatic process that uses silver ions, and magnetic treatment.

## Conserving

Saving water is good for your budget and for the planet. Most of us take for granted an abundant supply of good, fresh water. However, we shouldn't. Although almost eighty percent of the Earth is covered with water, only three percent of that is fresh water. Less than one percent is available for human consumption; the rest is bound up in glaciers and polar ice caps. Unfortunately, our thirst for water – to create electricity, grow crops, run factories, and for household and sanitation needs – is increasing faster than the population is growing. Global water consumption rose almost tenfold in the last century and many parts of the world are now reaching the limits of their supplies. According to the United Nations, if current trends continue, two out of every three people on earth will suffer moderate to severe water shortages in little more than two decades. Globally, one in six people still have no regular access to safe drinking water, and more than twice that number lack access to adequate sanitation facilities.

North America is one of the biggest water wasting areas of the world. According to the American Water Works Association, the average U. S. resident uses about one hundred and ten gallons (four hundred and sixteen liters) a day. Statistics Canada says that Canadians use three hundred and thirty-five liters (eighty-nine gallons) per day – thirty-five percent for bathing, thirty percent for toilet flushing, twenty percent for laundry and cleaning, and ten percent for drinking and cooking.

Aside from the issue of declining supplies, water uses a great deal of energy to pump, move, and purify. So if you want to do your part to tackle this looming water problem, here are some ways to conserve water in your home. (For ways to conserve water in your garden, see chapter 5.)

## Bathroom

- When you brush your teeth, don't keep the tap running continuously. Instead, half fill a glass to wet your brush and rinse your mouth.
- When you shave or wash your hands, put water in the basin and dip your razor or hands as needed, rather than letting the tap run.
- Don't flush the toilet unnecessarily. Don't use the toilet as a waste receptacle.
- Take short showers, not baths. Get wet, turn the water off, lather up and apply shampoo, then turn the water on to rinse.
- As you wait for shower water to heat up, collect the cold water in a bucket for watering plants.
- Bathe small children together.
- Turn faucets off completely but carefully to avoid drips and slow leaks.
- Install flow restrictors with aerators on faucets to automatically reduce flow without noticing the effects of the reduction.
- Install an adjustable showerhead and set to the lowest setting.
- Turn the valves under the sink to reduce the rate of flow or install a pressure reducing valve on the main water supply.
- Replace an older toilet, which uses five gallons (nineteen liters) per flush, with a more modern one, which uses just over one-and-a-half gallons (six liters) per flush, or a dual-flush or ultra low flow model that can give a half gallon (two liter) flush.
- If you can't replace your toilet, place a filled plastic container in the tank to displace an equal amount of water.
- Install a composting toilet that doesn't use any water.

- Be alert to potential faucet and toilet leaks. Put a little food coloring into the tank; if the color trickles into the bowl before flushing, there is a leak. Common reasons for toilet leaks include a float that needs adjusting or replacing, a faulty fill valve that continues to allow water to enter the tank, and a flapper that needs adjusting, cleaning, or replacing.
- If your home has a water meter, check it just before your family goes to bed at night, then again in the morning to see if there has been any water usage during that time period. Providing nobody got up at night for a drink or flushed the toilet, the meter reading can be a good indication of whether or not you have any leaks.
- Install an insulated recirculating hot water line or a wall-mounted hot water boiler (tankless water heater) to provide instant hot water and reduce the need to run the faucet while waiting.

## Kitchen

- Select the proper size pans for cooking. Large pans require more cooking water.
- Use tight-fitting lids on pans to keep water from boiling away faster.
- Cook food in as little water as possible (which also prevents loss of nutrients.) This often means steaming.
- Refrigerate and re-use the water left after you cook vegetables for soups or for cooking other raw vegetables.
- Follow recipes carefully and do not overcook or measure out more water than necessary.
- Drink warmer water, or keep a covered bottle or pitcher of water in the refrigerator so you won't have to let the tap run.

- Use a small pan of water to wash, peel, or clean vegetables rather than letting the water run.
- Limit use of in-sink garbage disposal equipment, which requires a sizeable amount of water to operate properly. Compost food scraps instead.
- Hand wash cooking utensils and serving dishes that take up a lot of dishwasher space.
- If you use a dishwasher, wash only full loads. In a newer model, that can use less water than washing by hand
- Scrape/wipe dishes rather than rinsing if they are to be washed immediately in the dishwasher.
- Follow your dishwasher manufacturer's instructions on how to best save water and energy. Select shorter cycles when possible.
- When hand washing dishes, use a pan of soapy water for washing and one of hot water for rinsing, rather than running the faucet.
- While waiting for faucet water to warm, catch it and use for meal preparation and dish washing, or to water plants.
- Prepare meals that do not need much water. Fix one-dish meals where vegetables and meats are cooked without water or provide their own cooking liquids.

## Laundry

- Wash clothes when they are dirty, not just to remove wrinkles.
- Hand wash several items at the same time. Use the final rinse water from one group of items as the wash water for the next.
- Launder full loads.
- If the washing machine has a water-level control, adjust it to the laundry load size.

- Use good laundering techniques – sort clothes and follow the detergent or bleach recommendations carefully.
- Before using a permanent press cycle, read the washing machine manufacturer's directions. This cycle may fill the tub an extra time, which can use a lot of extra water. If so, use a different cycle.
- Turn your washer's water supply off when not in use. Check the hoses and look for leaks periodically.
- Purchase a front-loading washing machine, which, according to the EPA, will use about forty percent less water and fifty percent less energy than a conventional washer.
- If you use a water softener, check how often it backwashes and how many gallons of water are used for regeneration. A weekly cycling is usually more than enough for a family of four. Run unsoftened water lines to the toilet and other select faucets.

## Cleaning

- Clean up spills quickly so you won't have to mop the floor or shampoo the carpet as often.
- Wash outside windows with a pail of soapy water. Rinse quickly with a hose using high pressure, low volume, and a pistol-grip nozzle.
- Plan household cleaning chores so that you can reuse water for certain activities.
- Clean the driveway, patio, sidewalks, and garage floor with a broom rather than a hose.
- If you wash your car, park it on the grass. Use a bucket of water without detergents, and then rinse quickly with a hose that has a shut-off nozzle.

# Chapter 4
# Cleaning Up

While we're on the subject of cleaning, any green, healthy home will have a green, healthy cleaning supply closet. However, if you are purchasing cleaning supplies, that's easier said than done.

A leading laundry soap has more than four hundred ingredients. In North America, the manufacturer can call those ingredients a "trade secret" and not list them on the container. (In Europe, manufacturers must tell you if a product contains a carcinogen or other harmful ingredient.) But if a manufacturer won't tell you what's in the product, why should you trust it to be safe to clean the bathtub in which you bathe your children, the clothes that your family wears, or the dishes on which you eat your food? And you probably shouldn't. Some of those ingredients are extremely nasty and, as I noted in the Introduction to this book, they're often tested by the manufacturers, not the government, prior to being unleashed into our homes.

Nevertheless, there are known health effects from many of the chemicals commonly used in household cleaning and laundry products. Animal studies have shown reproductive harm: testicular damage, reduced fertility, maternal toxicity, early embryonic death, and birth defects. Some of the ingredients are proven carcinogens.

Glass cleaners and laundry detergents commonly contain phthalates, which are used as carriers for fragrance. Phthalates

have been linked to increased allergic symptoms and asthma in children. And, as we saw in Chapter 2, some phthalates are also known endocrine disruptors and have been linked to birth defects and breast cancer.

Many glass cleaners and all-purpose spray cleaners also contain glycol ethers, such as 2-butoxyethanol. These solvents have been associated with low birth weight in exposed mice.

Alkyl phenol ethoxylates (APEs) and nonylphenol ethoxylates (NPEs) are surfactants found in laundry detergents, stain removers, and all-purpose cleaners. They have been found to reduce embryo survival in fish and to alter tadpole development.

Monoethanolamine (MEA) – a surfactant found in some laundry detergents, all-purpose cleaners, and floor cleaners – is a known inducer of occupational asthma.

Disinfectants called ammonium quaternary compounds, found in both sprays and toilet cleaners, have also been identified as inducers of occupational asthma. A number of studies that have been published in the medical journal *Thorax* over the past decade have linked regular exposure to cleaning chemicals of this sort to asthma, both in school children and in professional cleaners.

Some carpet and upholstery shampoos include perchlorethylene, which is a known carcinogen that damages the liver, kidneys, and nervous system. Another common ingredient in these products is ammonium hydroxide, which is corrosive and extremely irritable to eyes, skin, and respiratory passages.

Oven cleaners are among the most dangerous chemical cleaners on the market. They typically contain sodium hydroxide (a derivative of lye), which is so corrosive it can cause severe skin damage. They also contain benzene, toluene, xylene, methanol, and ethylbenzene, which are all known carcinogens

and damaging to the nervous system and unborn children. What's worse is that these cleaners hang around, releasing residue as toxic fumes into the air and food when the oven is heated.

Most drain cleaners contain lye, hydrochloric acid, or trichloroethane. Hydrochloric acid is corrosive, an eye and skin irritant, and damages kidneys, the liver, and the digestive tract. Trichloroethane is a nervous system depressant that also damages the liver and kidneys.

Among the nasty ingredients in furniture polish is petroleum distillate, which can cause skin and lung cancer.

And so the story goes, on through each product designed to specialty clean each part of your home.

One cleaning product, whose particular nastiness lurks behind a heavy scent, is fabric softener. Although they may make your clothes feel soft, be static-free, and smell fresh, fabric softeners and dryer sheets can also make them toxic. Health problems can range from headache, lightheadedness, and fatigue to serious organ and central nervous system damage, and even cancer.

A University of Washington study published in July, 2008 in *Environmental Impact Assessment Review* found one hundred different volatile organic compounds (VOCs) in dryer sheets and liquid fabric softeners (as well as air fresheners), measuring three hundred parts per billion or more. Some of those VOCs can be cancerous or cause harm to respiratory, reproductive, neurological, and other organ systems.

The researchers tested the air around items exposed to fabric softeners to identify the chemicals that people could be breathing. Ten of the one hundred VOCs that they identified qualified under U.S. government rules as toxic or hazardous, and three of those – 1,4-dioxane, acetaldehyde and

chloromethane – are "hazardous air pollutants considered unsafe to breathe at any concentration."

The product labels gave no indication that the irritating and potentially dangerous chemicals were present, so researchers checked the products' Material Safety Data Sheets (MSDS). These industry-generated technical documents provide ingredient information for the safety of workers and emergency responders. They, too, disclosed little detail, mostly citing ingredients such as "essential oils" and "organic perfume."

"It's a reasonable expectation to think that laundry products should be free of chemicals that can cause cancer," says Erika Schreder, a staff scientist with the Washington Toxics Coalition. But as the University of Washington study shows, it's disturbingly easy to find toxic chemicals in everyday products like these.

In addition, according to the EPA and the MSDS, many of these ingredients are used in untested combinations, the health and environment results of which are therefore unknown. They include:

- Benzyl Acetate: It is linked to pancreatic cancer and its vapors can be irritating to eyes and respiratory passages, creating coughing. It can be absorbed through the skin.
- Benzyl Alcohol: This upper respiratory tract irritant can cause central nervous system (CNS) disorders, headache, nausea, vomiting, dizziness, and dramatic drops in blood pressure.
- Ethyl Acetate: This narcotic is on the EPA's Hazardous Waste list. Irritating to the eyes and respiratory tract, it may cause headache and narcosis, anemia with leukocytosis, and damage to the liver and kidneys.

- Limonene: It is a known carcinogen, as well as an eye and skin irritant and sensitizer.
- Terpineol: This chemical causes CNS disorders and is highly irritating to mucous membranes. Aspiration into the lungs can produce respiratory depression, pneumonia, or even fatal edema.
- Camphor: It causes CNS disorders and is on the EPA's Hazardous Waste list. It is easily absorbed through body tissues, causing irritation of eyes, nose, and throat. It can also cause dizziness, confusion, nausea, twitching muscles, and convulsions.
- Linalool: This narcotic causes CNS disorders and respiratory disturbances, which, in animal testing, have led to death.
- Chloroform: It is neurotoxic, anesthetic, and carcinogenic and on the EPA's Hazardous Waste list. Inhalation of vapors may cause headache, nausea, vomiting, dizziness, drowsiness, irritation of respiratory tract, and loss of consciousness. It aggravates disorders of the kidney, liver, heart, and skin, and is especially a problem when subjected to heat.

Many of these chemicals pose a greater danger when combined with heat. That makes dryer sheets more harmful than liquid softeners. And, of course, dryers exhaust the toxic fumes into neighborhood air, to which anyone walking on residential streets on laundry day can attest! For some highly sensitive people, that makes taking a neighborhood stroll problematic.

Because fabric softeners are made to stay in your clothing, the chemicals are slowly released, either into the air for you to inhale or onto your skin for you to absorb. You may have noticed that using fabric softener sheets results in less-absorbent towels; that's because of the residue that is left in the towels. That residue can clog up dryer vents, causing some dryer

manufacturers to include a warning in their user manuals not to use fabric softener sheets, or a clause stating that use of chemical based dryer sheets will void the dryer's warranty.

To make the problem worse, most fabric softeners have fragrance added to them in order to cover up the chemical smells. And cosmetic fragrances contain many more dangerous chemicals.

Babies, with their immature immune systems and small size, are particularly vulnerable to these products. Some researchers have even suggested the need for research into a possible connection between Sudden Infant Death Syndrome (SIDS) and the use of products for washing baby clothes and bedding. They say that in at least some cases of SIDS, an anaphylactic reaction is responsible, so fabric softener, with its many chemical components, shouldn't be ruled out as a possible cause.

## Antibacterial Soap

Another group of products that have no place in a green and healthy cleaning closet is antibacterial soaps. Their use in the normal household is unnecessary and causes far more harm than good, both to human health and the environment.

Since 2000, the American Medical Association (AMA) has been advising the U.S. Food and Drug Administration (FDA) to closely monitor and possibly regulate the home use of antimicrobials. That's mostly due to concerns that they help to create antibiotic-resistant bacteria.

The problem is that antibiotics kill more bacteria than the disease-causing ones to which they are directed. Once the ecosystem is cleared of other bacteria, resistant bacteria can multiply and dominate the environment due to lack of competition, resulting in drug-resistant "superbugs." The phenomenon can

be likened to weeds that have overgrown a lawn because the grass has been completely destroyed by an overdose of herbicides.

And all of that for nothing! The FDA's panel of health experts has overwhelmingly said there is no proof that antimicrobials are more effective than regular soap in preventing infections among average consumers.

They are especially worried about a bacteria-fighting chemical called triclosan, which they are currently reviewing. Triclosan is classified as a drug by the FDA and a pesticide by the EPA. It is a chlorophenol, a class of chemicals suspected of causing cancer in humans. According to Peter Vikesland of the Virginia Polytechnic Institute and State University, in research published on *Environmental Science & Technology's Research ASAP* website, the triclosan antimicrobial agent used in household dishwashing soaps reacts with the chlorinated water from our taps to produce unacceptably high levels of chloroform, which is known to be a probable human carcinogen.

Triclosan is found in many liquid and bar soaps, as well as toothpastes, acne creams, deodorants, lotions, and a wide range of consumer products like toys, cutting boards, toothbrush handles, hot tubs, and athletic clothing.

Babies, children, older people, and those with compromised immune systems are especially vulnerable to the harmful effects of triclosan and other chemicals in household products. Damage can be permanent, causing lifelong illness. Babies often react with rashes, frequent crying, and/or diarrhea.

So make sure you buy pure, natural soap, which will get rid of most harmful bacteria just as well. Use it and you will be effectively, safely, and inexpensively warding off infection while not destroying your family's natural immunity.

In addition, we also need to be aware of the cumulative impacts from all of the chemicals in our lives, because we aren't exposed to cleaning products, air fresheners, perfume, cosmetics, textile treatments, pesticides in food, outdoor air pollution like car exhaust, and so on in isolation from each other. As I noted earlier, scientists really have little idea what all these chemicals do in combination with each other!

That is why it's important to take precautions whenever we can and avoid whatever chemicals we can. Here are some ways to clean our homes without exposing ourselves, our families, and the environment to dangerous toxins.

## Natural Alternatives

First of all (take a deep breath here!), we could consider lowering our standards so that our whites don't have to be so white and our homes a little less than hospital operating room clean. Our immune systems can usually handle that and, in fact, would probably benefit.

Reducing dirt in the first place is also a good idea. For instance, encourage family and visitors to remove their shoes before entering your house. That, alone, will greatly reduce the amound of bacteria, dust, and other dirt in your home. Get into the habit of placing your shoes by the door when you are inside and you will spend much less time cleaning. And remember to replace the air filters in your furnace and air conditioning unit at least once a month, even if they don't look dirty. That goes for your vacuum cleaner bag too; if the bag is too full, the vacuum can begin spitting dust back into the carpet and air, so replace or empty it regularly and your house will be a bit cleaner because you won't be recirculating the dust.

Also, we could slow down a bit. One of the standards for commercial cleaning products is the speed at which they cut

grease and remove stains; you might have to substitute a little more time and elbow grease for those heavy duty chemicals, but it will be healthier in the long run.

If you want to use commercial products, choose only those that list their ingredients on their labels (keeping in mind that there is no requirement for this and that the list could be incomplete). Greenwashing is rampant in this industry. So, as we saw in Chapter 1, mistrust green labels with the words "natural," "eco," or "pure" unless those words are backed up with an ingredient list or third-party certification.

And it goes without saying that you should avoid explosive or poisonous symbols on the label, which means there is probably at least one chemical in the product. Another indication of the presence of chemicals is a warning to use the product in a well-ventilated area.

You can at least partially avoid harm from chemical ingredients by streamlining your cleaning cupboard. Use fewer products, and less of them. You do not need a different product for every room in your house, so choose one or two and you'll find they clean things they might not be sold to clean.

Or, you can make our own cleaners using common (and benign) household ingredients. In many cases, they clean just as well as the commercial products, are much less expensive, are healthier, and don't pollute the environment.

A group called Women's Voices for the Earth has come up with the idea of Green Cleaning Parties, which have been tagged as twenty-first century Tupperware™ parties where you BYOJ (bring your own jars). A group of people get together to whip up a batch of home-made household cleaners using ingredients like vinegar, water, baking soda, castile soap, glycerin, and essential oils. Then they split up the batch and take them home in their own glass jars.

Whether you make your own or demand that companies make safe products, getting rid of that cleaning pail of toxic waste is healthy for your family and the environment. Here are some tips and recipes to help you get started.

## Make Your Own (And Save Money Too)

- Salt will take out wine or fruit stains.
- Club soda will remove lighter colored stains.
- Baking soda and cornstarch make good deodorizers.
- Clean your oven with a paste of baking soda, salt and water.
- One part water to one part white vinegar in a spray bottle will clean most areas of your home.
- Remove toilet bowl stains with white vinegar.

**All-Purpose Cleaner**
2 cups white vinegar
2 cups water
20 drops of essential oil (optional)
Warming until lukewarm will boost cleaning power for tough jobs. Useful for countertops, appliances, windows, mirrors.

**Creamy Scrub Cleanser**
2 cups baking soda
½ cup liquid castile soap
4 teaspoons vegetable glycerin (optional but acts as a preservative)
5 drops antibacterial essential oil such as lavender, tea tree, rosemary (optional)
Stores up to two years in a sealed glass jar. For exceptionally tough jobs, spray with vinegar first, let sit and follow with scrub. Great for kitchen counters, stoves, bathroom sinks.

**Furniture Polish**
¼ cup white vinegar
a few drops of olive oil
2 teaspoons lemon juice
Store in refrigerator. Shake well before using. Dip a clean, dry cloth into the polish and rub wood in the direction of the grain.

**Drain Opener**
½ cup baking soda
½ cup white vinegar
Pour baking soda down the drain and follow with vinegar. Cover and let sit for 30 minutes. Flush with boiling water.

**Fabric Softening**
- Add a quarter cup of baking soda to wash cycle to soften clothes.
- Add a quarter cup of white vinegar to wash or rinse cycle to soften clothes (don't use bleach at the same time).
- Dry your clothes outside on a clothesline to eliminate static cling.
- A piece of wadded up aluminum foil placed in the dryer with clothes will cut down on static cling.
- Use less laundry detergent for softer clothes.
- Install a water softener.
- If you really feel that you need to use a commercial product, check out your local health food store for a natural fabric softener or reusable cloth dryer sheets that use a natural base like soy instead of chemicals.

## Let It All Hang Out

When I was a child in the 1950s, I loved helping my mother hang out the laundry to dry. She had a special window

installed in the sun porch at the back of the house so she could stay warm inside during the winter while easily reaching the clothesline. My job was to hand her the clothes pegs and later to help fold. I still remember the wonderfully fresh smell the sheets had…a scent that lingered even when they were on my bed. I've been able to hang out my own family's laundry to dry occasionally since, but too often, we've lived in houses where clotheslines were forbidden on aesthetic grounds or in apartments without balconies, where clotheslines were impossible even if they had been allowed.

But these days, concerned about global warming and the cost of energy, increasing numbers of us are letting it all hang out, like hasn't been seen in a generation. And that, coincidentally, means that we're exposed to fewer chemicals.

In fact, bans on clotheslines may be going the way of cosmetic pesticides and cigarette smoking in public places. There is even a "Right to Dry" activist movement that is trying to establish clothesline rights. This laundry underground includes those frugal folks who've always used a clothesline and are a bit befuddled as to what all the fuss is about, people from countries where hanging out the laundry is part of the culture, those who don't like other people making up rules regarding their lifestyle habits, and those who realize that foregoing a clothes dryer is an easy adjustment to make in order to reduce the amount of carbon dioxide sent into the atmosphere.

Those in favor of bans on clotheslines say that environmental leanings have to be balanced against the desires of those who find their neighbors' blue jeans, undies, and flannel nightgowns to be unseemly or unsightly. However, those against the bans – including Vermont Senator Richard McCormack – dismiss such concerns. He told the *Christian Science Monitor* that amid growing concern about global warming, governments

have a responsibility to protect people's right to voluntarily conserve, if not actively support energy conservation.

The numbers tell the conservation story clearly. Electric and gas dryers emit an average of over fourteen hundred pounds of carbon dioxide annually, or up to ten percent of residential energy use. It is estimated that line drying your clothes in the spring and summer can prevent an estimated seven hundred pounds of carbon dioxide per household from releasing into the atmosphere.

**Clothesline Drying Tips**

- Hang T-shirts by the shoulders with an extra pin in the middle to prevent stretching.
- Hang pants by the bottom of the leg to speed up drying and fold the legs where you want creases.
- Fold sheets so they billow in the wind.
- Use extra pins to ensure heavy items don't blow away.
- Hanging clothes (especially diapers!) in direct sun is a great way to bleach them. But be careful about drying black and navy clothing – or anything else that will fade – in the sun.
- To prevent line-dried items from becoming stiff, add a half cup of vinegar to the washer to soften them.
- Although it may seem counterproductive, tossing your towels in the dryer for just a few minutes after they have dried on the line will make them softer... and still save a lot of energy.
- If you don't have trees or posts from which to hang a line, or have a small yard (or laundry-intolerant friends or neighbors) try a collapsible "umbrella" clothesline, which can be stored when not in use.
- An indoor drying rack is a good investment for inclement weather. Avoid raw wood, which can leave marks and odors on your clothes.

- Avoid drying laundry indoors if your house has a moisture problem.
- Before you erect a clothesline, check with your condo or homeowners' association and local bylaw department. Hanging clothes outdoors is still banned in some areas.

## Managing Household Pests

The need to eject insects and rodents that have moved into your home can be another problem that makes even the greenest person consider reaching for a chemical solution. Many pests are often just a nuisance; however, some can damage food or possessions, or bite and pass along diseases to people or pets.

Simple preventive measures stop most problems before they begin. Often, simply removing their food supply and breeding sites is the most effective control. Steps like managing garbage so that it is less attractive, cleaning up spilled food – especially pet food – and eliminating damp conditions around the house are other simple deterrents. The first defense is making sure pests don't get into the house. Seal cracks, including spaces around exterior plumbing and electrical outlets, attic vents, and under doors. Use window screens. Don't leave porch lights on all evening, as they collect insects, which are swept into the house when the door is opened. (That wastes energy anyway, so install motion-sensitive lighting.) Here are some additional tips for dealing with specific pests:

- To discourage ants, sprinkle their nest with red pepper, eggshells, bone meal, talcum powder, wood ash, sulphur, blood meal, or coffee grounds.
- Prevent an infestation of carpenter ants in your home by repairing wood damaged by moisture, ventilating damp areas, cleaning gutters, and storing firewood away from the house.

- Cockroaches thrive in areas with moisture, food, and darkness. To trap them, place glue board traps in areas to which they are attracted. Monitor these traps and clean all areas where their droppings are present with soap, water, and a disinfectant. Seal cracks or spaces larger than a quarter of an inch, particularly in the bathroom or kitchen. Cover open vents with a fine mesh screen. Eliminate all traces of grease, dirt, and clutter. Repair leaky taps and avoid water accumulation.
- Mix molasses and vanilla extract or lemon juice with water to attract and drown crickets. Plug entry points.
- The older food is, the more likely it is to develop an infestation of flour moths and beetles, so buy small amounts or store in the freezer. If you buy food from open bins, seal it in plastic bags and freeze for a week before using. Dry and bulk food should be stored in glass containers with tight lids. Dispose of contaminated food and wash cupboards.
- Bed bugs can be stubborn to eradicate. You'll have to carefully and thoroughly vacuum your matress, box spring, or futon, as well as any carpets, rugs, and upholstered furniture. Then, thoroughly vacuum every crack and crevice along the baseboards, behind light switches and switch plates, as well as the bed frame and other furniture. When you're finished, empty the vacuum canister into a plastic bag, seal, and destroy. Extreme heat and cold will kill nymphs and eggs, so put furnishings, toys, etc. outside in those temperatures if possible. Wash clothing, bedding, pillows, area rugs, and any other fabrics in extremely hot water and dry in a hot dryer. Delicate clothing can be sealed in plastic bags and put in the freezer for at least six hours. If all else fails, there are a few supposedly non-toxic insecticides sold especially for bed bug infestations.

## Cleaning Up the Air

A green and healthy home is one with good indoor air quality. There are some big offenders like mold and radon, but most houses have more minor problems. These range from ordinary mustiness from dampness or old carpets to pet smells, stale cigarette smoke (which can linger for years), and even the fleeting odor of last night's fish dinner. Some of these are more harmful than others and need to be cleaned up quickly before they affect your family's health. With them all, the green and healthy method is to eliminate the source.

## Mold

Scientists have found more than one thousand different varieties of mold inside North American homes. Even though only a few types of mold, such as *stachybotrys* and *aspergillus*, release toxins into the air along with the spores, they could be making you and your family sick. Nosebleeds, memory loss, disorientation and other neurological problems, fatigue, headaches, asthma attacks and other respiratory problems are some of the health issues blamed on molds.

Although the U.S. Centers for Disease Control and Prevention claim there's no hard proof yet to these health claims, there is plenty of good evidence. In a study published in 1999, Mayo Clinic researchers concluded that mold causes most chronic sinus infections. Even more alarming, doctors at the Mount Sinai School of Medicine in New York City believe there is a relationship between exposure to *stachybotrys* and problems with memory, learning, and concentration.

And that sort of evidence is enough to be causing a lot of problems for builders, municipalities, and health care officials ...and creating quite a bit of business for lawyers. One group of

lawyers working together to represent mold victims received one thousand calls from prospective clients in one year.

There seem to be many reasons for both the incidences of ill-health from and the increase in awareness of the dangers of mold. Some newer building materials – like paper-coated drywall – retain moisture, unlike traditional materials like plaster. In addition, we're sealing our houses more tightly to save energy but not always ventilating properly. And during new housing booms, the push to reduce construction times has resulted in less drying time for concrete. In addition, we have become more aware of the quality of our indoor air and are starting to make connections between mold and previously undiagnosed illnesses.

Some families have even resorted to burning their homes down to get rid of mold infestations! If you suspect your problem is that big, consult an expert. Mold thrives on moisture and "food," such as wood, paper, or stale bread. It can hide in walls, under carpets, and in crawl spaces – anywhere a leaky pipe or other source of moisture gets it started.

Winter is the best time of the year to check for indoor mold. If you can smell a musty or earthy odor, mold may be present. You may also be able to see the dark discoloration produced by mold growth. Look especially closely at areas that have been damaged by water. While not all stains are mold-related, those that are fuzzy or expanding and green to black in color are likely due to mold, especially if the area has been damp.

To identify a spot of mold, dab it with a drop of chlorine bleach. If the color changes or disappears, the stain is likely organic and probably a mold. And don't forget that once you have found a spot of mold on the floor, wall, or ceiling, there may well be mold growth that you can't see.

While moisture is the cause of your mold problem, you need to carefully add more moisture during the cleanup process so the spores don't spread through the air. It is best not to vacuum, since that may increase your exposure to mold spores, which can pass through ordinary vacuum filters and remain suspended in the air for hours or days. Central vacuums that vent outside or vacuums fitted with HEPA filters will help minimize this exposure.

Scrub mold off hard surfaces with bleach and water, then dry completely. Do not use an ammonia detergent at the same time you're using bleach, since the mixture will release dangerous chlorine gas. Mold can be cleaned from wood and gyproc with a ten- to thirty-percent solution of hydrogen peroxide applied with a spray bottle. While you're working, wear gloves and a respirator to avoid breathing in mold or mold spores. Remove people and pets from the area.

Moldy porous materials such as books, carpet, furniture, ceiling tiles, and wallboard may need to be discarded. Washable drapes that can be safely bleached may be salvageable. Dry-cleaning should be done by a professional who knows how to remove molds.

Finally, eliminate the moisture that caused the mold to grow in the first place. Check your home's humidity levels by buying or borrowing a hygrometer and watching the changes that occur throughout a typical day in different rooms of the house and over the heating season. One of the most common places in a home where mold grows is in poorly maintained humidifiers, dehumidifiers, air-conditioning units, and filtration systems.

If you are renovating, ensure that lumber or drywall is dry when installing it. Don't use vinyl wallpapers in high-moisture areas, as they can create a vapor barrier that traps moisture in

the wall, where mold will grow. Add insulation around cold surfaces to reduce the possibility of condensation. Ensure that rainwater drains away from the building through downspouts and proper landscaping.

And most importantly, provide ample and properly sized venting fans in kitchens, bathrooms, and laundry rooms; make sure they are properly positioned (over the stove in the kitchen, in the bathroom ceiling) and that they vent directly outside.

## Air Fresheners

The common response to indoor air quality issues – including moldy, musty smells – is to freshen the air with products like room sprays, plug-in deodorizers, odor neutralizers, air sanitizers, or aromatherapy candles. However, these products don't get rid of smells; they just mask them, either with chemical-laden perfumes or by interfering with your ability to smell by coating your nasal passages with an oil film or releasing a nerve deadening agent.

Known toxic chemicals that can be found in air fresheners include formaldehyde, camphor, ethanol, phenol, petroleum-based artificial fragrances (which contain their own mix of toxins), and benzyl alcohol. As we've already seen, these chemicals can cause symptoms like headaches, rashes, dizziness, migraines, asthma attacks, mental confusion, coughing, and more. Some of the substances in air fresheners are also known carcinogens and others are hormone disruptors.

Severity and triggers as well as symptoms vary from person to person. But when used in a confined area like a house, the intense amount of toxins in a small area can be especially problematic. And don't forget that, like with any other toxin, children are particularly susceptible to harm from chemicals in indoor air.

Asthma is a major problem related to air fresheners and perfumed cleaning products. In a 2007 European study, researchers found that using air fresheners as little as once a week can raise the risk of developing asthma in adults. The epidemiological study, undertaken by the Centre for Research in Environmental Epidemiology at the Municipal Institute of Medical Research in Barcelona, Spain, was published in *American Journal of Respiratory and Critical Care Medicine.* The investigators used baseline data from the first phase of the European Community Respiratory Health Survey, one of the world's largest epidemiologic studies of airway disease, and interviews conducted in a follow-up phase. They found that the risk of developing asthma increased with frequency of use, but on average was about thirty to fifty percent higher than in those not exposed to sprays. The researchers didn't identify the specific cause of the higher asthma cases, but other studies have.

One of those is a 2006 study by the National Institute of Environmental Health Services, which found that a VOC common in air fresheners may harm lung function. The study, published in *Environmental Health Perspectives*, linked 1,4-Dichlorobenzene to a reduction in pulmonary function, a link found significant even when smoking was factored in.

There is also a problem with air fresheners that plug into electrical outlets. A study by the EPA has found that harmful smog can form inside homes through reactions between ozone and fragrance molecules like pinene and limonene, which are emitted by plug-ins. The reactions generate formaldehyde, which is a carcinogen, and related compounds that many experts believe are responsible for respiratory problems. Ozone, produced at ground level when vehicle exhaust emissions react with sunlight, is a common urban pollutant and can be present in buildings with open windows or regularly opening doors. In

addition, some people use indoor ozone generators that are intended as air cleaners, which will exacerbate the problem.

Phthalates are another hazard associated with the use of air fresheners. When researchers for the NRDC tested fourteen brands of common household air fresheners in 2007, they found that eighty-six percent of scented sprays, gels, and plug-in fresheners tested contained phthalates, even those bearing "all-natural" and "unscented" labels.

As we saw in the Chapter 2, phthalates are hazardous chemicals known to cause hormonal abnormalities, birth defects, and reproductive problems. When people use air fresheners, the phthalates are released into the air, where they may be inhaled or may land on the skin and be absorbed. Once these chemicals enter the bloodstream, they can alter hormone levels and cause other health problems like allergic symptoms and asthma.

As a result of its *Clearing the Air* report, the NRDC, along with Sierra Club, the Alliance for Healthy Homes, and the National Center for Healthy Housing, petitioned the EPA and the Consumer Product Safety Commission (CPSC) for stricter regulations around air fresheners. They asked the EPA to pay particular attention to the link between asthma and air fresheners. The petition stated that Americans suffer significant exposure "to a veritable cocktail of dangerous and potentially dangerous volatile organic compounds. In cases of mold and damp indoor environments, air fresheners may hide an indicator of potentially serious health threats to the respiratory system."

## Candles and Oils

Scented and so-called aromatherapy candles appear to be no better at clearing the air than air fresheners. Traditional

candles are made of paraffin wax, a petrochemical that is a by-product of the gasoline industry. And, as usual, many of the scents are full of harmful chemicals.

The black soot that is created when you burn paraffin – and especially scented – candles is toxic. Soot is a product of the incomplete combustion of carbon-containing fuels, usually petroleum-based. The soot not only discolors walls and furniture, it can also contaminate your home's ventilation system.

While little research has been conducted into the health effects of exposure to candle soot, studies into the risks of exposure to soot from diesel exhaust and factory emissions suggest candle soot can be very harmful. Since soot particles are typically quite small, they can potentially penetrate the deepest areas of the lung. According to the American Lung Association, using slow burning paraffin candles creates poor indoor air quality, and is a serious health concern. The Asthma Society of Canada recommends that the very young, the elderly, and those with respiratory diseases like asthma avoid exposure to candle soot.

The problem seems to be getting worse, due to the popularity of scented and "aromatherapy" candles, as well as potpourri and scented oil lamps. If these products are not properly manufactured, or contain too high quantities of fragranced oils that are not suitable for combustion, the result could be a serious indoor air quality problem.

One study, published in 1999, found a variety of nasty materials in scented candle emissions. David Krause authored a Master of Science in Public Health thesis entitled *Characterization of Scented Candle Emissions and Associated Public Health Risks* while studying at the Department of Environmental and Occupational Health, College of Public Health, University of South Florida. His study characterized the products of

emission by individually burning ninety-one candles inside a stainless steel combustion chamber and determining specific emission rates of soot, benzene, and lead.

The candle soot typically contained up to sixty-six percent elemental carbon and carried numerous adsorbed organic compounds including dibutyl phthalate, diethyl phthalate, toluene, and styrene. Volatile organic compound emissions found included benzene, styrene, toluene, ethylbenzene, naphthalene, acetaldehyde, benzaldehyde, benzene, ethanol, and 2-butanone (methyl ethyl ketone). Analysis for lead revealed some candles emitted significant quantities of aerosolized lead during combustion. Krause concluded that "the possible impacts on public health from consumer use of scented candles may include increased risk of cancer, neurological and behavioral deficits, and acute aggravation of existing respiratory diseases such as asthma."

Of course, the National Candle Association (a trade organization) disagrees that consumers should be concerned. While admitting that "microscopic amounts of organic compounds or special ingredients used to formulate a particular scented candle may be released when a candle is burned," it insists they are too minimal to pose a health risk. However, it also admits that scented candles can trigger asthma attacks and suggests only burning them in well-ventilated rooms.

To make matters worse, despite laws against it in many countries, many candle wicks – especially those in cheap imported candles – have been found to contain lead, which is dispersed as the candles burn. Lead is linked to impaired learning and brain damage in children.

If you think incense is a good substitute for scented candles as an air freshener, the available evidence doesn't agree. In 2003, scientists at the Hong Kong Polytechnic University

studied indoor air pollutants emitted from ten types of commonly used incense. They found higher than permissible levels of carbon monoxide, formaldehyde, benzene, toluene, methyl chloride, and methylene chloride – even among two brands that claimed to be "environmentally friendly."

Here are some ways to minimize indoor air pollution from candles:

- Burn only beeswax candles, which burn cleaner than those made with paraffin wax.
- Ensure the wick is the correct size for the thickness of the candle. Avoid too thick candle wicks and those with a wire core that keeps the wick upright. Burn candles with thin, braided wicks that curl over when burned. The wick should burn down evenly with the wax.
- Avoid multiple wick candles.
- Trim the wick to one-quarter of an inch before lighting.
- Keep your candle in a draft-free area. The goal is a low, even flame.
- Don't burn your candle in a narrow mouth container, which will cause unsteady air flow, increasing flicker and indoor air pollution. Candles poured into glass jars or ceramic containers can be similarly problematic.
- Only burn candles made of hard wax.
- Avoid highly aromatic candles. Ensure the scent used in the candle is specifically formulated for candles and avoid wax that contains volatile aromatic hydrocarbons.
- Cease burning any candles that leave sooty residues on candle holders or surrounding surfaces.
- Increase ventilation in rooms where candles are burning, while avoiding direct drafts on the candles.
- Extinguish candles after one hour of continuous burning and allow them to cool before relighting.

You're best to avoid chemical air fresheners and candles altogether, and attack the source of the odor as a permanent solution. But in the short-term, you might be able to use pure, organic essential oils to mask nasty odors. However, do not burn them (as in candles) because they are highly flammable and the smoke from burning essential oils may contain potential carcinogens, such as polycyclic aromatic hydrocarbons (PAHs). A good way to use essential oils is to vaporize them. This is commonly done with an oil burner, where a few drops of an essential oil are placed in a container of water, then heated with a small candle. You could also use a diffuser that heats the oil with a low wattage light bulb or other electrical element. Or add a few drops of essential oil to a shallow saucer of water and place the saucer on a radiator or in a sunny window.

Another way to use pure essential oils is to add a drop or two to a mister filled with distilled water and spritz around the room (but avoid directly inhaling). If you don't have young children or pets, you could also add drops of orange, lemon, or lavender essential oils to organic cotton balls and scatter them around the house

You should be aware, though, that exposure to pure, organic essential oils can cause breathing problems for children and for some people with asthma or other respiratory problems. Some essential oils are actually suspected of causing allergies; these include aniseed, bay, cardamom, citronella, jasmine, bay laurel, orange, pine, and verbena. The use of essential oils during pregnancy is controversial among aromatherapists. Most sources say that pregnant women should avoid the essential oils of angelica, basil, cedarwood, clove, coriander, fennel, hyssop, jasmine, juniper, marjoram, oregano, peppermint (which should also be avoided while nursing), rosemary, sage, thyme, and wintergreen. At any rate,

essential oils are very potent and it is recommended that they only be used under the supervision of trained professionals for valid healing purposes.

Additionally, many of the plants used to make essential oils are gathered from the wild. Tiny amounts of essential oils require massive quantities of plant material, especially compared to the amounts required by herbalists to make infusions. As a result, there is a serious sustainability issue with the most popular scents of rosewood and sandalwood, which are both being decimated in the wild.

## Air Purification Systems

A more effective but expensive alternative to cleaning up the air in your home is to purchase a portable air filter. Many of the smaller portable filters will remove odors and small dust particles. Look for one with a HEPA (high-efficiency particulate air) filter. Be aware that some electronic portable ionizing air purifiers produce ozone and other oxidants as byproducts; ozone is a lung irritant – especially for those with asthma or other respiratory problems and should be avoided.

There are also ozone generators, which intentionally produce significant amounts of ozone and are sometimes sold as air cleaners. (Ozone is what you smell outside just before a rain storm, or if a computer printer or photocopier has been operated for a long period of time in a closed area.) Restoration contractors use ozone generators to remove smoke odors after fire damage, musty smells after flooding, and other strong odors, but the use of ozone generators is controversial and many experts do not recommend them for home use. In fact, the California Air Resources Board has banned in-home ozone generators and requires testing and certification of all types of air purifiers to verify that they do not generate too much ozone.

Most people's first reaction to a nasty smell is to open windows to bring in fresh air. Strategically placed portable fans can increase air circulation on a temporary basis. The principle of air exchange is an excellent way to ensure good indoor air quality, but this method is not energy-efficient. That can be solved by installing an air exchanger that draws fresh outside air into your home while preheating it. There are three different types of systems: air-to-air heat exchanger, earth-to-air heat exchanger, and the solar pre-heat air intake method.

In an air-to-air heat exchanger system, fresh air is drawn in from a port open to the outside of the building, and passed through a chamber, also know as the exchanger, which is surrounded by indoor air. Highly conductive metal transfers the heat that is being exhausted from the house to the incoming air. The preheated fresh air is then ducted throughout the house. During the energy exchange, humidity can condense into water. A drain pan inside the exchanger chamber will allow the water to be collected for removal and a condensate pump might be used to eject the water outside.

A properly sized air exchanger will completely replace the air inside your house a total of six times per day. The sizing of the system will therefore depend upon the amount of air inside your home (calculated by multiplying length, width, height.)

An earth-to-air heat exchanger (also known as an earth tube) preheats incoming air using the warmth of the earth, rather than the exhausted house air. It involves a length of pipe, usually about one hundred feet long, buried at least five feet below ground level. Outside air is drawn from a filtered air intake through the pipe, where it is moderated to near earth temperature before being distributed via the home's ductwork. The pipe should be installed on a slight grade and have a condensation drain to eliminate the build-up of moisture and mold.

The solar pre-heat method uses solar energy to preheat fresh air. One example often seen on large buildings is the "solar wall" or "transpired solar air collector system," which involves a dark-colored, perforated facade covering a south-facing wall. Outdoor air is drawn through tiny perforations in the surface of the collector and heated as it absorbs the sun's energy. The warm air rises in the space between the collector and the building's wall (called a "plenum") and is moved into the building's air duct system. Some manufacturers have developed smaller, residential solar panel systems that accomplish the same preheating function.

## A Growing Solution

A natural and often overlooked contributor to good indoor air quality is living plants. NASA has named a variety of plants that are known to clean the air of certain indoor pollutants. Trichloroethylene, benzene, and formaldehyde are three common chemicals found indoors that plants are capable of removing from the air. One plant for every one hundred feet is the minimum recommended to purify the air and remove these chemicals from the indoor atmosphere.

Here are some suggested plants for three of the main indoor air pollutants.

- Formaldehyde (from foam insulation, plywood, clothes, carpeting, furniture, household cleaners): philodendron, spider plant, golden pothos, bamboo palm, corn plant, chrysanthemum, mother-in-law's tongue
- Benzene (from tobacco smoke, gasoline, synthetic fibers, plastics, inks, rubber): English ivy, marginata, chrysanthemum, gerbera daisy, peace lily
- Trichloroethylene (from dry cleaning, paints, varnishes, adhesives): gerbera daisy, peace lily, marginata, warneckei

If you want a project that is more ambitious (and considerably more expensive) than hanging a few plants around your home, try a green wall. The practical and aesthetic benefits are many, encouraging both individual gardeners and eco-aware architects to create new incarnations of the hanging gardens of Babylon.

Green walls have become a popular design feature in modern commercial buildings, but there are also residential installations. These are walls planted with a variety of greenery, which eventually fills in the entire wall space. The plants requiring the greatest amounts of water are located at the lower regions and those whose water needs are less are located at the top and they drip irrigate each other. Some green walls involve an elaborate perpendicular hydroponic system designed to purify the air and provide a natural interface for occupants.

For a few decades now, Toronto biologist Wolfgang Amelung has been creating miniature indoor ecosystems using vertical plantings and water features. In the mid-1990s, he began to install large corporate applications, including biofiltering "breathing walls" at the Toronto corporate headquarters of Canada Life Assurance Company, Panasonic, and Club Monaco. In these installations, water flows over a lava rock wall covered by moss and other plants, then into a small pond. Contaminants in the air are absorbed by the vegetation and consumed by micro-organisms in the soil. Any excess waste is carried to the pond, where it is eaten by fish, frogs, or insects. A team of researchers from the University of Guelph has evaluated the potential of these walls for mitigating poor indoor quality. In controlled tests, a green wall was found to be capable of removing between fifty and eighty percent of some contaminants introduced to the system.

# Chapter 6
# Your Outdoor Garden

Natural outdoor landscaping can be healthy for your family because both the act of gardening and the enjoyment of your lush oasis will relieve stress. Gardening is also great exercise. The natural approach is also healthy for birds and other animals, and for the environment in general, because it uses native plants and avoids harmful chemicals.

## Natural Landscaping

Gardening with native plants can be time-consuming initially. However, it will eventually be relatively low maintenance and provide you with lots of time to enjoy your creation. Non-native plants, on the other hand, are high-maintenance and usually require substantial inputs of fertilizers, pesticides, and water, which place strain on the ecosystem and create a toxic environment.

Native plants have evolved in a particular region over many thousands of years. Therefore, they have adapted to the climate, geography, and animal populations of your region. So they require minimal fertilizer or irrigation, and they attract beneficial insects that prey upon pests and eliminate the need for pesticides. They also reduce air pollution, improve water quality, and reduce soil erosion.

Native vegetation, unlike cultivated landscapes, does not require the use of lawn maintenance equipment (a major

contributor to air pollution and a source of climate change gases). Native plants improve water quality by filtering contaminated runoff and they reduce soil erosion by stabilizing soils with their deep root systems. They also provide shelter and food to birds, butterflies, and other wildlife, promoting biodiversity.

Your local ecosystem will determine what species you should select for your property. For example, open grassland, woodlands, and wetlands each have their own communities of plants that are native to those particular ecosystems. Each species has its own ecological requirements, whether it's the need for shade, sun, high moisture, a specific soil type, or topography. Do some basic research to find out what is appropriate for your specific area and property, or hire a knowledgeable landscaping company that is familiar with using native plants. Native plants growing wild on local vacant lots are indicators of suitable species.

If you already have trees on your property, you might like to plant a shady woodland garden with rich soil, a variety of trees and shrubs, and under-story wildflowers and groundcovers.

If the area is open and sunny, it would suit prairie and/or meadow species. They will create a colorful natural garden that attracts a number of wildlife and insect species.

Or you might want to plant native species that are specifically designed to attract birds or butterflies. Birds enjoy a variety of tree, shrub, and wildflower species that provide food such as berries, as well as shelter and perches. Bird gardens also require a water source. A butterfly garden will include a combination of wildflowers to provide larval and adult food sources, as well as basic needs such as shelter from strong weeds, resting places, and a source of water.

Plant for diversity, imitating natural growth patterns and looking for species that are drought-tolerant to minimize watering. You could try to grow plants from seed, but if time and energy are at a premium, check with your local garden center, many of which are now selling native species.

Never take plants from the wild. Collect seeds from the wild only with the landowner's permission. Take a few seeds from many plants, rather than all the seeds from a few.

You can also try rescuing native plants from being destroyed by land development and roadside maintenance. Before attempting rescue, seek permission of the relevant landowner. Many plants do not transplant well; many orchid species, for example, have formed a symbiotic relationship with *mychorrizal* fungi that cannot be immediately duplicated in a new site. When digging up the plants you are trying to rescue, make sure you get the entire root ball and sufficient soil. If possible, try to plan plant rescues for cooler, overcast fall days.

## Wildflower Meadow

Depending on the size of your property and your expectations regarding showiness and occasional messiness, you might want to cultivate a wildflower meadow. The beauty of a wildflower display is seasonal. These plants are exquisite during the blooming season, but may look a little ragged once they have gone to seed.

Wildflower meadows are not for everyone. If your idea of a perfect landscape is one that is predictably clipped and manicured, then wildflower plantings will probably not suit you. If, on the other hand, you find great delight in a glorious display of nature's most beautiful flowers, and understand that you are participating in the inevitable cycle of the seasons, then wildflowers are for you.

During the first year of your wildflower meadow, annuals will offer a spectacular display of colors. Depending on the combination of wildflowers planted, you may have full bloom from annuals and growth from biennials and perennials, which will not bloom until the next year. Annuals included for first year display are usually both native species and some quick blooming, easy to grow, naturalized, or non-native species. If you allow the annuals to form seed heads before mowing, in mild climates many will reseed to bloom during the second year, along with flowers from biennials and perennials.

Weeds and other unwanted species will always be part of a planted wildflower meadow, as Nature tries her best to follow natural succession. When present in a wildflower planting, weeds should be dealt with quickly and mercilessly. Prevention, of course, is the best answer, and weeding will be much easier if you rid the area of as many weed seeds as possible before planting. As you weed an existing meadow, sow seeds of the original mix or annuals in the spaces left bare.

By the third year, your meadow should begin to take on a mature look and the perennials should be well established. To continue to receive good color from annual wildflowers, it may be necessary to reseed every year. Watering to help seedlings develop a good root system, weeding out invasive plants, and periodic mowing of the area will always be necessary to keep your meadow looking good.

## Wetland Garden

Again, depending upon your situation and circumstances, a small wetland garden using the water that flows off your roof might be a better project than a larger wildflower meadow. Many municipalities are requiring homeowners to disconnect their downspouts from the municipal sewer systems for

environmental reasons. So redirecting your downspout into a bog or wetland garden is an effective water conservation project and an alternative to a rain barrel as a way to capture rainwater for your garden.

Aside from roofs, the many impermeable surfaces (roads, sidewalks, driveways, patios, buildings) in cities prevent rainwater from being absorbed into the land to recharge groundwater. Instead, rainwater and snowmelt run off these surfaces into sewers, picking up dirt, oils, pesticides, and other pollutants along the way. Then, the water entering storm sewers flows out in a concentrated and often polluted rush at single points along nearby waterways. This rush of water can create erosion, wash away fish-spawning beds, and cause other damage.

By redirecting storm water from your roof to your garden, you can reduce that impact. Besides, rainwater is healthier than municipally-treated water for our gardens, as some plants are sensitive to chlorine and other additives. Create a native plant wetland garden at the end of your downspout and you'll virtually eliminate the need for watering, fertilizing, and pesticides.

Some of the most beautiful and unusual of our native plants thrive in the wet, acidic conditions that characterize a bog. Once completed, your bog garden will look like any other but you will only need to water it during the most severe droughts. Here's how to get started:

- Outline the shape of your downspout garden and dig it out to a depth of one meter (three-and-a-quarter feet.) The bottom of the plot should slope slightly away from the foundation of your house to direct excess moisture elsewhere.
- Line the plot with heavy plastic and poke a few holes several centimeters (three-quarters of an inch) above the bottom to allow excess water to drain out. (A bog is characterized by poor drainage, so don't go overboard.)

- Bog plants like acidic soil, so line the hole with an acidic drainage material and refill with a mixture of the excavated soil and other organic materials you have on hand (compost, pine needles.) Mound the soil somewhat to allow for settling. Wet the mix thoroughly.
- Cut your downspout and attach an elbow and, if necessary, an extension, to direct rainwater into your garden and away from your house foundation. Most hardware stores carry an array of downspout extensions.
- Finally, add your plants and get ready to enjoy a beautiful and unusual garden. Swamp milkweed, joe pye weed, and pitcher plant are examples of bog plants. To find others, consult a native plant organization or nursery.

## Lawns

You might want to maintain some grass in your landscape plan. And that's fine unless you are prey to "golf-course syndrome," which causes us to have an unrealistic ideal of a totally weed-free lawn. There are a few tricks you can use to keep your lawn lush and relatively weed-free without resorting to herbicides (which are increasingly becoming illegal for cosmetic residential use) or causing undue environmental or health damage.

- Use a hand-operated lawn mower rather than a power mower.
- Mow high – about two-and-a-half or three inches – to discourage weed and insect invasion. Long grass blades stay much stronger, prevent weeds from sprouting, shade the roots and prevent drying of soil, and encourage longer, healthier roots. Also, keep lawnmower blades sharp to avoid tearing grass and making it susceptible to disease. Don't mow wet grass and mow in the evening or on cloudy days.

- Leave the clippings on the lawn as mulch. This reduces the need for organic fertilizer by at least thirty percent. In wet periods, or if the grass was very long, compost the clippings instead.
- A healthy, well-cared for lawn out-competes most weeds. Check often for stressed areas like bare spots (they invite weed invasion) and treat promptly by eliminating the cause (such as heavy traffic). Overseed when necessary. Remove occasional weeds by hand.
- In late spring or early summer, use a rake to gently remove thatch (compacted layer of clippings and dead grass which prevents water from percolating to the roots). Also in spring, you should aerate your lawn. Aeration is the process of removing small plugs of earth to decrease soil compaction, increase water retention capacities, and increase air circulation to roots. You can rent an aerator from a nursery or tool rental store.
- After you aerate, top-dress with compost and overseed. Loosen soil, spread compost, sprinkle grass seeds of a hardy species, press in, and water.
- You must feed the soil in order to have a healthy lawn. So fertilize in the fall with an organic fertilizer.

## Water-Efficient Landscaping

Your lawn will require about one inch of water a week. If there is insufficient rain, you will need to water with a hose or sprinkler in order to keep it lush. However, much of the water applied to lawns doesn't even benefit the grass, landing instead on non-porous surfaces like sidewalks and driveways, and being lost to runoff. Frequent, light sprinklings not only waste water but encourage shallow roots, so if you must water, do it just once a week. Trickle or drip irrigation techniques use

twenty-five to fifty percent less water than standard hoses or sprinklers.

Other than letting your lawn go dormant and brown when it gets hot and dry, the best way to conserve water is to get rid of the lawn and replace it with water-efficient landscaping, sometimes called xeriscaping. That simply means landscaping with plants that have adapted well to the amount of moisture naturally available in their surroundings. If you live in an area that experiences hot, dry periods, that will mean drought-resistant plants, such as annual and perennial grasses, vines, and shrubs; plants with grey, fuzzy, waxy, or finely divided leaves tend to be drought-tolerant. And don't forget that each property can include a variety of micro-climates created by exposure, soil type, available shade, and drainage. Your local nursery or government agriculture office may be able to offer advice on the water-efficient plants for your situation.

If you don't install a downspout bog garden, you can capture what rain does fall in a rain barrel. Be sure your rain barrel has a screened top, a child-proof lid, an overflow mechanism, and a faucet or hose attachment.

Mulch is an important component of any water-efficient landscaping plan because it keeps soil moist and cool, while discouraging erosion. As an added advantage, it controls weed growth. Organic mulches such as pine bark, shredded cedar, straw, leaves, and wood chips work best. Gravel mulches are counterproductive to water efficiency, since they retain heat and dry out the soil too quickly.

## Tear Up Your Turf

Another way to create natural landscaping is to replace your turf with an organic vegetable garden; it won't necessarily be as water-efficient as a xeriscaped yard, but any water

used will at least result in food for your family. Modeled on the so-called Victory Gardens of World War II vintage, a front-yard veggie garden can be attractive and useful, providing your family with inexpensive, healthy food. It will also build community (your neighbors will love stopping by to chat about your unusual landscaping and are sure to appreciate the odd extra zucchini or tomato) and reduce your property's carbon footprint.

Lawns are monocultures that use ten times as many chemicals per acre as industrial farmland – chemicals that pollute groundwater and contribute to global warming. Then there is that power mower, which pollutes more than your car. And the water: The lawns in the United States alone consume enough to water eighty-one million acres of organic vegetables for a whole summer.

Aside from the water, the space occupied by the grass that surrounds your home could produce enough vegetables to feed your family, with enough space left over for a bit of recreational turf (maintained with a push mower, of course). While it requires more work than the relatively low-maintenance established native plant garden, growing food is the highest use of land, makes a strong social statement, and is a positive step towards healing our planet's many ills.

It not difficult to get started. You might want to transition from full lawn to full garden, reclaiming a bit of grass each year. There are a couple of effective methods for removing grass that don't involve chemicals. If your lawn is healthy and you want quick results but don't mind the work involved, you can rent a sod cutter to slice out strips of grass. Roll the sod up and use it elsewhere, give it away to neighbors, or advertise it for sale on craigslist.org or a local bulletin board. You'll probably have to add a layer of topsoil and compost once the grass is

gone, because the soil under the lawn will be compacted and not rich enough to support food plants.

You can start your garden in the fall, using the "lasagna" or sheet mulch method. Put down a thick layer of cardboard and/or newspaper and then pile six inches or more of compost, clippings, mulch, and topsoil on top. The grass underneath will die off and decompose, and you will be ready to add more topsoil and compost to plant your veggies next spring. Some people prefer to use sheets of black plastic, which is removed once the grass dies, and can be re-used.

## Peat Moss

For many gardeners, bales of peat moss are on the list of garden supplies each spring. But peat moss does not have a place in the ecological garden. It is not a sustainable resource and gardeners around the world are moving away from using it.

Peat is the dead, decomposed product of the moss that accumulates in the lower levels of a living peat bog. More logically, it could be called "moss peat." The living sphagnum moss from the peat bogs is used widely in the floral industry for wreaths and to line hanging baskets.

Although peat was dried and burned in some countries as a source of fuel for centuries, it has only been used on any scale for horticulture since the 1940s. It is typically sold screened and dried, in either bags or compressed bales, to be mixed in with your garden soil. It is often sterilized, for starting cuttings or seeds. Most commercial potting soils contain peat. It is useful for growing plants requiring an acidic (lower pH) environment. It also has good water and air holding qualities, although it is virtually devoid of nutrients.

The problem is that peat moss develops in a peat bog or peatland, which is a special type of wetland on which decom-

posing moss has accumulated to a depth of at least sixteen inches. And it is not easily renewable. Peat accumulation is around one millimeter (one-twenty-fifth of an inch) per year. Approximately three percent of the earth's surface is covered with peat bogs that have been developing for thousands of years. Finland has the largest expanse in the world, followed by Canada, Ireland, and Sweden.

The peat moss is commercially harvested from these bogs. The process involves digging a network of drainage ditches and settling basins so that the water drains away from the wetland and the bog begins to dry out and die. Once that happens, all surface vegetation is removed and the area is ready for peat production. The surface peat layer is dried by the sun and wind. The topmost layer is typically harrowed to enhance the drying process. After a few days, the dry peat layer is collected using a large vacuum harvester or other equipment, then transported to a processing facility for screening and packaging.

Peat bogs are seen by some scientists to be as important and fragile as rainforests, and that is where the concern lies about the use of peat moss by gardeners. Peat companies are destroying these fragile, unique, and valuable bog ecosystems by removing the peat.

Wetland loss due to agriculture and development is a major biodiversity problem worldwide, threatening wildlife habitat. But peat bogs have their own special ecosystem issues and threats. They are home to rare wildlife, including untold numbers of highly specialized native plants, many of which may be endangered and found only in the peat bog.

Peat bogs are also a rich source of social and environmental information. The highly acidic conditions in peat bogs result in very slow decay. That means they provide a unique and irreplaceable record of climate, vegetation, and human activity

dating back ten thousand years. There have been some remarkable finds in peat bogs, including people buried thousands of years ago and wooden artifacts that have not survived elsewhere.

Peat bogs, like other wetlands, are Nature's water purifiers. They contribute to healthy watersheds and, in some areas, to safe drinking water for nearby populations, filtering an estimated ten percent of global fresh water resources. They also provide effective flood prevention. Destroying a bog destroys these benefits. In addition, the ditches required to extract the peat lower the water table and often negatively impact local waterways.

Perhaps the biggest contribution of peat bogs to a healthy environment is as global coolers, helping to fight climate change. As the mosses grow, they absorb carbon dioxide, which is locked up within the plant structure as the plants turn to peat. Scientists think these bogs contain more carbon than all of the world's tropical rainforests. But when the bogs are drained for peat extraction or otherwise disturbed, the peat starts to decompose and the carbon dioxide is released back into the atmosphere, where it acts as a potent greenhouse gas.

Fortunately, the use of peat in horticulture is not necessary. There are many alternatives, some of which are cheaper (often free) and more effective.

Peat is often used as a soil improver but other materials perform better, since peat has little or no nutrient value. Wood-waste, spent mushroom compost, composted garden or green kitchen waste, leaf mold, and well-rotted farmyard manure are all more effective and less expensive soil enrichers.

Peat is also a poor mulch, tending to dry out and blow away. There are many other more suitable materials available. You could try chipped bark, shredded tree prunings, straw,

cocoa shells (a byproduct of the chocolate industry,) spent mushroom compost, composted garden waste, or leaf mold.

As a growing medium, commercial nurseries are finding that alternatives like leaf mold compost or coir work well and are even better than peat in some circumstances. Coir (pronounced "koi r") is the fibrous outer husk of coconuts that is used to make rope and mats. During the fiber stripping process, the pulp surrounding the coir fibers is removed as a waste material. And it is now being satisfactorily used as a replacement for peat moss. Unfortunately, coir must be transported from places like Sri Lanka and the Philippines where it is produced, so it is better to look for things that are more local.

## Grow on Your Roof

If you have exhausted the possibilities of your yard, consider your roof as the location for a garden. Sloped or flat, large or small, the possibilities for urban greening, air cleaning, community building, and food production are limitless. In 1995, Toronto-based architect and green roof booster Monica Kuhn wrote in *Natural Life Magazine* that once you cover a roof with plants, you have immediately achieved several things:

"Environmentally, by increasing the city's biomass, you have increased oxygen levels in the air – and decreased the amount of carbon dioxide, which is produced by cars and other fuel burning technologies. You have cut down on dust and air-borne particulates, since plants act as natural filters. You have had a hand in altering the local climate, because plants absorb rather than reflect heat. And because roots hold and absorb water, every time it rains your roof is retaining storm water runoff, thereby decreasing the load on the city storm sewage systems."

Layers of soil and foliage are great insulators, keeping your home warmer in winter and cooler in summer, thereby reducing your energy bills. Because the extreme temperature swings – and therefore the expansion and contraction experienced by the roof – will be moderated, the life span of your roofing membrane will increase. And since the roofing will be covered, the membrane will be protected from harmful UV rays, and from everyday wear and tear. Add to that the ability to grow vegetables and flowers, create a private outdoor addition to your home, and increase the value of your property.

Kuhn advises that there are several issues that you should be aware of regarding the planning and installation of a green roof.

The first is loading. Soil, decking, people, and plants – and where they are placed on your roof deck – all have an impact on the existing structural/carrying capacity of the roof, as well as that of the rest of the building. So you will need to have a structural engineer confirm the additional weight that the roof can accommodate.

The second consideration is safety. How do you access the roof? How do you get materials and water up to the roof? Who will be using the roof? Is there a railing? Are you insured? Building codes have specific regulations regarding structural, health, and safety issues as they relate to new and existing buildings. A call to your local Building Department or an architect will help to get you started.

Your roofing material itself is also an issue. What kind is it and what condition is it in? Can you walk on it or should it be protected? Will plant roots penetrate the membrane and should you be elevating your plants? How and where does it drain? If you have to replace or repair it in five years, can you do so without disrupting your established garden?

And then there is the specific micro-climate of the roof itself. Gardening up on a roof is quite different from gardening at grade. It is very sunny, sometimes windy, and the temperatures are often extreme. This will have a direct effect on what will grow well, how often you have to water, and whether your plants can survive through the winter.

But with some careful planning, your green roof can be an excellent addition to a green and healthy home.

# Chapter 7
# Renovating Your Home

Millions of us are renovating our homes every year, spending more money annually on renovation than on new home construction. Since buildings are responsible for forty percent of worldwide energy flow and material use – and the largest share of carbon dioxide released into the atmosphere – how you remodel can make a big difference to the environment.

Upgrading insulation, furnaces, cabinets, and fixtures like water heaters and toilets means less fossil fuel pollution and reduced resource depletion. It can also save you money in the long-run. However, renovations can be fraught with unintended consequences like indoor air pollution. There are so many aspects of green home renovation that I could write a whole book! But here are some general tips for undertaking your renovation in a healthy, environmentally friendly way.

A green renovation involves two interrelated concepts. One is to be as earth friendly as possible by using sustainable and/or recycled or reused materials, and to reduce energy and water use by employing measures like solar and geothermal heating, high-efficiency lighting, and green roofs. The other is to create a healthy living space by using nontoxic alternatives to conventional building products.

The current interest in environmentally friendly building and renovating has created a bit of a gold rush around the term

"green," with some products being labeled that way that aren't, or that are, at best, a very pale shade of green, as I wrote in Chapter 1. Fortunately, there are some certification and labeling programs that can help the confused consumer sort out the green claims.

Lumber that has earned certification as sustainably harvested can be found at most lumberyards; appliances such as water heaters and refrigerators carry the U.S. government's Energy Star rating labels; the Green Seal program recommends products like carpet, floor care products, wood finishes and stains, lighting and environmentally friendly room air conditioning; The UL Environment and Terrachoice's EcoLogo programs certify everything from bamboo and other wood-substitute flooring products, carpeting, composting toilets and water-saving showerheads to exhaust fans, solar systems, wallboard, hot water tanks, and shingles.

Beyond labeling, use a common sense approach to purchase natural, non-petroleum-based, recyclable materials that will last longer and save landfills from being filled with poorly made junk. When choosing renovation products or fixtures, look for aggressive rates of recycled content, absence or reductions of undesirable chemicals like formaldehyde, and products that conserve resources and are manufactured locally from local materials.

## Flooring

Reconsidering your floor surfaces is a basic aspect of converting to a green, healthy home. And if you have wall-to-wall carpets or a lot of rugs, you might want to replace them. While carpets provide a warm, cushiony surface for children who like to play on the floor, they can also release dust and fumes that cause sniffles, headaches, asthma, and other health problems.

More than two hundred chemicals – many of them petroleum based – are used in the manufacture and installation of synthetic carpets and their backings, not to mention the fact that even regular vacuuming fails to remove all the dirt, molds, dust mites, and pesticide residues tracked in from outside. Hard surface floors are much easier to keep really clean. If you like the look and feel of rugs, you can avoid all the problems by using smaller, washable carpets made from natural fibers.

Aside from being easier to keep clean than carpeting, wood floors can add value to a home and give it warmth and a natural aura. However, clear-cutting forests for their lumber can create loss of wildlife habitat, runoff into streams from erosion, and decline in carbon storage capacity, severely impacting climate change.

Some types of wood are better than others. Eucalyptus, for instance, is grown on very productive plantations, where stands of indigenous trees are interspersed to preserve natural habitat. The wood can be harvested in just fourteen to sixteen years, which is much faster than other premium hardwoods grown in colder climates.

Any new wood that you use should, ideally, have been cut from forests managed sustainably, such as that certified by the Forest Stewardship Council (FSC), an international nonprofit organization whose certification program is backed by both industry and environmental organizations. Wood carrying this certification must be produced in a way that minimizes such environmental impacts as road building and erosion, keeps pesticide use to a minimum, protects species, and promotes diversity within the forest. There is a paper trail, called a chain of custody, back to the forest where the wood originated, so you know just how the wood has been grown, harvested, milled, stored, etc.

A better alternative, which avoids felling new trees altogether, is to use recycled wood. Old reclaimed wood is often salvaged from large warehouses and buildings, from landfills or urban tree salvage, from old barns, and even from riverbeds. Especially prized are the wide planks and massive hand hewn wood beams, in sizes that are unmatched in today's lumber yards. Recycled lumber is strong and dense; it is also dry wood and is therefore unlikely to twist, warp, or shrink. It features deep, beautiful colors, character features, and a rich patina that can only be bestowed by time. And it also has a history that lends its story to your home. Heart pine, old growth oak, Douglas fir, cypress, and black cherry are all being rediscovered after centuries of growth and almost that many more years of aging. These rediscovered woods can be re-milled into boards used for flooring, moldings, stairs, cabinets, and furniture. Getting this old wood cleaned and ready to market is a labor-intensive job, so the price of reclaimed lumber is comparable to, or sometimes higher than, that of new wood.

Some recovered wood is certified under the FSC banner. SmartWood is a recovered wood certification program that authenticates the wood, providing a chain of custody document that describes the origin and handling of the wood.Some companies and trade organizations, such as the Reclaimed Wood Council, offer their own documentation and wood histories. For instance, wood obtained from a demolition contractor can be linked to an address and photos. Lost timbers recovered from riverbeds can be identified by the number of growth rings. Whatever the method, verify that the dealer is reputable before investing in recycled wood.

Another category of options is sometimes referred to as green wood products. These include formaldehyde-free composite wood panels, particle board made from waste wheat

chaff, arsenic-free pressure-treated lumber, engineered structural wood, and plastic "lumber." Most of these products are not certified, although there is some certified particleboard available and greater demand is leading to more certification. Often, green wood products use small, second-growth trees of lesser-used species, such as aspen and poplar, reducing the demand on species like Douglas fir and southern pine, and helping to preserve old-growth giants. They also often are made by recycling waste material like sawdust from other wood milling projects.

A less expensive alternative to wood flooring is tongue-and-groove strip flooring made from bamboo. Bamboo is very hard and strong. Environmentally, you cannot argue with a wood substitute that matures in three years, regenerates without need for replanting, and requires no or minimal fertilization or pesticides. However, many bamboo flooring products are made with an adhesive that contains urea-formaldehyde, which is a probable carcinogen, so be sure to look for one made with low-VOC adhesive.

If you want a resilient flooring for kitchen, bath, or family room, your contractor may also be able to locate rubber flooring, which is often used commercially. It is made from recycled tires through an energy efficient, low-waste manufacturing process, creating a tough, waterproof, slip-resistant floor. Available in rolls and tiles, rubber flooring can be cut, shaped, and customized to any length needed for easy installation and comes in many different color options.

Cork is another, more readily available, and generally less expensive, option. Contrary to what many people think, cork is not endangered (unless the market for it caves in and the forests are clear-cut). In fact, cork extraction is one of the most environmentally friendly harvesting processes in the world, with

not a single tree cut down to get the cork. Cork cutters make precise incisions into the cork bark and then strip it off the trees. The cork bark grows back and is ready to cut again in nine years. Some trees in the ancient cork forests of Spain and Portugal are four hundred years old. The forests are home to the Iberian lynx and other endangered wildlife, and the conservation group WWF is concerned that the wine industry's increasing use of synthetic and screw-top stoppers will lead to falling demand for cork and perhaps the destruction of the cork forests for other uses.

Cork flooring comes in a variety of types, including large tiles that are glued down, and tiles that are formed into a click-together system that is backed with chipped cork and has a fiberboard middle layer. The bottom layer provides excellent cushioning and resiliency, which is great in the kitchen, where a lot of standing happens. The click system does not need to be glued or nailed down and can be effortlessly lifted when you move or renovate. Another benefit of a click-together cork floor is that if one tile is damaged, it can be replaced without the need to tear apart the entire floor. Most click systems can be installed over radiant heat and are impermeable to water. Cork is fully recyclable and its final crumbs can be added to concrete to provide lightness and bulk, or allowed to biodegrade. Cork flooring is available through reputable flooring retailers. However, be sure to inquire about the middle layer, and the glues and finishes used, to be sure they are formaldehyde-free.

Lastly, and especially if you have kids, consider natural linoleum. Made with natural materials and installed with solvent-free adhesives, there are no harmful VOCs emitted. Its anti-static properties make linoleum a good choice for people with dust allergies. And its bactericidal properties guard against various micro-organisms often found in kitchens.

## Walls

Repainting your home is perhaps the quickest and least expensive way to freshen things up. But it can negatively affect indoor air quality. According to the EPA, paints, stains, and other architectural coatings produce about nine percent of the VOC emissions from consumer and commercial products, making them the second-largest source of VOC emissions after automobiles. Formaldehyde is a VOC commonly found in paint. The EPA has found that indoor concentrations of VOCs are regularly up to ten times as high as outdoor concentrations, and can climb up to a thousand times as high as outdoor concentrations when you are applying paint.

Choosing paint based on its reportedly low level of VOCs can be problematic. Government regulations tend to allow products to be labeled as having zero or no VOCs even when they contain small amounts. Non-profit certifiers like Green Seal set more comprehensive requirements, but some paints may still contain harmful ingredients such as preservatives, fungicides, and biocides. Since VOCs and other toxins are often contained in the pigment added to paint at time of purchase, actual emissions may be higher than those quoted for the base paint. And since darker colors require more pigment, deeply colored paint may contain more VOCs than paler colors. So check the quality of the pigment being used, as well as the base paint; requesting the Material Safety Data Sheet for the pigment will help you to avoid obviously harmful substances like cadmium, mercury, and other heavy metals.

So-called latex paints have lower VOC levels than oil-based paints, simply because they use water as the carrier rather than petroleum-based solvents. Except for appearance, the latex used in paint is in no way connected with the natural latex used, for instance, in some kinds of rubber gloves, which

can cause allergic reactions. Latex paint cleans up easily with water, so you don't need harsh VOC-emitting solvents to work with it.

There is an increasing availability of natural paints, composed of materials such as citrus oil, lime, clay, linseed oil, and chalk. Because natural paints do not contain petroleum products, they emit few if any VOCs, and are healthy and environmentally friendly. They use linseed and soy oils as binders, pine- and balsam-derived turpenes or citrus oils as carriers, minerals as pigments, and lime and chalk as thickeners.

Milk-based paint, which is made from a milk protein called casein, is the least toxic and least environmentally damaging paint. It contains no VOCs, lead, formaldehyde, oils, or biocides. You can buy milk-based paint premixed or mix it yourself, which lowers shipping-related pollution because it weighs less. However, it is not suitable for use in kitchens or bathrooms because it can host mold.

Once you are finished repainting your home, you will inevitably have some paint left over, a problem shared by paint retailers, manufacturers, contractors, and others. The Product Stewardship Institute (PSI) estimates that thirty-four million gallons of leftover consumer paint are generated annually in the U.S. alone. PSI is working with governments, industry, and environment groups to develop leftover paint management solutions that are both financially and environmentally sustainable.

As a result, some companies are producing recycled finishes, although in a limited number of basic colors. These are reclaimed products made from mixing together unused portions of recovered conventional paints and stains. While decreasing waste, these products are only as healthy as the original product was.

## Countertops and Cabinets

Make sure new kitchen, bathroom, and laundry room cabinets are made of certified wood with environmentally-sound finishes, use low VOC finishes and glues, and drawers made from renewable, formaldehyde-free products like wheatboard. This is a good place to repurpose used or even antique furniture for storage.

Countertops can feature recycled content, such as terrazzo-style slabs made with recycled glass. A durable, mineral-based solid surface, this material contains no resins or polymers and is made with glass diverted from landfills, old traffic lights, curbside recycling, manufacturer overruns, and factory scraps. Smooth as marble and four times stronger than concrete, it is an environmentally-friendly alternative to synthetic, engineered surface materials.

Another choice for countertops is porcelain tile, which does not produce fumes or support mold or mildew growth (although the grout used between the tiles does). Look for a product that uses naturally occurring clays and locally-mined minerals. There are also tile products made from recycled tiles.

## Kitchen Appliances

You may already own a refrigerator and stove, but keep in mind that today's appliances require just twenty percent of the energy needed to run older ones. If it is time to buy new appliances, choose products that carry the Energy Star certification label, which means they are highly energy efficient. And get rid of that old energy-sucking basement beer frig! However, remember that those appliances have already emitted $CO_2$ during the manufacturing process, so you need to consider that embodied carbon. That's a good argument for buying high quality products in the first place because they last longer and

their manufacturing emissions can be factored over many years. It also means that if you have a choice between repairing and buying new smaller appliances (given a similar cost), repairing could lessen the carbon load.

If you are renovating, give some thought to relocating appliances for increased energy efficiency. For instance, heat makes refrigerators and freezers work harder, so try not to locate them near windows, heat ducts, radiators, or the stove.

How you use your appliances is important too. They use energy even when they are not being used, so pull the plug when you're not using them or plug them into a power bar and turn that off at night. If you use a dishwasher, turn off the dry cycle on the dishwasher and let dishes dry naturally, or dry by hand. Pressure cookers and steamers use less energy than conventional ovens. Well maintained and regularly cleaned appliances will run better and save energy. So defrost the freezer regularly, check the seals, and de-scale the kettle and other appliances (and investigate softening your water).

We don't always think about a water heater as an appliance, but it is. The newer tankless models save a great deal of energy and provide on-demand hot water. If you have the conventional sort, check to see if its storage tank is well insulated. A tank that is warm to the touch needs more insulation. Wrapping it with insulation can reduce standby heat losses by twenty-five to forty-five percent and save up to ten percent in water heating costs. You can buy an easy-to-install kit at a hardware store; it will pay for itself in about a year. Lower your water heater temperature to one hundred and twenty degrees F (forty-nine C); any higher than that risks scalding anyway. For each ten degrees F reduction in water temperature, you can save between three and five percent in energy costs. Washing your clothes in cold water will also save energy. Unless you're

dealing with oily stains, the warm or cold water setting on your machine will generally do a good job of cleaning your clothes. Switching your temperature setting from hot to warm can cut a load's energy use in half. And it will help your clothes last longer too.

A renovation is a great time to replace your heating/cooling system's thermostat. A programmable model is a good investment, saving you up to fifteen percent on your energy bill. But even if you have the regular kind, you can still manually regulate the temperature when you're not home. Adjusting temperatures five to eight degrees F (down in winter, up in summer) can help save energy if you're going to be away from home for several hours. Even when you're home in winter, you can add another blanket at night and wear a sweater during the day.

## Bathroom

A poorly equipped bathroom can be, literally, a real drain on both natural resources and your bank account. So it's a good place to green up. You could begin by referring back to the tips in Chapter 3 about conserving water in your bathroom, and replacing showerheads and faucet aerators.

The toilet can typically account for one-third of total household water use – more if the tank's fittings leak. In one month a single leaky toilet can waste as much as twenty-eight hundred liters (seven hundred and fifty gallons) of water. Even if there is no leak, you might want to consider replacing your old toilet with a more modern one. In my opinion, an ultra-low-flush toilet should be standard in any environmentally friendly bathroom.

Low-flush toilets had a bad name when they were first introduced onto the market back in the early 1990s. They often

plugged or at least didn't clean the bowl adequately, prompting many users to flush twice. However, manufacturers responded to the complaints and the newer models perform well with powerful flushes and wide trapways.

The dual-flush toilet takes water-efficiency one step further by using six liters (one-and-a-half gallons) of water to flush solid waste but only half that to flush liquid waste. Dual-flush toilets typically use a "washdown" flush action versus the siphonic flush action more common in North American toilets. Before you replace your old toilet with a low-flush model, check with City Hall. Many municipalities have subsidized toilet replacement programs.

Another alternative is to go completely waterless with a composting toilet, which will reduce your organic "waste" to an odorless nutrient-rich fertilizer suitable for your garden. Although the cost of a good unit is high, the long-term savings are significant. Composting toilet systems require careful siting and installation, as well as electricity for operating the fan and/or heater. You must also be prepared to prevent toxic chemicals from being dumped down the toilet, and to do some regular maintenance.

If you cannot afford a new toilet, you might settle for one of the retrofit devices that have been developed to allow older toilets to operate on less water. The most common approach is placing a displacement device such as a filled plastic bottle or a brick in the tank in order to reduce the volume of water used to flush. Bricks may deteriorate and cause damage to the flushing mechanism, so if you go this route, wrap the brick in plastic. You can also create a dam using two pieces of flexible plastic wedged into the tank on either side of the flush valve to hold back some water each time the toilet is flushed. These devices can reduce water consumption by about fifteen percent.

Yet another retrofit approach is the early-close flapper. This device replaces the standard flapper valve and is designed to shut sooner, before all the water in the toilet tank can flow into the toilet bowl. Early-close flappers often are adjustable, so you can find a good balance between saving water and having the toilet bowl reliably cleared. Because the flush has the weight of a full tank of water behind it, this method provides a cleaner flush than dams or bricks.

## Fabrics

Another way to make sure your home is as green and healthy as possible involves your choice of household fabrics for window coverings, upholstery, carpeting, and so on.

Although environmentally and health conscious consumers have traditionally favored natural fibers – primarily cotton – over synthetic, conventional cotton is a poor choice. Cotton is one of the most toxic crops grown. It uses approximately twenty-five percent of the world's insecticides and more than ten percent of the pesticides. In addition, over two billion pounds of synthetic fertilizers are applied to conventional cotton. To put these numbers into perspective, it takes roughly one-third of a pound of chemicals to grow enough cotton for just one T-shirt. And of these, the U.S. EPA considers seven of the top fifteen pesticides to be possible, likely, probable, or known human carcinogens.

Fortunately, there is a rapidly developing organic fiber industry, which will help solve the problem of dressing your home in a manner that is healthy for both your family and the environment. You now have your choice of a growing selection of bedding, window coverings, and towels made from organic wool, linen, hemp and flax, in addition to cotton and some newer fibers like bamboo and soy.

Hemp, which can be grown without herbicides or pesticides, has been used for centuries in household linens and work clothes because its fibers are four to six times stronger than cotton and it is hypoallergenic. A strong hemp fiber industry is developing in North America; although hemp cannot be legally grown in the U.S., Canada legalized it in the 1990s.

Bamboo is another potentially environmentally friendly plant that can be used for many purposes including flooring, as we have already seen. Made into fabric, it has a luxuriously soft feel, flowing drape, and many other positive properties including being wrinkle-resistant and absorbent. However, bamboo fabric is not necessarily as eco-friendly as it's made out to be because harsh chemicals are often used in the manufacturing of the fiber (which is essentially rayon), although eco-friendly processes are being evolved. And in a controversial move in 2009, the U.S. Federal Trade Commission disputed the claims of bamboo clothing manufacturers that their products were antibacterial and biodegradable.

Bamboo's biggest eco benefit is that it grows quickly and is one of the most renewable resources on earth. Chemical pesticides and synthetic fertilizers are not needed to grow it, as it is seldom eaten by insects or infected by pathogens, and it does well in impoverished soils. Bamboo also has relatively low water needs, especially compared to cotton and most other crops. In addition, its roots help retain water in a watershed area due to their tight hold on the soil. It has been reported that, compared to an equivalent stand of trees, bamboo takes in more carbon dioxide, removing this greenhouse gas from the atmosphere, and produces thirty-five percent more oxygen.

Aside from the fabrics used, your choice of window covering styles can make a big contribution to the greenness of your home. In cold climates, window quilts can provide a great

deal of protection from cold infiltration through window surfaces. In an article in *Natural Life*, green interior designer Eileen Wosnack provided simple instructions for home sewers who want to make their own window quilts. She said that the quilt should have two or three layers for optimum insulation. The decorative fabric layer, which will face the room, can be light and match the room style, while a middle layer of black or white organic cotton flannel will afford additional thermal value. The backing, which will face outside, can be white organic cotton to reflect the sunlight in the summer. Quilting the three layers together will help keep them in place. And the shade can be hand rolled and pinned up when not in use, or equipped with rings and cords for easy raising and lowering. For optimum protection against the cold, Velcro can be used to seal the quilt to the sides of the window frame.

## Bedroom

We spend about a third of our lives in bed, so the quality of the air and of the materials of which our mattress and other bedding is made is important to our health. If you are undertaking a bedroom renovation – perhaps ripping out carpet and installing wood flooring, and refinishing the walls – that is a good time to also replace your old mattress – especially if it was made using petroleum-based chemicals, foams, and plastics. However, be careful what you choose as a replacement.

The popular visco-elastic polyurethane foam ("memory foam") products include toxic substances like toluene di-isocynate, polyether glycol, silicone surfactant, tertiary amines, stannous octoate, flame retardants, and pigments/dyes. These compounds continue to evaporate into the air and are then inhaled by the person sleeping on the bed. The close proximity of sleeper to mattress results in breathing these

VOCs in higher concentration than in other situations and they can also become part of house dust as the foam breaks down over time.

Research suggests people can become ill after repeated and continuous exposure to these chemicals. There are common complaints of fatigue, migraines and other headaches, eye irritation, skin rashes and itching, muscle and joint pain, sore throat, shortness of breath, onset of asthma attacks, and more after sleeping on these mattresses. Worse, some of these substances are documented carcinogenic and mutagenic compounds, and have the ability to weaken or damage the immune and nervous systems.

Polyurethane foam is inherently combustible, resulting in the need for fire retardation. The U.S., Canada and EU have flammability standards for all mattresses sold. These are generally performance-based, meaning they don't specify how manufacturers should make their products safe, nor do they require manufacturers to disclose their method of choice to consumers.

The Canadian legislation specifies three ways to meet the regulation: treatment with fire retardants, use of smoulder resistant filling materials, and use of barrier materials. Until a few years ago, manufacturers regularly used fire retardants like polybrominated diphenyl ethers (PBDE). After research suggesting it could create nervous and reproductive system damage, most manufacturers voluntarily stopped using PBDE in bedding in the mid-2000s. However, the replacement chemicals, such boric acid, phosphate esters, or TCEP, are also toxic. The Labour Environmental Alliance Society (LEAS) has canvassed the major Canada manufacturers of mattresses and been told that fire retardants are seldom their method of choice. The U.S.-based Sleep Products Association claims that its mem-

bers also tend to avoid chemical retardants and, instead, use "fire resistant barriers of man-made fibers" – the content of which is unknown. If you wish to purchase a mattress without fire retarding chemicals, you may be able to obtain an exemption via a prescription from your doctor.

Some mattresses are made either entirely or partially of latex foam. Since this is derived from the sap of rubber trees, it's advertised as a natural alternative to other kinds of foam. It supports the body well, and has antibacterial and anti-dust mite qualities, although some people are allergic to it. Its high cost means that the vast majority of latex mattresses on the market are, in fact, made from a combination of natural and synthetic latex. Unfortunately, the synthetic version doesn't have the positive qualities of the real thing. And it is a styrene-butadiene polymer, exposing workers to a carcinogen in the production process.

Because of the low-flammability characteristics of wool, it's a very desirable material to use inside or as a cover for futons and mattresses. But be sure you choose organic.

The material that covers a mattress is another source of concern. Conventional mattresses for children are often covered in vinyl, which begins life as a hard plastic and is softened using additional harmful chemicals like phthalates. In many countries (including Canada and the U.S.), the sale of children's mattresses containing phthalates is illegal. Cotton is a better material, but conventional cotton bedding is bleached and treated with chemical dyes, color fixers, permanent-press and stain- and water-repellent finishes.

As with other materials, be sure to look for third-party certification seals, rather than something made up by the manufacturer or retailer. The Organic Trade Association's website includes a directory of manufacturers and retailers of organic

mattresses and other bedding products in the U.S. Some mattresses will bear the Oeko-Tex® seal. The Oeko-Tex® Standard 100 certification is a third party testing program that, while not organic, assures that textile products with its logo are free from harmful levels of more than one hundred substances known to be detrimental to human health.

## Insulation

One of the most cost-effective green home renovation projects is also one of the simplest. Insulating and sealing your home will pay for itself many times over in energy savings. According to Natural Resources Canada, air leaks can bleed as much warm air from your house as an open window would – a *big* open window: In a pre-1945 house, the air leaks can add up to the equivalent of a hole in your wall twenty-one inches in diameter and, in a more modern conventional home, fourteen inches. A thorough air sealing job can save at least fifteen percent on your heating bill.

Contractors can test your home for air tightness. But you can find most leaks yourself. On a windy day, hold a lit incense stick next to your windows, doors, electrical boxes, plumbing fixtures, electrical outlets, ceiling fixtures, attic openings, and any other locations where there could be possible air paths to the outside. If the smoke stream travels horizontally, you have located an air leak that may need caulking, sealing or weatherstripping. A feather or a piece of tissue held to the baseboards, window frames, etc. on a cold day will also show you the drafts.

Once you have found the leaks, caulk and weatherstrip any doors and windows that need it. Also caulk and seal air leaks where plumbing, ducting, or electrical wiring penetrates through exterior walls, floors, ceilings, and soffits over cabi-

nets. Install gaskets behind outlet and switch plates on exterior walls.

If you have access to the attic or crawl space, or if your basement is insulated, look for dirty spots in the insulation, which often indicate holes where air leaks into and out of your house. You can seal the holes by stapling sheets of plastic over the holes and caulking the edges of the plastic.

Your home's duct system is a network of ducting in the walls, floors, and ceilings that carries the air from your home furnace or air conditioner to each room. Unfortunately, many duct systems are poorly sealed and not insulated. Ducts that leak air into unheated or non-cooled spaces can add a lot of money to your heating and cooling bills. Sealing your ducts to prevent leaks is even more important if the ducts are located in an unheated area like an attic or vented crawl space. If the supply ducts are leaking, heated or cooled air can be forced out unsealed joints and lost. In addition, unheated air can also be drawn into return ducts through unsealed joints. Look for sections of duct that should be joined but have separated. Then look for obvious holes. If you use duct tape to repair and seal your ducts, look for tape with the UL logo to avoid tape that degrades, cracks, and loses its bond with age.

If your home has a fireplace, keep the flue damper tightly closed when it is not in use. A chimney is designed specifically for smoke to escape, so until you close it, warm air from your house will also escape. Better yet, equip your fireplace with tightly fitting glass doors.

An inefficient furnace is another energy and money waster. So have a heating contractor do a maintenance check every year or two to make sure your furnace is operating at peak efficiency. Keep the furnace filter clean. Replace it yourself every one to two months during the heating season. A dirty

filter reduces the air flow to the furnace and makes it run longer.

It's a larger and more expensive renovation project, but if your house has single-pane windows, installing storm windows will save energy and money. Storm windows will as much as double the R-value of single-pane windows and can reduce drafts, water condensation, and frost formation. As a less costly but also aesthetically less pleasing (and perhaps less healthy) alternative, you can use a heavy-duty, clear plastic sheet on a frame or tape clear plastic film to the inside of your window frames during the cold winter months. Better still, replace your existing windows with double-pane windows.

Whether you are replacing or simply caulking the windows in your home, you should also think about shading the windows from excess sun. Exterior awnings can provide some shade by overhanging the window and shielding the direct sun without depleting the light and, for that reason, are very useful in northern climates with short winter days. Properly constructed, awnings or overhangs will not block winter sun, but will shade the windows in the summer.

Exterior shutters are another possibility. Shutters can be either automatic or manually operated. They can be very protective from the wind and cold, as well as helpful for darkening a room if someone needs to sleep during the day. In areas where break-ins are a concern or for extended absences from the home, exterior shutters greatly deter thieves since the glass is not exposed.

If you prefer a more natural look, trellises or lattices covered with vines and other greenery can provide attractive and functional exterior shade for your windows. Don't, however, grow vines directly on the walls of your home, since they can damage the bricks or siding and make a huge mess.

## Solar Power

The popularity of solar energy is increasing as people look for alternative ways to heat homes and water supplies, or to power lights and appliances. However, there are substantial initial costs involved because a solar system places all the costs up-front, rather than spreading energy payments over a long period of time, as with natural gas or electricity. However, once the system is paid for, the sun doesn't charge for its energy, so the payback begins.

The initial costs (and, hence, the payback timeline) will depend on the purpose, type, and size of the solar system you choose. And that will depend on your budget, as well as the size of your family, your lifestyle, your geographic location, and the way your house is situated. However, many governments offer financial incentives to encourage homeowners to switch to solar, so you will need to research what's available in your area.

There are two main ways to use the power of the sun to reduce energy costs in your home. You can use the heat from the sun's rays to heat your home or your domestic hot water, or to produce electricity to power lights and appliances. You are probably looking at a relatively high initial cost to retrofit your home with a thermal space heating system. But just about anyone whose house or yard is exposed to continuous sunlight can preheat their hot water using solar energy, so that might be a good place to begin your solar adventure. The initial cost is not as high as other solar projects and the payback won't take long.

In 2006, the solar industry reported that the average price of a solar domestic hot water system in Canada was around six thousand dollars. Estimated payback periods for a solar water heater range from six to thirteen years for water originally heated by electricity, and twelve to twenty years for natural gas

heating. That system will easily cut your water heating bill in half and could save up to two metric tonnes of greenhouse gas emissions annually.

Solar water heating systems involve solar collectors and storage tanks. Two main types of solar collectors are used for residential purposes in cold climates. They are flat plate collectors and evacuated tube collectors. Glazed flat-plate collectors are insulated, weatherproofed boxes that contain a dark absorber plate under one or more glass or polymer covers. Unglazed flat-plate collectors – typically used for pool heating – have a dark absorber plate, made of metal or polymer, without a cover or enclosure. Evacuated-tube solar collectors feature parallel rows of transparent glass tubes. Each tube contains a glass outer tube and metal absorber tube attached to a fin. The fin's coating absorbs solar energy but inhibits heat loss.

In climates where temperatures rarely dip below freezing, a direct circulation system can be used, where pumps circulate household water through the collectors and into the home. In colder climates, an indirect circulation system is used, with pumps circulating a non-freezing, heat-transfer fluid through the collectors and a heat exchanger.

There are other ways to heat water using the sun. A thermosyphon system works on the principle that warm water rises as cooler water sinks. The collector is installed below the storage tank so that warm water will rise into the tank, typically situated on a roof. This sort of system is often used to heat the water for swimming pools.

Most solar water heaters require a well-insulated storage tank. In two-tank systems, the solar water heater preheats water before it enters the conventional water heater. In one-tank systems, the back-up heating system is combined with the solar storage in one tank.

Then there is a solar electric system, using photovoltaic (PV) cells, which are semiconductor devices, usually made of silicon. Photons in sunlight are absorbed by the silicon and electrons are knocked loose from their atoms, allowing them to flow through the silicon to produce electricity.

Because they contain no liquids, corrosive chemicals, or moving parts, PV cells require very little maintenance, don't pollute while in use, and operate silently. In a household system, the cells are bundled together into solar panels, which have a sheet of glass on the front, allowing light to pass while protecting the cells from the elements. Panels are linked together in arrays to fit individual generation needs. You can add panels to your roof at any time after installation – given that you have the available space, of course – in order to increase power output. Or, depending on your location, you can mount a solar array on tilted racks beside your house.

These PV panels generate direct current (DC), the kind of electricity used to charge batteries. Most North American electrical devices require 120-volt alternating current (AC), which is what is supplied by local utilities. In other parts of the world, the mains supply – and therefore household equipment – is based on 220-volt alternating current. A device known as an inverter is used to convert the solar-generated DC to AC current for use in your home, to power lights and appliances.

The energy generated by solar panels can be stored in batteries. But in many urban areas, your roof-mounted PV system will probably be grid-tied, meaning that any excess electricity generated is sent to the transmission grid. Net metering programs give these systems a credit for the electricity they deliver to the grid. This credit offsets electricity provided from the grid when the system cannot meet demand, effectively using the grid as a storage mechanism.

Due to the growing demand for solar energy, the manufacture of solar cells and PV arrays has been increasing by almost fifty percent a year. Technology has also been improving rapidly, decreasing the cost and making the cells smaller and more flexible. For instance, a recent development is a dark blue roof tile made from a high-performance polymer used in car bumpers that has flexible solar technology embedded inside. The tiles are lightweight, unbreakable, and recyclable and are designed to be compatible with clay roof tiles. Additionally, a number of companies are introducing flexible, thin-film solar PV cells and foil modules that can be attached to rooftops.

Although prices vary, for a small scale PV system you would probably pay around twice what you pay for a solar water heating system and the payback period would be approximately fifteen to twenty-five years. Greater cost savings are usually realized through an economy of scale: The larger the solar energy system, the lower the cost of energy delivered for the money invested.

If you are building a new home, or undertaking extensive renovations, you should consider installing passive solar features. If you have ever sat by a sunny, south-facing window on a cold day, you have felt the effects of passive solar energy. Passive solar uses walls, windows, floors, and roofs, in addition to exterior building elements and landscaping, to collect and store heat generated by solar radiation. Although it won't provide all of the space heating necessary in a cold climate, passive solar can significantly lower your bill. Experts claim that using building envelope upgrades alone, passive solar can supply twenty-five percent of a building's heating requirements.

For effective passive solar heating, high performance windows are necessary, including insulated frames, multiple

glazing, low-e coatings, insulating glass spacers, and inert gas fills. The most efficient window orientation for heat gain is due south, but any orientation within thirty degrees of due south will work. To let the sun in, a ratio of roughly eight percent window to floor area is recommended for south walls.

Once the heat is in, R-2000 levels of insulation and an air-tight building envelope help keep it there. With the heat contained, a simple ceiling fan or your furnace fan can distribute the heat. The solar warmth can also be maintained by using thermal mass in the walls and floors to absorb the sun heat and radiate it back into the room in the evening. Common thermal mass materials include stone, cement, and water encased in barrels.

Another feature you might want to consider is a solar (or thermal) chimney. This is a passive solar ventilation system composed of a vertical shaft connecting the interior and exterior of a building. As the chimney warms, the air inside is heated causing an updraft that pulls air through the building.

## Wind Power

Wind power is the renewable energy technology that is growing most quickly, largely because it is one of the least expensive. Like solar, the cost of wind power has fallen dramatically over the last decade or so.

However, most residential wind turbines are installed on towers and few are attached to roofs, and that makes wind power difficult to utilize in urban areas due to physical issues and municipal regulations. Many small wind experts feel that wind turbines do not belong on roofs, but on high towers. They say that there is too much turbulence and inconsistent flow of wind from trees and other buildings at the height of most roofs, and that turbines create too much noise and vibration. Typical

advice is that for proper operation, the rotor of a wind turbine should be situated at least ten meters (thirty-three feet) above anything within one hundred meters (three hundred and twenty-eight feet). If you live in the city, you likely won't be allowed to install a tower of that height in your backyard due to zoning regulations.

Wind turbines don't involve complicated technology. Their blades use lift the same way airplanes do. The wind passes over the blades and the lift created causes them to move. The moving blades turn a shaft, which in turn rotates a series of large electromagnets inside a tightly wound copper wire coil within the generator. The moving magnetic field between the coil and the magnets creates an electric current, which is drawn off and transmitted as electricity.

Wind turbines suitable for residential use come in a variety of sizes and capacities from a three hundred watt (W) mini turbine that a hobbyist homeowner can install him or herself, to a six kW turbine comprising a rotating blade and generator that will produce around fifteen thousand kWh/year. This is enough to power a small office.

There are two main types of wind turbines: vertical axis and horizontal axis. Small wind turbines that have a vertical axis are more suitable for rooftop mounting. They are impacted less by winds that change directions, work at lower wind speeds, can be quieter than horizontal axis units, and can have a more pleasing aesthetic than other models. Some even look like roof vents.

There is a new type of vertical axis rooftop turbine that uses rare earth magnets to suspend the turbine above the base (sometimes referred to as "levitation"). Since the magnets repel each other and never touch, the turbine blades can start turning and generating electricity in wind speeds as low as

three miles per hour. They are also said to work well in higher wind speeds when other turbines may automatically shut down to avoid damage. Their conical or cone-shaped design creates low resistance. The magnets mean there is no wear and tear on ball bearings, and little energy is lost due to friction.

In an altogether different approach, a U.K. company has created what it calls a "ridgeblade" micro wind generation system. It employs discreetly housed cylindrical turbines positioned horizontally along the apex of a sloping roof. The slope of the roof naturally channels wind into the turbine chamber, meaning it can produce electricity under low or variable wind conditions.

Installing a solar or wind system on your home can be a daunting task. You have to figure out the questions to ask, then learn about the technology, find a reputable supplier and installer, meet regulations, obtain the necessary permits – or even rezoning variance – in order to attach the equipment to your roof or install a tower in your yard, and apply for government incentives and rebates, not to mention figure out how to get connected to the grid.

Contacting your neighbors and discussing your plans is also a good idea, especially if they will be able to see or will otherwise be affected by your solar or wind system. You will especially want to be prepared to answer questions regarding common misconceptions about wind power such as bird and bat kills, noise, and vibration because these concerns might cause them to oppose your installation.

Increasingly, friends and neighbors are banding together and cooperating to tackle these hurdles as a group. As well as pooling their knowledge, homeowners who work together can enjoy substantial savings by buying and installing systems in bulk.

## Lighting

No matter what the source of your household electrical power, one easy way to save energy is to switch from incandescent light bulbs to something more efficient. According to the Rocky Mountain Institute, residential, commercial, industrial, and municipal lighting uses twenty-two percent of all the electricity generated. In the U.S. alone, lighting accounts for about thirty-nine million tons of carbon dioxide emissions from electric generating plants.

Incandescent bulbs are actually small heaters that produce a little light on the side, wasting energy and creating pollution. Compact fluorescent light bulbs (CFLs) are one alternative. If you are lucky, you will find compact fluorescents that rival the warm light of traditional bulbs and that do not buzz. But depending upon where you live, the selection can be spotty and not always match your needs.

CFLs are relatively high in cost compared to incandescent bulbs, although the cost is declining as they gain popularity. The quality of light can also be a problem. Incandescent filaments emit the full spectrum of light, but most fluorescent lamps do not. Manufacturers must create a mixture of different phosphors in a CFL in order to approximate the warmth of incandescent light. However, that increases cost, so you might find that the less expensive bulbs emit a colder, more glaring light, which can be inappropriate for some residential uses.

Some people worry about the health effects – including fatigue – of living without the full light spectrum. Full-spectrum CFLs are now available, which mimic natural light and have all the energy-saving benefits of regular CFLs. Of course, they are more expensive than regular CFLs.

Aside from those issues, deciding which CFL bulb to buy can be a bit tricky. Incandescent bulbs are known by how much

power it takes to light them – a 40-watt bulb is on the dim side and uses less power; a 100-watt bulb is bright and uses more energy. Energy-saving CFLs provide much more light per watt. To get a CFL with the right amount of light, choose one that offers the same lumen rating as the light you are replacing. A 450-lumen CFL is said to be equivalent to a 40-watt incandescent. The higher the lumen rating, the greater the light output. Look for a CFL with a wattage of about one-quarter of the incandescent you are replacing. For example, a CFL in the 15-watt range replaces a 60-watt incandescent.

You will also have to get used to the fact that many CFLs do not turn on instantly. Some may appear dim initially, taking thirty seconds or more to reach full brightness. Others can flicker when they are first turned on. These issues have to do with the warming up of the ballast that lights the bulb. Traditionally, fluorescent lamps used magnetic ballasts, but those are replaced with electronic ballasts in the newer models. That removes most of the humming, flickering, and slow starting traditionally associated with fluorescent lighting. That high frequency flicker has been identified as the cause of headaches and eye strain in some individuals.

To be sure that you are buying good quality bulbs, look for the Energy Star logo on the packaging. In addition to meeting other quality requirements, they must turn on instantly, produce no sound, and fall within a warm color range or be otherwise labeled as providing cooler color tones.

One of the supposed benefits of CFLs is their long life in relation to other types of bulbs – around ten thousand hours. That long life is a benefit often used to overcome resistance to the high price. However, when manufacturers of CFLs claim on their packaging that a bulb will last for ten thousand hours, there is almost always a disclaimer that says this life rating is

based on "normal use," which apparently means that the light is on for three to four hours at a time. The electronic ballast employed to start the lamp shortens the life of the bulb every time you turn it on. So installing CFLs in bathrooms or storage closets, where they would typically be turned on and off often, for short periods of time, is not recommended. To get the most energy savings, replace bulbs where lights burn the longest, such as your home office, living room, kitchen, dining room, and porch.

To use a compact fluorescent bulb on a dimmer or three-way switch, you must buy a bulb that is specifically made for that purpose. Otherwise, you will nullify the bulb's warranty. Track lighting, pot lights, and other enclosed or recessed fixtures can also be a problem for CFLs, so make sure you buy the right kind for your purposes. There are a number of reports of bulbs partially melting, smoking, or smelling when used incorrectly.

CFL light output is roughly proportional to phosphor surface area, and high output CFL bulbs are often larger than their incandescent equivalents. This means that the CFL might work fine in the socket, but that the light cover might not fit over it or that there might not be enough space for your fingers to install it. Manufacturers achieve shorter bulbs by bending the tubes into corkscrew shapes, but some people feel those bulbs are ugly and not suitable for use in exposed situations.

For those applications, manufacturers have created CFLs that approximate the look of an incandescent bulb by enclosing the bulb behind a cosmetic glass cover. But this decreases the brightness and efficiency of the lamp.

The industry says that these problems have largely been solved using special mercury compounds and other techniques.

However, that mercury is the main problem with CFLs. The amount varies from brand to brand, but is estimated to be much less than that found in the average watch battery, an amalgam dental filling, or the average thermometer. Nonetheless, mercury is classified as a hazardous substance and CFLs should be treated as household hazardous waste and recycled. Some municipalities, manufacturers, and retailers have established recycling programs. As the popularity of the bulbs increases, more of them are being thrown into the garbage, either through carelessness, lack of recycling options, or lack of knowledge about the danger. They end up broken in landfills and emitting vaporous methyl mercury, which can get into the food chain more easily than the mercury removed during the recycling process.

If a CFL breaks, try not to inhale the remains, and keep children away from the scene. Carefully sweep up the broken pieces (rather than vacuuming). Put the broken pieces in a plastic bag and wipe down the area where the pieces fell with a damp towel. Then throw the towel in the bag and dispose of the bag as hazardous waste. Yes, that does seem like a hassle just for disposing of a light bulb!

Fortunately, there are mercury-free alternatives. A halogen lamp is an incandescent lamp that uses a tungsten filament and has gases from the halogen family, such as iodine, sealed inside. It has similar light output to a regular incandescent while using up to forty percent less power. Although halogen lamps are more expensive, they last two to four times longer than conventional incandescent bulbs. Unfortunately, they operate at very high temperatures and, in some instances, can pose a fire hazard. Halogen torchiere floor lamps are actually so dangerous they are banned in some areas due to their tendency to tip and start fires. Due to their heat, halogen lamps are

not suited for use in areas where young children could touch them. And they can shatter into pieces of hot glass if they get wet while in use.

Parabolic aluminized reflector (PAR) lamps, typically used as spotlights or floodlights inside or outside homes, are also available with halogen technology. A standard 150-watt incandescent spotlight can be replaced with a lower wattage halogen lamp, reducing electricity consumption by up to forty percent.

However, the best alternative to incandescent bulbs is the light-emitting diode (LED.) LEDs are commonly used in electronics, flashlights, headlamps for hiking, and Christmas decorations, but their use as household lighting is not yet widespread, possibly due to the high price. They are far superior to CFLs because they do not contain mercury, and better than halogens because they burn cool and aren't fragile. They last up to ten times longer than CFLs. They are also highly directional, which means that they only put the light where you aim it. And they turn on instantly.

LEDs for household use can be hard to find in stores, but are available on the Internet at prices in the range where CFLs were not that long ago. As demand increases, the prices are going down, and availability and selection increasing. One of the reasons LEDs have been slow to catch on is their low light output. But now designers have figured out how to group LEDs together to get brighter output and are using them to make highly efficient headlights, streetlights, traffic signals, and even light bulbs for standard fixtures. Another problem with the early LED bulbs has been their hard, white light. But again, consumer demand is sure to improve that situation.

The best way to handle the lighting dilemma in your green and healthy home is to maximize the use of natural light and

turn lights off when they're not needed. Just doing that can save sixteen hundred tons of carbon and a few hundred dollars a year.

## Small is Beautiful

If you're thinking of raising your home's roof or adding on a few rooms, please think twice. Do you really need extra space, or can you reorganize, repurpose, or downsize your possessions in order to fit more happily into your existing space? Big houses are resource-hungry. And, according to many experts, one of the best ways to reduce a house's energy consumption is by decreasing its size.

In most of the world, micro-homes are the norm because land is scare and expensive, and extended families are used to sharing their lives, living spaces, and other resources. But compact dwellings are becoming more popular elsewhere, where increasing numbers of people are developing a new appreciation for smaller living spaces with tiny footprints. This downshifting trend has people "right-sizing" their living spaces, and redirecting financial resources away from big mortgages and high energy consumption.

Writing in the *Journal of Industrial Ecology* in 2005, the editors of *Environmental Building News* Jessica Boehland and Alex Wilson noted that a small house built to only moderate energy performance standards uses substantially less energy for heating and cooling than a large house built to very high energy performance standards. They also point out that as house size increases, more land is occupied, increased impermeable surfaces result in more storm-water runoff, and construction resource use increases.

Aside from saving resources, there are other ecological advantages to living in a small space. An obvious one is the

need to own fewer possessions and therefore to consume less. Another advantage is that if you are renovating or decorating a small living space, the reduced size might mean you can afford to use a greater volume of high quality, healthy, natural materials.

Other advantages? Since small houses require good design and efficient use of space (think boat galley or travel trailer), many people find that they have just as much livable space in a small house as they did in one with many more square feet and lots of wasted space. And I would be remiss if I didn't mention that a small living space takes much less time, effort, and materials to clean!

But how, then, to accommodate that home office, craft studio, or extra bedroom for a growing family or elderly parent? Sarah Susanka, an architect and author of *The Not So Big House: A Blueprint for the Way We Really Live*, advocates small houses in order to create sanctuaries that simplify our lives rather than taxing our energies in maintaining them. And to accomplish that, she suggests making rooms do double duty. She points out that many people live in houses with formal living rooms and dining rooms, yet these rooms are rarely used. So instead of adding specialty rooms for exercise or television watching, which are only occasionally used, she suggests that we organize our living space relative to whether it is used for public or private purposes. Her "Not So Big" strategies include lowering ceiling height in part of a larger room to create a cozy reading spot or using controlled lighting to set the ambiance for different occasions (for example, making an eat-in kitchen into a dramatic dining area one night or a brightly lit office the next day.) That will free-up rooms for other purposes.

Unfortunately, adding on may be easier than building a very small new space, at least when it comes to municipal

zoning bylaws and mortgage lenders. In many municipalities, homes under a certain size are prohibited. Lenders and realtors thinking about resale value are often wary about what they consider to be too-small spaces.

Fortunately, times are changing. Issues like the need for affordable housing and the scourge of ugly "McMansions" have led some cities to encourage smaller homes through the use of zoning and design.

There are many wonderful older houses around that were built in the era of smaller homes – say, between 1945 and 1975. They are usually less expensive that their larger suburban cousins, often accessible to stores by transit or walking, and just waiting to be fixed up and loved by someone who understands that small can be beautiful.

So, to summarize, the key to making a building green is to view the entire structure as a system. While it may seem like every little environmentally friendly upgrade would be a good thing, it is also true that every aspect of your home can positively or negatively affect the other areas. For example, sealing cracks and adding insulation affects how your heating system functions and can negatively impact indoor air quality or create mold growth. That is why it is important to think through your needs and budget, and draft a long-term plan for your renovations. And don't forget to check with your municipal, provincial/state, and federal government sources to see if there are tax credits, rebates, or grants available for energy efficient retrofitting of your home.

# Chapter 7
# Avoiding Radiation

There are health and environmental problems lurking in our homes that – because they're invisible and don't smell – are often ignored. Two worrisome ones are radon and electromagnetic radiation.

## Radon

As its name might suggest, radon is a radioactive gas resulting from the natural breakdown of uranium. It is colorless and odorless, and can seep into your house from the surrounding soil and rock on which the house is built. It enters through dirt floors, gaps in suspended floors and around pipes, cracks in concrete walls, sump pumps, joints, basement drains, the furnace base, and jack posts if the base is submerged in the floor.

If you live in an area where the soil and rocks contain uranium, granite, shale, or phosphate, you'll likely find radon. It may also be found in soils contaminated with certain types of industrial waste such as the by-products of uranium or phosphate mining. In fact, at one time, some houses were built using the sand-like uranium tailings (pulverized rock) as construction material. As a result, some houses contain levels of radon even higher than those found in uranium mines.

As radon decays, it produces something called "radon daughters." Two of these – polonium-218 and polonium-214 –

decay rapidly themselves, and emit alpha particles. When alpha particles interact with an object, the energy in them is absorbed by the surface of the object.

Human skin is thick enough not to be affected, but if you breathe in alpha particles, they can be absorbed by and damage bronchial and lung tissue. When lung cells are damaged, they have the potential to result in cancer when they reproduce. Until recently, research into the dangers of radon exposure was focused on uranium miners. But two independent scientific studies in Europe and North America have shown that lung cancer risks extend to levels that are found in some homes.

In confined spaces like a house basement (or a uranium mine), radon can accumulate and be dangerous. A non- smoker exposed to elevated levels of radon over a lifetime has a one in twenty chance of developing lung cancer. That estimate increases to a one in three chance if a smoker is also exposed to elevated levels of radon over a lifetime.

The 2008/2009 report *Reducing Environmental Cancer Risk: What We Can Do Now* by U.S. President Obama's Cancer Panel has some of the most strongly-worded recommendations ever in regard to radon exposure. It notes that the cancer risk attributable to residential radon exposure has been underestimated but is clearly demonstrated, and urges government to better address the risk. According to the report, radon is the second leading cause of lung cancer in the U.S. and the leading cause of lung cancer among people who have never smoked.

R. William Field, a University of Iowa professor of occupational and environmental health and epidemiology, says, "Radon is likely our leading environmental cause of cancer mortality in the United States." During the past fifty years, over a million people have died nationwide from radon-related lung cancer.

In 2008, Field testified before the President's Cancer Panel regarding environmental factors in cancer. At that meeting, he discussed ever-increasing exposure to radon due to new homes being built without radon-resistant features faster than existing houses are mitigated to reduce radon.

The Canadian government is also concerned about residential levels of radon. It estimates that in 2006 close to two thousand lung cancer deaths in Canada were due to radon exposure. As part of its National Radon Program, Health Canada is currently conducting a multi-year residential radon survey in an effort to gain a better understanding of radon concentrations in houses across Canada. Thousands of houses will be tested and many more residents will complete phone surveys.

Predicting the level of radon in a building is difficult. Testing is the only way to be sure if the gas is present in your home. Experts recommend that homeowners periodically check their homes for radon levels and that homebuyers conduct a radon test in any home they are considering buying. You can either hire a company to do the testing or do it yourself. The typical cost for a test is between fifty and one hundred dollars, according to the Lung Association. Radon detectors are available at hardware stores, building supply centers, and online, and through some health departments.

The detector is exposed to the air in a house for an indicated period of time. (Some kits suggest a few days but the preferable term is several months.) If possible, testing should be conducted with the doors and windows closed, during the cooler months. The test kit should be placed in the lowest lived-in level of the house, and away from drafts, high heat, high humidity, and exterior walls. After testing is completed, the home test kit is returned to the manufacturer for laboratory analysis.

The concentration of radon in the air can be measured in two different ways. The international community uses the Becquerel per cubic meter method of air measurement, while the U.S. uses picocuries per liter. One pCi/L is equivalent to thirty-seven $Bq/m^3$.

In 2009, the World Health Organization set its recommended radon reference level to one hundred $Bq/m^3$ for residential structures, with an upper limit that should not exceed three hundred $Bq/m^3$. Canada's guideline for maximum exposure to radon in indoor air is two hundred $Bq/m^3$ (updated in 2007 from eight hundred). The reference level in the USA is four pCi/L or approximately one hundred and fifty $Bq/m^3$. Reference levels for individual countries in the EU range from two hundred to four hundred $Bq/m^3$.

If testing indicates that high levels of radon are present in your home, you should act quickly to reduce the levels. According to the EPA, high levels of radon can be solved at a price comparable to having a hot water heater installed or the house painted. A trained contractor with experience in radon mitigation can examine your house, locate the source of radon, and make repairs.

There currently is no certification program in Canada for radon mitigation contractors, although Health Canada is developing one. In the U.S., certification programs are offered through the National Environmental Health Association and the National Radon Safety Board. Canadian contractors who have undergone that training are recognized by Health Canada.

Renovations to basement floors, particularly dirt ones, sealing cracks and openings, and sub-floor ventilation can prevent radon from entering. Two coats of paint followed by a sealant are recommended for cement basement floors and foundation walls. Levels of radon three feet below the ground

level can be a few hundred percent higher than the levels inside a basement, so it is important to ensure that all cracks are filled.

Soil depressurization ventilates the soil surrounding the house so that radon is drawn away before it can enter. This system can be installed in an existing house and is increasingly being put in place during construction of new houses.

Increasing the ventilation within your home will also help lower the levels of radon. (See Chapter 4.)

## Electromagnetic Radiation

In this high-tech information age, many of us are living in an electronic smog that can make some people ill with symptoms such as nausea, headaches, asthma, chronic fatigue, chronic pain, tinnitus, brain fog, restless sleep, and rashes. The illness is sometimes called electrohypersensitivity or EHS.

The cause is thought to be low frequency radio waves that are generated by equipment like cell phones, cordless phones, wireless Internet connections (wi-fi), baby monitors, televisions, dimmer switches, computer monitors, fluorescent light bulbs, halogen lights, radios, microwave ovens, electrical transformers, and high tension wires. And the physical complaints that are increasingly being attributed to these electromagnetic fields (EMF) may be just the tip of the iceberg, since new research indicates that exposure to EMF may cause damage at the cellular level.

There is much puzzling and sometimes conflicting research on this topic; there are studies that corporations can use to placate people's fears, as well as studies that could turn us all into Luddites. For instance, one study on hands-free mobile (cell) phones (i.e. those with a wired ear attachment) funded by the U.K. government contradicts another study by the Consumers Association, which found that the hands-free style

tripled the radiation going into the user's brain; the government study found that hands-free cell phones cut radiation by up to eighty percent!

As far back as the pre-wi-fi and cell phone 1950s, it was found that relocating asthmatics to areas of low electrical fields eliminated their symptoms. But it took until 1998 for an international panel of researchers meeting in Vienna, Austria – including a professor from Queens University in Canada and a representative from the U.S. EPA – to agree that the biological effects from low-intensity exposures to EMF are well-established.

In 2004, the European Union's EMF Reflex Research Project – an in vitro study – was released, showing that EMF radiation can damage DNA in human cells. The report also cautioned about the health risks of exposure to cell phone antennas or towers (referred to as "base stations").

In 2006, the International Commission for Electromagnetic Safety (ICEMS) released a six hundred and fifty-page report citing more than two thousand studies (many very recent) emphasizing that the accumulated evidence points to "adverse health effects from occupational and public exposures to electric, magnetic, and EMF at current exposure levels." In June of 2008, the group reiterated, in stronger terms than in 2006, its warnings about the negative effects of electromagnetic radiation in its *Venice Resolution*.

By then, the European Environment Agency (EEA) had called for immediate action to reduce exposure to radiation from wi-fi, as well as cell phones and their transmission towers. It suggested that delay could lead to a health crisis similar to those caused by asbestos, smoking, and leaded gasoline. The warning followed an international scientific review which concluded that safety limits set for EMF radiation are "thousands

of times too lenient." That review, produced by the international BioInitiative Working Group of leading scientists and public health and policy experts, said the "explosion of new sources has created unprecedented levels of artificial electromagnetic fields that now cover all but remote areas of the habitable space on Earth,"causing long-term and cumulative exposure to "massively increased" radiation that "has no precedent in human history."

A study published in the journal *Atmospheric Environment* in August of 2007 describes how electrical fields from computers, cell phones, wi-fi systems, and everyday household devices can give people asthma, influenza, and other respiratory diseases. A team of scientists at Imperial College London's Centre for Environmental Policy found that electrical fields can charge minute particles in the air such as viruses, allergens, bacteria, and other toxic particles. The problem is that the charged particles are less than eighty times the thickness of human hair, so they are small, light, and always airborne, which means they constantly are being inhaled. Once the particles are electrically charged, they will stick to the tissue of the lungs and respiratory tract when they are inhaled. The greater the electrical field, the greater the charge on the particles, which increases the speed at which they strike the tissue, causing them to deform and embed in the tissue more firmly. Once embedded in the tissue, they can cause infection and other health problems.

Cell phone signals utilize pulsed electromagnetic fields, which can greatly exceed the strength of other EMFs like those from television and radio signals. Because of that, and the fact that cell phones are used in closer proximity to the body, there has been a lot of research conducted into their safety. And the result of much of that research isn't pretty, with a few studies

linking cell phone usage and cancer. One study, published in 2006 in the *International Archives of Occupational and Environmental Health*, found a significant increase in the risk for malignant brain tumors for subjects with first use of both cellular and cordless phones at less than twenty years of age.

Another study of twelve thousand mobile phone users in Sweden and Norway found "a statistically significant association between calling time/number of calls per day and the prevalence of warmth behind/around or on the ear, headaches, and fatigue." The mobile phone users studied used their phone less than two minutes or two calls per day. The researchers also found dose/response relationships with concentration, memory loss, fatigue, and headache for people who used the phones for over one hour per day total.

The impact of other sources of EMF on human health hasn't been as well studied. Nevertheless, there is concern. The president of Lakehead University in Thunder Bay, Ontario has banned wi-fi on campus, likening it to second-hand smoke. And Toronto's public health department has questioned plans to install a citywide wireless network.

They are impossible to avoid unless you move away from them, but high voltage power lines are another controversial source of EMR that have been around much longer than wi-fi. A study published in 1979 in the *American Journal of Epidemiology* by Nancy Wertheimer and Ed Leeper reported an increased incidence of childhood leukemia, lymphomas, and nervous system tumors for children exposed to very high electromagnetic fields, which related to the distance they lived from power lines, and the thickness and number of conductors distributing electricity.

More recently, a large, publicly-funded study in the U.K. found that children under the age of fifteen living within one

hundred meters (one hundred and nine yards) of high-voltage power lines have nearly twice the risk of developing leukemia. This Oxford Childhood Cancer Research Group study involved thirty-three years of data on thirty-five thousand children diagnosed with cancer.

Magda Havas, an environmental science professor at Trent University in Peterborough, Ontario, has worked with citizens concerned about high voltage transmission. In her research, she has found that symptoms of MS, diabetes, and other illnesses improve when capacitors are used to filter the radiation from the electrical wiring in their homes. Since 1995, Havas has been teaching a unique course on the biological effects of electromagnetic fields at Trent's Centre for Health Studies and has recently publicly warned against exposing children to wi-fi in schools.

In spite of all this research and scholarly activity, some people insist that the science is uncertain, and many physicians say EHS is psychological. But we must remember that the dangers of tobacco usage and second-hand smoke, not to mention the problem of global warming, have their share of naysayers. And many of them are funded by the industries whose profits are threatened by suggestions of problems with their products.

The German government is already advising its citizens to use wired Internet connections instead of wi-fi, and landlines instead of cell phones. In 2005, Canada's top public health official, Dr. David Butler-Jones, advised Canadians to limit their and their children's use of cell phones until science resolves uncertainties about long-term health effects. Also in 2005, the U.K.'s National Radiation Protection Board issued a warning that no child under age eight should use a cell phone, citing the growing scientific evidence that exposure poses a health risk. France, Germany, and England have dismantled wireless net-

works in schools and public libraries, and other countries are considering the same.

In September 2009, the Director of the European Environment Agency stated that the evidence for potential risks is now strong enough to justify steps to reduce people's exposure to radio frequency electromagnetic fields and that the current exposure limits needed to be reconsidered.

Until there is scientific consensus (which, due to competing interests, may be a long time coming), I agree with many scientists world-wide who urge the use of the Precautionary Principle: If there seems to be a possibility of harm, limit your exposure. That may mean something as simple as moving an electric clock a few feet away from your bedside table, or as complicated as rethinking your cell phone and wireless Internet usage or where you live in relation to high tension power transmission lines.

# Chapter 8
# Putting It All Together

Each one of us has the power to make a difference. In addition to the changes we make in our homes, small changes to our daily routines can help to keep our families healthy and to mitigate global warming. However, at the same time as we individuals are doing our part, government and industry also have to jump onto the bandwagon and help create massive change in areas like emissions reductions, switching to renewable energy, product regulation, and so on.

Meanwhile, many of the green and healthy choices suggested in this book will save you money and stress and, believe it or not, won't make you miserable. British sailor, carpenter, and green living pioneer Mukti Mitchell, sailed around Britain in 2007 in his hand-built, zero-emission fifteen-foot boat to promote low carbon lifestyles. Endorsed by Britain's leading politicians and environmentalists, he says that "low carbon living is easy and fun, good for the planet, and improves your quality of life."

Any activity that creates carbon dioxide contributes to climate change and less healthy living conditions. That would include driving cars, flying planes, heating our homes with fossil fuels, generating electricity, as well as manufacturing and transporting goods. So, in addition to the topics discussed in this book, I encourage you to get work by walking, biking, or sharing a ride (or working at home); to spend your vacation

close to home, or take the train rather than a plane; to buy local products and eat locally grown food; to make your own gifts; to buy only what you need; to recycle; and so on – all things that we write about in *Natural Life Magazine.*

A web search will direct you to a variety of online carbon emissions calculators designed to help you figure out your starting level of personal carbon emissions and to set a goal for reducing them. Many of them suggest a target of a three to five percent reduction per year, which is relatively easy to achieve. Mukti Mitchell says a seventy-five percent reduction is quite possible over a period of ten years. All the little things add up!

You might, at this point, be wondering about purchasing carbon offsets to minimize your carbon emissions. An offset is a certificate representing the reduction of one metric ton of carbon dioxide emissions. Selling these certificates is a way for companies or non-profits to finance carbon reduction efforts like large renewable energy projects or tree planting. Typically, a broker collects and merges the credits from individual projects and resells them.

But remember that carbon offsetting is not a substitute for reducing one's carbon footprint. It merely reduces or negates the impact of greenhouse gas polluting activities by avoiding an equal amount of pollution. You should be wary of purchasing offsets that fund tree planting operations. Most tree planting projects are sold on a front-loaded basis. That means you are buying an offset based on an estimate of the reductions that could be achieved over the next forty or one hundred years as those trees mature. So if you buy a tree-based offset today, you are sponsoring a reduction that won't be complete for about forty years, since trees grow slowly and don't sequester much carbon until they're mature – if they even survive that long. So to be at all effective, your offset purchase this year should

reconcile with your energy usage this year. That means you should contribute to something permanent and in the present, as well as something that will immediately reduce the amount of carbon dioxide in the atmosphere, such as a large scale solar or wind power project, for instance.

Reducing our dependence on fossil fuels will take time, so carbon offsets can be seen as a useful interim measure. And given the law of supply and demand, the more we invest in renewable energy technologies, the lower their price will become and the more popular they will be. So if you decide to offset some of your carbon emissions, be sure to investigate thoroughly. And don't do it to avoid the more difficult lifestyle and housing changes that are required if we are to solve the climate change problem.

As we have seen throughout this book, all the choices we make in life have an impact on our health and on the environment, whether direct or indirect. So living a healthy, green lifestyle is not about denial but about improving life for ourselves, our families, and the planet.

Slowing down to a walk avoids those frustrating traffic jams. Kneeling in our gardens to produce our own food is healthy and reduces stress. Using natural materials in our homes and on our bodies is more sensual. Less time spent shopping means more time to spend with people we care about.

I hope this book has both prompted you to make some green and healthy changes in your home and your lifestyle, and has given you some tools for doing so. And I invite you to get more information by subscribing to *Natural Life Magazine's* print or digital editions, and visiting its website at www.NaturalLifeMagazine.com.

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# About the Author

Wendy Priesnitz is the editor of *Natural Life Magazine.* She is also the author of nine books, an award winning journalist, a blogger, and a poet. She has been happily married to the same man for over forty years and is the mother of two adult daughters.

Wendy is an agent of change who, when she was barely out of her teens, recognized the need for rethinking how we work, play, and educate ourselves in order to restore the planet's social and ecological balance. Her work is rooted in her experience of motherhood, which taught her about the emotional, social, cultural, economic, educational, and environmental responsibilities involved with bringing a child into this world. For the last forty years, her mission has been to help people understand the interconnections within the web of life on Earth, and to encourage the challenging of the assumptions inherent in the often conflicting choices we make in our daily lives.

In her quest to inspire, support, and live grassroots change, she has been at the leading edge (and ahead, in some cases) of many progressive trends and movements. She is recognized as a pioneer in unschooling, environmentally sustainable business practices, and women-owned home-based business. She heads up Life Media, the company she co-founded with her husband Rolf in 1976 to publish books and *Natural Life Magazine*. Among her many other activities, she found time for a successful run for the leadership of the Green Party of Canada in the mid 1990s.

# About This Book and its Publisher

Life Media is an independently-owned, environmentally conscious and progressive multimedia information publishing company, launched in 1976 and still owned and operated by its founding family. Our books, *Natural Life Magazine*, *Life Learning Magazine*, and our various websites provide information and inspiration about how we live...in our families, in our homes, in our communities, and on our planet.

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**This book is based on Natural Life Magazine's popular Ask Natural Life column. Natural Life is the original natural family living magazine, founded in 1976. Its print and digital editions are reader-supported and trusted by thinking people around the world who want positive, sustainable alternatives to high cost, high consumption lifestyles for themselves and their families. Visit us at www.NaturalLifeMagazine.com.**

**About the Author:** Wendy Priesnitz is the editor of Natural Life Magazine, which she co-founded with her husband Rolf. She is an award-winning journalist, a former broadcaster and author who has written nine other books. She and Rolf have two grown daughters and her work is rooted in her experience of motherhood, which turned her into an agent of change who recognizes the need for rethinking how we work, play and educate ourselves in order to restore the planet's social and ecological balance. For the last forty years, her mission has been to help people understand the interconnections within the web of life on earth and to encourage them to challenge the assumptions inherent in the often conflicting choices we make in our daily lives.

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