ENVIRO DECISIONS

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Inside this Issue

There will be no GREENSTARS AWARDS in this issue of ENVIRODECISIONS. Space is limited because of the length of our feature articles. The Editor apologizes. Also, we are seeking new nominees for these awards from our readership. We encourage you to take the time to make some recommendations for consideration.

Thanks, The Staff

Something New at ED !!

Those of you who've been reading ***ENVIRODECISIONS*** over the last few months will notice a change starting with the next issue. We will have a brand new sponsoring organization! We are pleased to announce that the Society for Environmental Education (SEE), the parent organization responsible for the conception and publication of ***ENVIRODECISIONS,*** has merged with The Audubon Institute, another New Orleans based, not-for-profit organization. The Institute's mission to cultivate awareness and appreciation of life and the interdependence of all living things and to help conserve and enrich our natural and human-made world through conservation, education, research, leadership, and recreation enhances SEE's own environmental education mission. We are excited about our new association and the expanded opportunities it offers us.

The Audubon Institute operates several world class, environmental and recreational facilities in the greater New Orleans area including the nationally-renowned Audubon Zoological Gardens, the Aquarium of the Americas, the Freeport-McMoRan Audubon Species Survival Center, and Woldenberg Riverfront Park. Currently under construction is the Audubon Center for Research on Endangered Species (ACRES).

As SEE merges, its primary facility, the Louisiana Nature & Science Center, with a 15 year history of expansive environmental education programs, will prosper as the newest member of The Audubon Institute and will enhance those programs already existing at the Institute's other facilities. Dr. Robert Thomas, formerly the Society's CEO, is Vice President for Environmental Policy for the Institute. Bob Marye, former Director of Exhibits at SEE has assumed the role of Acting Director for the Louisiana Nature and Science Center .

As for ***ENVIRODECISIONS***, we are eagerly looking forward to expanding its scope. *Come see us!*

The Editor

The **ENVIRODECISIONS** newsletter is published quarterly, on recycled paper, by the Society for Environmental Education. The editor encourages letters, recommendations for topical issues, and submissions of articles containing balanced environmental information and issues affecting citizen education, or about curriculum aid suggestions. For more information, contact the newsletter editor at the address below.

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Editor's Corner

We are faced with making many kinds of decisions in our day to day lives: Rapid decisions for immediate action — what to wear, who to see; contemplative decisions for measured action — how to ask for a raise, where to go on vacation; and reflective decisions for long-term action — who to marry, how many children to have. Understandably, some decisions are easier to reach than others. The decisions we make for environmental action also span these three action categories: immediate — where to throw our chewing gum wrapper, measured — how to dispose of used motor oil, and long-term — which environmental policies to support. This sounds simple enough, but making decisions about which we feel comfortable, especially reflective decisions for long-term action, is not always easy. There may be no clear guidelines or standards of behavior upon which to base our decisions; we may not have the proper, or even enough, information; we may encounter unclear or conflicting data which confuses rather than informs us. Environmental decisions are among those which are the most difficult to make because the issues surrounding them are often complex, ill-defined, incomplete, or swept-up in hype. Yet we are faced with making such decisions all the time.

Let me give you an example: this year legislators are will be reauthorizing some of our nation's foundational environmental policies, such as the Endangered Species Act, the Clean Water Act, and the Coastal Zone Management Act. Some support amendments to weaken environmental legislation in favor of private or quasi-public concerns, while others move to strengthen the legislation in consideration of habitat protection. Some would like to see these policies repealed altogether. Lines are drawn; allegiances sworn; amendments sponsored; money committed; points of view endorsed. There are strong supporters and opponents all around; each with seemingly valid data to support their arguments. We will need to decide how we want our environmental vote cast. But how do we outside the Beltway make informed, reflective decisions for long-term, rational action? Are we left feeling more confused than enlightened? Upon what do we base our decisions? Personal intuition? Academic scientific research? Corporate scientific research? Family or cultural values? Religious faith? A combination of any or all of these? The point is, there is no easy way to answer this, except to suggest that investigating the many points of view, which may agree or disagree with one another, is one of the only ways to be informed enough to make the best decision. In other words, since there may be no "right" decision, the "best" decision is one which is not immutable and which is informed by science and framed by a cultural context. The best decision may be the right decision for it's time.

To this end, I hope by engaging in difficult, often emotionally-charged issues, this publication, will help to alleviate some of the hype while presenting different points of view — Points of view which are informing not only legislative debates, but which also need to inform us, our decisions, and our environmental actions. Investigating disparate views often means embracing uncomfortable issues. Is this easy? No. Is this necessary? I would suggest that it is.

Lida

The Homeowner's Guide to Integrated Pest Management

by Bob Thomas

Integrated Pest Management (IPM) is a simple concept: when confronting a pest problem, one develops a plan of steps designed to manage the pest, ranging from doing nothing, to cleaning, to using non-toxic procedures, and, as a last effort, to use pesticides. The most crucial research for implementing an IPM program is to ***know your pest***. Let me use my home roach control system as an example.

The two main roaches we have in New Orleans are the American and German cockroaches. The latter live outside and occasionally come inside looking for a meal. They are large and drive my wife and daughters crazy. Since they don't inhabit my house, and we only see one or so a day, I either ignore them or (if my girls are around) capture them and throw them outside. They are important in composting the organic matter I pitch into my flower beds.

German cockroaches are a different matter. They live in my house, produce potentially tens of thousands of offspring per year, infest my food, and have the potential to carry diseases. Since they eat my food and scraps, the first thing I should do is keep my kitchen spotless and my in-house garbage can tightly sealed and clean. This seems to be impossible. I have failed if I leave a few small crumbs on the counter or a film of grease or kool-aid on the counter. For IPM, I do my best.

My rule-of-thumb is to ignore the German cockroaches unless I see several on several successive nights when I turn on the kitchen lights or open cabinets, or if I see them in any other parts of the house. If this happens, then I take my first active step. I do a thorough cleaning, especially under my sink. Next I clean all cabinets and kill all roaches found (I smash them or use a pyrethrum spray). I then dust under my cabinets with boric acid, and I add a fine layer in the rear of each. I also use bagon granules. If the problem persists for two more weeks, then I spray with a carbamate compound (such as Ficam). I have always been successful at this step. If I ever fail here, I will call a pest control operator and have a single application of an "acceptable" organophosphate such as a dursban/diazinon combination (the standard used in the industry). The only thing left is thermonuclear!

The key to IPM is that I manage a system that may eventually result in the use of pesticides. Even then, I use less toxic forms first, and am not against using the most toxic if convinced that I must.

Naturalists should also know the entire local critter community in order to avoid mistakes. Keep spiders around. In our neighborhood, Mediterranean geckos are great roach eaters. Do not remove wasp nests (unless they are very near where you move about), since they are exceptional insect predators, especially on caterpillars. My neighbor religiously removes paper wasp nests, and sprays his vegetation to kill caterpillars. I tolerate wasps and never spray. Hmmm?!? Also, its best to remove mud-dauber nests. These critters spend their days capturing spiders to feed their young. Keep the mud-daubers, you'll lose your spiders, and soon you'll spray!

In our neck of the woods, fire ants are a real pest. Everyone wants to eliminate them. The deep South has generally escaped the scourge of lime disease. It has recently be found that the main reason might be that our fire ants love to eat ticks (and fleas).

A key to using IPM is to develop tolerances to the critters around us. The more we learn about them, the more we tolerate. My family now loves to watch jumping spiders and geckos. We tolerate fire ants when they live away from our normal paths. Wasps are okay if not near a door. Roaches? *Not yet!* Being a good environmentalist is easier if you're a good naturalist! ⚖

Hierarchy of pest control products in Descending order of potency

Chlorinated Hydrocarbons: These are the bad-guys that seem to persist forever and become tied up in fatty tissue (DDT, dieldren).

Organophosphates: These are commonly used by pest control operators and are in most insect sprays. They are long enough lasting to continue to kill pests for weeks after the spray, and they break down in living systems. However, they are very toxic to most living things, including humans (dursban, diazinon).

Carbamates: These are widely used and are lethal to arthropod pests, but break down quickly and do not persist (sevin dust, ficam, bagon).

Fumigants: These keep pests away (napthalene, paradichlorobenzene/PDB).

Botanicals: These are natural plant derivatives and, though immediately toxic, are very short-lived (pyrethrins—from chrysanthemums, rotenone, nicotene)

Synthetic pyrethroids: Human-made products based on natural pyrethrin models.

Inorganics: These are inorganically derived and may kill by poisoning (boric acid) or by dehydrating (silica, diatomaceous earth).

Insect growth regulators (IGRs): These chemicals interfere with the development of a pest, such as keeping it from metamorphosing into an adult (methoprene, dimilin).

Biologicals: These are living critters who consume pests (mosquito fish, copepods, fungi) or poison them (Bacillus thuringiensis/Bt).

Miscellaneous: Odds and ends, such as using stale beer to kill slugs.

Smashing: This is biologically the best—either stomping or swatting that pesky intruder! Or catch it and let it go outside, if it's a good guy.

Population: a *Tough* Issue

The Earth's resources are not inexhaustible.
Numbers of people do make a difference.
There is no guarantee that Earth's finite resources can be technologically manipulated or externally supplemented. Lynton Caldwell

by Lida Ochsner Durant

According to Peter Berle (1991), President of the National Audubon Society, "There is no issue of importance to the environmental community that is not affected by increasing numbers of people . Unless we can limit population growth," he says "we cannot achieve ecological stability." Russell E. Train (1991) of the World Wildlife Fund agrees, "Achieving and maintaining a sustainable relationship between human populations and the natural resource base of the earth is the single most critical long-term issue facing the peoples of the world."

Human beings interact with the environment in three main ways: We use it as a space for living; as a bank of resources; and as a sink for wastes. Our needs for food, water, wood, shelter, fuel, and sewage treatment have a significant environmental impact, and this impact increases as population increases. This is certainly not to say that population numbers alone are responsible for all environmental woes. Other factors (excessive consumption, unnecessary waste, short-sighted management, and ignorance about the ecological costs of new technologies) have also played an important role in these problems. But, it seems safe to say, at whatever standard of living, today's five billion people have a greater impact on the earth's environment than five million people. What are we to do about these impacts?

SIGNS OF TROUBLE Many of us remember when environmental alarms were sounded in the 1960's. We learned words like ecology and eutrophication and strontium 90. We feared that natural systems were being stressed to the breaking point: oceans were being polluted by oil spills and radioactive wastes; air and soil were being poisoned by chemicals with names too long to pronounce; rivers were becoming lifeless sewers as we dumped ever-greater amounts of sludge into them; Lake Erie was pronounced dead. Not only at home but in the tropical latitudes as well, grasslands and forests were being turned into deserts; streams were choked with silt from erosion as development advanced on every front; and the regenerative capabilities of natural environments was increasingly over-stressed by both commercial enterprise and the growing number of rural poor (Caldwell 1985). Then as now, the link between environmental degradation and numbers of people seemed irrefutable.

"The power of population is indefinitely greater than the power in the earth to produce subsistence." *Thomas Malthus*

When gloomy projections about worldwide famine, degradation of natural resources, lack of arable land, soil erosion, depletion of oil reserves, and the worldwide collapse of ecosystems failed to materialize, doubts emerged about the scientific validity of the link between population numbers and environmental calamity. When the next decade brought environmental improvements (water quality improved, soil erosion slowed) the wisdom and effectiveness of billion-dollar population control efforts were questioned (Mann 1993). Some felt such efforts were bureaucratic intrusions or veiled grabs for power; others that environmental problems should be left to market forces to correct. Only one fact emerged—experts disagreed both about consequences and solutions of the growing global population and about its effect on the environment.

"The year Lake Erie was proclaimed dead, it produced nearly 40 million pounds of commercial landings, in Canadian waters alone. Although damaged by pollution, it has been cleaned up and is now a thing of beauty." *James A. Miller*

The debate surrounding the suspected negative consequences of unbridled population growth is not a recent phenomenon. In 1798 the British economist, Thomas Malthus expressed concern for the difficulty of expanding food output sufficiently to keep up with rising numbers of people. His theory predicted that, since populations tend to increase faster (exponentially) than their food supply (arithmetically), there would inevitably be disastrous results (famine) unless the increase in population was checked. Since its publication, the Malthusian model has been widely ridiculed. The criticisms of his model rest primarily on its failure to anticipate the technological advances which allowed food production to outstrip increases in population. Many ecologists have subsequently argued that this failure doesn't deny the importance of the underlying assumption. The geometry of population growth means that even as the rate of growth slows down, the actual number of people being added to the existing population will remain high for decades. The doubling of our 5.5 billion population will be of far greater significance in terms of energy, resource consumption, and stress on the environment than any previous doubling of the worldwide population (Fox and Mehlman 1992).

On some level we are all aware that the global population can't continue to grow indefinitely. We are all aware that we do not want to live in population densities rivaling those of Bangladesh, Rio de Janeiro, Mexico City, or Calcutta. And we don't want these densities because of the conditions they create: misery, disease, poverty, conflict, slums, filth, pollution, aggression, crime, exploitation, violence. Whether we agree or disagree with the methods of birth control, there is a recognition that numbers of people cannot continue to increase indefinitely.

Traditional crops are abandoned for commercial varieties for export. To meet food needs, people are pushed into marginal lands to grow subsistence crops leaving the better lands for commercial crops. A vicious cycle ensues ... a growing need for more land to grow food or more money from commercial crops to buy food.

Despite our vague awareness, coming to grips with population issues is difficult. We don't want to, in effect, blame the individual for problems which may be more institutional or political than numerical. Yet we don't want to ignore the real environmental consequences of doing nothing. We are stuck, feeling uncomfortable and perhaps ill-equipped to make decisions. There are disparate points of view. Whom is one to believe? We don't want to be antifamily, antichild, antihuman, but we do want to protect and preserve the environment. How to avoid the us versus them; the rich versus poor; the people versus wildlife debate? We are stuck, with the emotional, moral, and ethical dilemma that this controversy presents. Let us examine some of the many perspectives surrounding this tough issue.

THE DILEMMA The population dilemma has been described (Splitt 1992) as having to do with two polarities: "an ecologic polarity between human activities and the life-sustaining capacity of the Earth, and a polarity between the haves and the have-nots (the so called North-South economic polarity)." Although the second polarity is not the focus of this specific article, it an important component of the population/environment dynamic. Research in this area is provocative and indicates that this polarity, which reinforces social inequality and encourages non-sustainable patterns of consumption and fertility, involves such issues and practices as changing agricultural systems from food crops (e.g., beans, squash) to export crops (e.g., coffee, cocoa, cocaine); or differentials in ability to fix, or "buy oneself out of," environmental problems; or undervaluing women's labor. These economic patterns interface in many complex ways with ecological carrying capacity and environmental degradation. Sandra Postel (1994) of the Worldwatch Institute claims that, "Tremendous inequity is a major cause of environmental decline: it fosters overconsumption at the top of the and persistent poverty at the bottom. People at either end of the income spectrum are far more likely than those in the middle to damage the earth's ecological health—the rich because of their high consumption of energy, raw materials and the poor by their sheer numbers."

Concerning the ecologic polarity, there is ongoing disagreement about environmental predictions, carrying capacity estimates, which environmental indicators are best, or just how many people the planet can sustain and at what level of consumption. There seem to be those who believe that improving technological capabilities (bioengineering, agriculture practices, environmentally-friendly products) can dispel concerns about population numbers and their impact on the environment. Those who see stressed ecosystems (too much consumption, too many wastes, declining capabilities) and a shrinking bank of agricultural technology to meet growing demands. While others, like Jodi Jacobsen (1994), argue that it is not too many people, but too much consumption by a relative minority that is the problem. Writing for *The Amicus Journal* she says, "Myths focus on the population (the consequence) rather than the causes of global demographics (the technologies and practices that consume too much energy and materials). What is needed more than anything else is consumption control."

The Population Research Institute (PRI), a conservative think-tank, argues that, "A large part of the problems bearing on food, housing, development and the environment cannot be blamed on population growth but rather they are caused by human failures, institutional errors, the lack of international solidarity, unjust political systems, culpable negligence, ignorance and varied vested interests" (d'Entremont 1991). James Miller (1991), also writing for PRI, questions the scientific validity of environmental predictions based on demographic projections "the African countries currently experiencing famines are among the least populated and have some of the lowest population densities in the entire world." Lynton Caldwell (1985), writing for another Washington think-tank, Population Environment Balance, disagrees, "Although some environmental trends are encouraging (birth rates falling, some positive progress on problems), the *Global 2000 Report* finds that the basic needs for food and shelter are growing more quickly throughout large areas of the world than the environment, aided by technology can meet." Researchers at the international nonprofit organization Zero Population Growth (ZPG) support Caldwell's point. "In the Third World, where 85 percent of the world's population growth is now occurring, the population is already outstripping available resources by a wide margin. An amazing 37 percent of the population is under 15 years of age- a figure which translates into nearly 2 billion more adults who will be searching for work, food, shelter, and clothing in the next two decades."

Women of reproductive age are increasing ten times faster in the less developed regions of the world.

Dennis Avery, Director of the Hudson Institute's Center for Global Food Issues, joins the debate on the side of those who feel we undersell technology's ability to meet a growing world food demand, "In the last 30 years world agricultural productivity has tripled. Farmers substitute better crop varieties, pesticides and fertilizers for extra acreage" (Bailey 1993). A 1982 United Nations

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Our Garbage Dilemma

Most consumers, business leaders, and government bureaucrats agree that municipal solid waste management is among the most serious issues we face. Public health and environmental safety issues must be resolved while acknowledging infrastructure limitations and economic development.

by Lida Ochsner Durant

What exactly is municipal solid waste? Municipal solid waste is residential trash mixed with some light commercial and/or industrial refuse. This stream of trash is made up of such things as cans, bottles, bags, leaves, lawn clippings, food scraps, magazines, junk mail, disposable diapers, broken furniture, rusty appliances, paper and plastic packages, used-up batteries, day-old newspapers, and worn-out tires. In other words, what the government calls municipal solid waste, everyone else calls garbage. Estimates suggest that in one year (1990), Americans generated over 195 million tons of municipal solid waste. If these estimates are correct, we produce almost twice as much trash, or municipal solid waste, as other developed countries. Such a trash rate could conceivably fill a convoy of 10-ton trash trucks 170,000 miles long—enough to circle the equator roughly seven times! Shockingly, the amount of refuse generated in the U.S. is projected to increase by 20 percent by the year 2000. At least this it what the analysts at EPA think.

Do we know how much garbage we throw away? Calculating the total annual volume or weight of garbage is difficult because there is no way one can actually measure or weigh more than a fraction of what is thrown out. All studies have to take shortcuts. So it is not surprising that estimates for the waste stream of the U.S. are quite diverse. Without a doubt it is a lot, but just how much is hard to say. This point is important to remember when reading cited statistics, even those in this article.

Although the last 30 years has seen a tenfold increase in recycling, net discards of municipal solid waste continue to increase so that the percentage which is landfilled remains large.

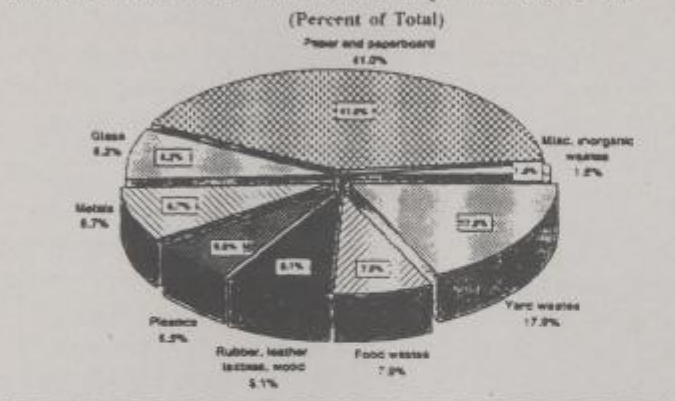
What are some of the chief problems associated with solid municipal waste? The types and extent of problems vary from region to region depending on waste type, land use and demographic characteristics, but some problems are clearly national in scope. As a result, the federal government sets minimum standards for municipal solid waste disposal, which state and local governments are responsible for actually implementing and enforcing EPA-approved waste programs. Local officials usually cite the growing shortage of landfill space/capacity and the high cost of managing waste. However, high cost and capacity shortages are only symptoms of the more basic problem: we all generate too much waste—citizens, officials and industry. The capacity shortage problem is twofold: actual space isn't so much a factor as unwillingness to accept siting decisions. No one wants garbage, but we seem to do little to reduce it—either by composting and recycling or reducing trash sources. Even if we dramatically reduce garbage flow as well as recycle and compost effectively, there will still be trash which needs landfilling. So, the challenge becomes finding landfill sites which are technically sound, environmentally safe, and socially acceptable.

Why do we produce so much garbage? One reason seems to be that, in general, we have little or no incentive to limit waste generation. Perhaps this is because we are not charged for disposal according to the amount of waste produced—neither manufacturers for packaging's disposal costs, nor consumers for disposal services (EPA 1989). In addition, today's intensive marketing efforts and our fast-food lifestyle produce more containers and packaging. Nor are there many incentives for manufacturers to design their products and packaging in a way that takes into account the fate of those products once they are discarded (EPA 1990). As alarming is the amount of paper that we throw away that isn't packaging. "Think of the telephone books and newspapers, 10 to 18 percent of our solid waste by volume," laments William Rathje, author of *Rubbish!* (1992). There is also a concern that as a society we disregard alternative disposal methods for much of this waste stream: many paper products can be potentially recycled, and yard wastes, which make up nearly 18 percent of our discards, could readily be used for compost instead.

Consumer habits may save time and reduce hassle for the individual, but they also produce significant social costs.

What are we doing with this swelling garbage stream? The most common form of disposal is burial in landfills. We landfill 80 percent of our municipal waste; of the remaining 20 percent, 10 percent each is either recycled or incinerated. This is despite efforts by the federal government to attain a goal of 25 percent solid waste recycling - a goal set for 1992 which has yet to reached as of 1994. A growing number of people feel that landfills, which do not last forever and have a history of both poor design and/or failed safeguards, cannot be relied upon as our main waste manage-

Materials Discarded into the Municipal Waste Stream



ment alternative. Disposal costs are skyrocketing, especially for more crowded urban areas. Higher transportation costs and land acquisition costs in the future threaten to make a bad situation worse (EPA 1990). The trash problem has become a top priority because our capacity to "process" solid waste is declining dramatically. In the very near future, nearly one-third of existing landfill capacity will have been eliminated as they reach capacity, become environmentally unsafe, or face closure because of public opposition (EPA 1990). Of course, it has long been the case that 50 percent of all new landfills close within five years, as maintaining excessive capacity has never been a waste management strategy (Rathje 1992). The difference is that new landfill capacity is harder to establish.

What options do we have? "There is one important truth about garbage," says Rathje (1992), "There are no ways of dealing with it that haven't been known about and used for thousands of years." These are: dump it (landfilling), burn it (incineration), convert it into something that can be used again (recycling and composting), and minimize the amount that is produced in the first place (source reduction). For most of our history we have dumped our garbage. The local dump, since renamed the 'sanitary landfill,' was the place where people scavenged usable goods for barter or sale, and semi-domesticated animals (e.g., pigs) ate up food scraps from garbage mounds. "Dumping, slopping, and scavenging were the norm in Europe and the United States until the late 1800s," says Rathje "and are still going on in many places."

In the U.S., the federal government is encouraging an integrated approach to solid waste management. This approach involves a combination of waste management techniques: source reduction, recycling and composting, and safer disposal capacity by improving the design and management of incinerators and landfills. Reducing waste at its source is EPA's favored management tool. Recycling, next in order of preference, helps to divert wastes from landfills. Landfills and incinerators fall next in line, but locating sites for them is meeting increasing resistance.

Many analysts feel that the obstacles to landfills have more to do with emotions and politics than with land shortage.

Why have landfills caused so much environmental concern? Problems associated with landfills, including poor design or location in geologically unsound areas, have raised questions about the efficacy of all landfills. At one time what were thought to be the ideal places for landfills are now believed to be the worst places to put garbage: along rivers and in wetlands. It is in unlined landfills in places like these that chemical 'leachates' have become a matter of grave concern. Some early landfills accepted toxic materials without proper safeguards or public notice and have, as a result have leached, contaminating surface and ground water. Contaminated sites pose health and environmental risks and are expensive and problematic to clean up. Consequently, as environmental awareness increases, landfills are harder to site, resulting in what is being called a "landfill capacity crisis."

What exactly is a sanitary landfill? A landfill is essentially a depression lined with clay, or other impermeable material, in which fresh garbage is dumped and then covered with a layer of dirt or plastic or both. The concept behind this methodology is that, over time, natural processes will decompose naturally degradable (paper, wood, metal, food) and synthetically-manufactured degradable (some new plastics) materials leaving only the inert remains (most plastics) buried. Most landfill biodegradation results from the complex interactions of three classes of soil dwelling bacteria. *Cellulolytic microbes* initiate the process by cleaving the cellulose in paper, wood and other plant wastes; bacteria called *acidogens* then take over, fermenting sugars into weak acids; *methanogens* complete the decay by converting the acids into carbon dioxide and methane (Loupe 1990). For years, landfill managers assumed that the piles of paper products, yard wastes, and food scraps they buried in landfills decomposed readily. Unhappily, researchers have discovered 30 year-old newspapers and food stuffs, which were presumed long biodegraded, still intact (EPA 1992). Degradation occurs very slowly in modern landfills. This brings new questions concerning the real value and long term viability

Integrated Waste Management

Source Reduction: Source reduction programs are designed to reduce both the toxic constituents in products and quantities of wastes generated. Source reduction may occur through the design and manufacture of products and packaging. It may also be practiced at the corporate or household level through selective buying habits and the reuse of products and materials.

Recycling/Composting: Both can reduce the depletion of landfill space, save energy and natural resources, provide useful products, and prove economically beneficial.

Waste Combustion and Landfilling: EPA does not rank one of these higher than the other. Waste combustion reduces the bulk of municipal waste and can provide energy production. Landfilling is necessary to manage non-recyclable and non-combustible wastes. Many new landfills use methane recovery technologies to develop marketable products.

Source: EPA 1993

"Garbage" continued on next page

"Garbage" continued from previous page

of previously held assumptions about landfilling effectiveness.

So, does landfilling work? This question is hard to answer directly, but landfilling does not seem to offer the solutions for degrading trash that were once hoped for. The dry burial practices of today delay significant degradation for half a century or more by choking off the oxygen that some microbes need and by withholding the moisture necessary to foster microbial decay (Loupe 1990). Sunlight cannot penetrate, so photo-degradation doesn't occur. Landfill conditions are far from ideal and, in effect, preserve garbage by sealing it in. The irony is, of course, that if materials degrade rapidly, the potential increases for leachate problems. Complicating this scenario are synthetic biodegradable products. It is unlikely that these products will achieve better results than newspapers and food, and even if they do perform as promised, critics complain that they use up resources potentially reclaimed through recycling, or, worse, create other environmental risks.

Following the energy crisis of the 1970s, fuel bills skyrocketed and fears of resource shortages swelled; incinerators were redesigned and renamed waste-to-energy, or resource recovery, units.

What about the other methods for handling garbage—incineration, recycling and composting, source reduction? In the lexicon of trash, "waste reduction" means burning, recycling, and/or composting wastes; "source reduction" means lessening the waste stream. One of the major tools heralded by waste managers for its ability to reduce trash is incineration. It is estimated by EPA (1989) that combustion can reduce solid waste volume by 70 to 90 percent. Municipal waste combustion can have two functions: *reduction* in the quantity of waste needing disposal and *production* of energy—commonly called "resource recovery." The idea behind resource recovery is simple: burn trash, garner from it valuable materials and at the same time generate power, generally electricity or steam, for nearby consumers. Of course, not all incinerators are mass-burn units which generate power. Some simply burn mixed refuse to reduce solid waste volume before landfilling, and some burn hazardous wastes.

Are incinerators safe? There are few clear answers. Epidemiological studies of a score of communities and several thousand individuals link respiratory and neurological problems to working or living near incinerators (*Science News*, Vol 143). None of these studies proves that incinerators harm health, but they do raise strong suspicions about the apparent links. In an effort to curb pollution, waste gases are blown into electrostatic precipitators (acid scrubbers). The ash residue is extracted, cooled, and generally dumped. Yet according to Walter Hang, director of New York's Toxics Project Research Group, incinerators release dioxins, furans, certain metals, and acids into the air, despite all their pollution controls. All of these substances have been implicated in birth defects and several kinds of cancers (Rathje 1992). Unfortunately, the existing analytical data for emissions from incinerators have serious limitations: only a limited number of chemicals are selected for analysis and the analytical methodologies have not been validated either for the test conditions or for the complex mixtures in incinerator emissions (Spier 1989). As a result, analyses are incomplete or unreliable.

What are some concerns associated with incineration? According to a 1985 report to the German Marshall Fund, garbage incinerator emissions and ash residues contain toxic contaminants that are thought to cause cancer, birth defects, cell mutations, and other irreversible health effects, even at very low levels of exposure. These contaminants include all 75 possible chlorinated dioxins, a wide variety of closely related chlorinated dibenzofurans (135 possible compounds in all), and literally hundreds, and perhaps thousands, of heavy metals, acids, polynuclear aromatic hydrocarbons, and other organic chemicals (Figure 2). Despite their success in identifying incinerator contaminants, scientists remain puzzled about the precise mechanisms that produce dioxins and other contaminants. Similarly, attempts to eliminate these emissions, either through changes in operating conditions or with pollution control devices, have failed (Hang 1985). To compound these fears, questions have been raised about the training of facility operators and the apparent lack of continuous monitoring requirements. Hazardous waste plants, for example, need only pass a one-time, limited, optimal condition "test burn" to begin operation (Spier 1989). Consequently, a growing segment of the general

Incinerator Ash Residue

Polychlorinated Dioxins and Dibenzofurans - Although susceptible to photodegradation, these compounds are generally stable because they have low vapor pressures and are highly resistant to biodegradation. Since they do not readily volatilize, the compounds tend to remain trapped on soil particles. In aquatic environments, they tend to adhere to suspended particulate matter as they are lipophilic and are more soluble in fats and oils than in water,.

Polynuclear Aromatic Compounds - These compounds are present in the gaseous emissions, fly ash, and bottom residues of incinerators. As they are easily dispersed by airborne transport, they are essentially ubiquitous in the environment. This is a very large class of compounds; most have uniformly high melting points, are soluble in fats and oils, and are virtually insoluble in water.

Toxic Metals - Concerns focused on these metals are due to their potential to cause a variety of health hazards. During incineration these metals are vaporized and absorbed by particulate matter. As a result, airborne particulates can be enriched with an array of toxic metals. Enriched particles can be inhaled and once deposited in the respiratory tract, stomach, or alveolar region of the lungs, they can be accumulated in blood, fatty tissues, and vital organs.

Source: German Marshall Fund Report, 1985.

public is distrustful of these facilities. Quite apart from the health issues, waste-to-energy incinerators are hugely expensive—as much as $400 million apiece. Potentially adding to this cost is the fact that users of waste combustion products demand a consistent supply. This demand means that combustion facilities must have either enough waste products to produce the required energy or have alternative back-up systems. Local critics of incinerator-generated power fear that supply demands will require importing other communities' garbage to ensure adequate supply, which means more noise, unpleasant smells, increased truck traffic, and lowered property values. Concerns have also been raised about the adverse impacts on recycling, composting and resource reduction efforts when incinerators maintain a waste supply stream. And just as with landfills, citizens are resistant to siting new facilities in their communities because of perceived risks from contaminated water and soil, toxic ash, and air emissions. Compounding the problems stemming from health and environmental concerns, local governments often lack effective dispute resolution mechanisms to settle siting impasses (EPA 1989). Such conflicts, whether over landfills or incinerators, means mounting garbage and management inefficiency as facilities avoid accepting more waste than they can handle. Of course, one way to avoid garbage is to reduce the waste stream at its source—a method called source reduction.

How much trash can source reduction eliminate? Some analysts are cautious concerning the amount of trash we can eliminate through source reduction, citing studies which suggest that even if every community met EPA guidelines for alternatives to landfills (recycling, reduction, composting, combustion), fully one quarter of today's trash stream would remain (Lewis 1993). Source reduction advocates often focus on eliminating unnecessary packaging as a major tool for reducing our garbage load. Packaging makes up an astonishing one-third of our waste stream (EPA). According to the Worldwatch Institute (1994), as much as half of all paper production and nearly a quarter of all plastics sold go into packaging. But just how much trash can be eliminated this way is unclear as most commodities, in the words of one analyst, "whether hamburgers, eggs or VCRs, have to be put in something." Yet Ken Brown, U.S. Forest Service geologist and source reduction specialist, considers source reduction critical because it, "can move us forward, to a better standard of living, toward sustainable economic development" (Lewis 1993).

Tips for Reducing Solid Waste

Choose recyclable products and recycle them.
Buy products made from recycled materials.
Compost yard trimmings and food scraps.
Buy and Maintain reusable, repairable products.
Reuse bags, containers, and other items.
Sell or donate goods instead of throwing them away.
Adopt practices that reduce waste toxicity.
Share, rent, or borrow items used infrequently.
Reduce the amount of unnecessary packaging.
Be heard—Make your preferences known to manufacturers, merchants, and community leaders.

Source: EPA, 1992.

"Source reduction is to garbage what preventative medicine is to health: a means of eliminating a problem before it can happen" ***William Rathje,* Rubbish!**

Where can reductions occur? Since packaging protects products, discourages theft or shoplifting, and presents merchandise attractively, it cannot be eliminated entirely. As Thomas Lewis, author of *Waste Not, Want Not* points out, "Reducing it will involve changing habits and challenging assumptions at every level." EPA reports that corporate America has its share of success stories in reducing product packaging—two examples: Herman Miller Inc., a Michigan furniture manufacturer, which uses reusable and recycled shipping containers and MacDonalds' Corp, whose switch from polystyrene clamshell containers reduced its waste stream by 70% (Lewis 1993). Rathje (1992) agrees that many consumer industries have responded to strong *economic* incentives to make products as compact and as light as possible, for ease of distribution and to conserve resources. The problem seems to be that there are few incentives for manufacturers to design their products and packaging for effective waste management when discarded (EPA 1990). Likewise, Jan Beyea, senior staff scientist at the National Audubon Society, would like to see the federal government, which uses more paper than any other institution, insist on recycled products. These kinds of changes,he feels, could potentially have as great an impact on our waste stream (and our environment) as targeting product manufacturers to reduce packaging (Rathje 1992).

What kinds of incentives are there to encourage source reduction? Economic incentives include taxes based on the amount of waste generated or tax credits to businesses that reduce these amounts. Other incentives include regulatory stipulations to promote source reduction activities such as minimizing toxicity and volume. Seattle, which pioneered such an idea in 1982, has cut household trash output by two thirds. The 'pay-as-you-throw' strategy has perhaps the most dramatic, immediate, and measurable results, according to the National Wildlife Federation (1993). It replaces the usual flat rate for garbage disposal with a charge for each bag or can of refuse. In Pennsylvania, some communities have dropped their waste streams by 60 percent with the imposition of a per-pound trash disposal fee. Minnesota, which has achieved one of the lowest landfill rates in the country, also offers grants to local governments and businesses for finding ways to generate less trash. Analysts also suggest that businesses conduct source reduction audits to find ways in which operations could be altered to generate less or reuse wastes (EPA 1989). Some commu-

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WISE USE: UNRAVELING THIS NEW TWIST TO A REVERED CONCEPT

"WHILE ENVIR ONMENTAL GROUPS BECOME BELTWAY BOUND, THEIR CORPORATE OPPONENTS GO GRASSROOTS." RICHARD M. SMITH

by Bob Thomas

Charles Cushman, of the National Inholders Association, has said that environmentalism is like a pagan religion, it worships nature while sacrificing people. It may well be said that hell-bent development is like the Seussian Once-ler, removing all the Truffula Trees simply to fulfill the short-term need for Thneeds!

So goes the battle between those who advocate for development-oriented business versus those who advocate for environment-oriented business. All too often, mainstream humanity is left to either suffer from lack of progress or, as is becoming more common, taking the bull by the horns and seeking solutions. Let's examine how we have arrived at this juncture.

We environmentalists have been hounded with the notion that all businesses (that is, *each and every one*) are out to maximize their profits with absolutely no regard for the environment. We have been led to believe that they are all directed by wealthy magnates who have a sinister attitude about the resources of the earth - get them now and the future be damned! At the same time, many business leaders are convinced that environmentalists are just the opposite. They claim that we care about nature to the exclusion of human needs, i.e., a snail darter is more important than providing jobs for destitute people. The unintended situation that results ends up with workers blaming environmentalists instead of changing the underlying economics which is the real root of the problem. Or environmentalists realize too late that when families are threatened they often grab any lifeline before asking what are the long term consequences or who is holding other end.

In 1988, some 250 organizations representing groups who advocate the use of public lands and fighting for property rights, met in Bellevue, Washington, for the purpose of identifying an action plan to oppose environmentalism. Some of those groups soon began using grassroots tactics to advocate for what the environmental community termed pro-business, "anti-environment" issues. They held petition drives, fax and letter campaigns, protest meetings, media events, and lobbying and organizing techniques that heretofore had only been used by environmental groups. To say that this caught the environmental community offguard would be an understatement, and underscored a strange irony—while environmeatal groups have become beltway bound, their corporate opponents have developed strong grassroots skills. The organization's focus was to paint the environmental agenda as the "evil empire," just as we had painted the economic agenda in years past. In seeking a catch phrase, they adopted a portion of the definition for "conservation", as coined by the Father of the National Forest Service, Gifford Pinchot: the controlled and wise use of our natural resources. They were labeled the "Wise Use Movement" (WUM), and henceforth, any business who sought to profit, in any way, from natural resources, regardless of their basic environmental ethics, has been placed in this group, whether they willingly belong there or not.

Unlike volunteer citizen activists who are not paid to participate in grassroots activities, Wise Use Movement activists are often employed by industries—transportation, meals, and paid days off are provided by industry for their involvement in these activities.

In fact, this back-lash Wise Use Movement is very real and very highly orchestrated. Its founders, Alan Gottlieb and Ron Arnold, are from a public relations background and, from their perspective, they cleverly identified an economic niche for themselves. At a time when the need was greatest to bring environmentalists and industrialists together, they created a wedge that is helping no one (except those who prey on divisiveness) and, what's more, it is certainly hurting our environment and the cause of consensus building.

As usual, one of the major problems is a failure to communicate. Folks who don't really know one another usually don't really know the other's motivations and agenda and this fosters distrust. It has been said that business uses a "political textbook of lies and dirty tricks, misrepresentation, and oversimplification." This phrasecology certainly marshals the anti-industry troops. Do understand that industry basically says the same of us environmentalists. They especially claim that distortions are used in our literature sent out seeking memberships for environmental organizations - that concepts are stretched to indicate that we are doomed unless we send money to the soliciting organization. They also point out that many of these organizations that ask for grassroots money are multi-hundred million dollar corporations who do not really relate to the person-on-the-street's concerns.

Of course, both characterizations are wrong. There is

always danger in trying to oversimplify the groupings of human philosophies and attitudes. In fact, we are a continuum with, yes, some at the far right and some at the far left, but the majority somewhere in the middle. And citizens representing the middle, by definition, see the virtues and failings of both ends of the spectrum.

As a "middle person," I would like to share my frustrations and present a few observations. I expect your agreement will depend on where you sit on the continuum!

1. Since I work closely with so many folks in industry, virtually all of whom are committed to the environment and are doing their best to improve it from their business's perspective, I get very upset with focused-agenda groups, such as the WUM, who operate away from the consensus table. They inflame the debate and make life very difficult for those of us who are trying to create conditions for progressive discussion.

2. Many of our environmental organizations have become as predictable as our large corporations. They can be counted on to consistently preach the same self-serving line, not taking a discussion to a new level by suggesting new avenues of thought. They are so caught up in the arguments that they rarely seek solutions and thus keep issues polarized. Pick any issue. In the wetlands debate, they are so against the "Hayes Bill" (HR 1330) that they refuse to thoroughly and publicly debate any of its points, even though some of its most influential proponents are willing to concede that it is not the perfect answer to protecting wetlands while gaining economic benefit from them.

3. I do not want to be aligned with left-wing environmental groups. Its just not my style to confrontively avoid seeking workable solutions that benefit all. Everything is not black or white - the world is many shades of gray. There is much crossover in support of environmental and economic causes. One would expect folks near the middle to see the virtues of both arguments and support a clean environment and a healthy economy - it is the best of both worlds and gives us the most benefits.

4. All businesses are not part of the WUM, and all environmentalists are not anti-economic growth. Only special interest groups with narrow agendas continue to distinguish this non-existent dichotomy of thought.

One positive outcome of the stir caused by the WUM is the trend for many environmental groups to begin recognizing that people and their needs are an intricate part of the ecosystem. Some businesses are still eager to polarize, but more, especially those with "60's-aged" management, are also coming more to the middle recognizing that good environmental policies create jobs by protecting the resource base.

The ultimate point: There are those on both sides who do sit down and talk about the problem, who listen, who can be honest, and who want to work out a solution. This is important to remember. Important, too, is for all of us, environmentalist and industrialist, to keep the lines of communication open between our historically adversarial groups, because, after all, the scary thing about a continuum is that each position feels that it has a balanced position. ☺

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study by its Food Agricultural Organization seems to bear out this point of view, "by using modern agricultural methods the Third World could support more than 30 billion people" (Mann 1993). But Lester Brown, Director of the Worldwatch Institute, says food is not the only issue. "Rapid population growth in poor countries has resulted in tremendous expansion of cultivated and inhabited areas, contributing to degradation of land and water and the rapid destruction of tropical rain forests. Loss of forest cover is believed to contribute to global warming trends and the rising levels of greenhouse gases" (1994). Brown is also concerned with overcropping, overgrazing, and poor land management practices which result in progressive salinization and/or desertification of large tracts of formerly productive land. Add to this increasing numbers of rural peoples fleeing impoverishment, flooding into already overcrowded cities, and he predicts even more rapidly deteriorating conditions. As economies diversify and as cities expand to accommodate population growth and migration, land is being rapidly lost to industrial development, housing, road construction, and the like (Worldwatch 1994). A portion of any cropland gains will be off set by losses from expanding population pressures and from reduced ecosystem capabilities.

"Wiser and more discriminating use of technology offers the possibility of tremendous gains in resource efficiency and productivity. Technology can help us stretch, no exceed, the earth's capacity to support humans sustainably." *Herman Daly*

And so, the debate continues and raises for us questions. Are we approaching the limits of our natural systems—farmlands to produce crops, oceanic fisheries to supply fish, rangelands to support livestock, aquifers and streams to provide fresh water, spaces to dispose of waste? What technologies are available and what can they do for us? Does anyone know how many people the planet can support?

TECHNOLOGY Technology can be broadly defined to mean the application of knowledge to an activity.

Question: Can't most environmental problems be solved through conservation and environmentally sound technology rather than through population stabilization? Don't improvements in agricultural technology make it possible to grow more on the same amount of land?

Comments: Without question, technological advances have not only helped boost food production (Malthus' concern), but have also increased our access to sources of water, energy, and minerals. Whether technology can continue to raise production potential to keep pace with population growth is open question. Researchers from the Worldwatch Institute express concern, "Given the pace of cropland and rangeland degradation and the slowdown of irrigation expansion, it may be difficult to sustain crop increases" (Postel 1994). However, the World Bank reports that virus resistant rice varieties are likely to be in farmers' fields by 1995, and resistant wheat varieties are under development.

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RISK ASSESSMENT: AGRICULTURAL PESTICIDES

In the last 30 years, world agricultural productivity has tripled, primarily through the use of high-yield, chemically assisted agricultural products and practices. Biotechnology is largely responsible for the new, more productive crop varieties; petroleum-based pesticides and fertilizers provide the chemical assistance. According to Ronald Bailey (1993) of the Competitive Enterprises Institute, food is being grown on about the same amount of crop land as in the 1950's, nearly 6 million square miles, equal in area to South America.

But at what cost has this tripling come? The industrialization of agricultural came about when the U.S. decided it would "maximize production and be the bread basket of the world and thus started the spraying both of crops and weeds. There are more chemicals being used by farmers than ever before" (Mcgivney 1993). Is this good or bad? There is a growing debate about the safety to the environment and human health with the persistent and escalating dependence on pesticides and fertilizers, especially but not exclusively, in agriculture. As in many environmental issues, the debate is over the balance between the benefits arising from versus the risks associated with these chemical applications.

Those who see benefits (Bailey 1993, Knutson 1994) cite studies which indicate that "modern farmers using high-yield chemically-assisted agriculture are responsible for saving about 10 million square miles of wildlife habitat." Advocates such as Dennis Avery (1993) claim that without high-yield farming an additional 10 million square miles of wilderness, the total area of North America, would be plowed in order to feed the current world population. He questions calls for sustainable development based on organic gardening, which he views as totally unsustainable on a world-wide basis. His question, "How many millions of square miles of wildlife habitat are environmentalists willing to give up in order to have organic farming?"

Supporting the pro-chemical side is the American Farm Bureau Research Federation (1994) which found that even a 50 percent cut in pesticide use would cut yields dramatically (on crops e.g., potatoes, oranges, tomatoes, and lettuce) and raise costs to growers and consumers. Ronald D. Knutson, director of the Agricultural and Food Policy Center at Texas A&M University, agrees "additional drawbacks of reducing pesticide use would include higher labor costs, higher food-processing costs, seasonal gaps in the supply of some fruits and vegetables, and the need to plant more acres" (Science News 1994).

Counter to these U.S findings, the International Rice Research Institute (IRRI), cites experiments and trials that demonstrate that losses associated with unsprayed, resistant cultivars typically average only 5 to 10 percent annually. When IRRI balanced the value of crops against the costs of both applying pesticides and of treating chemical handlers for pesticide-related health effects, it found that natural pest control - conserving natural predators by avoiding using pesticides - "consistently has the highest net benefits" (Science News 1994). They concluded that farmers waste much of their pesticide investments and that the benefits of pesticide use are negative once health costs are factored in. Their analysis indicates that the threats from pests are often exaggerated, while the costs to both health and pocketbook are largely ignored.

There are other concerns raised by the anti-chemical advocates (Williams 1993, McGivney 1993, Brinkley 1993). Chemicals sprayed from the air, destined for agricultural fields, end up in water ways and in backyards where the potential for causing harm is poorly understood, unknown, or if known-uncontrollable. In addition, EPA links impaired or threatened surface waters to pollution from agricultural activities. Another concern is that once chemicl products come on the market, it becomes difficult to stop their use even if suspicion arises. It becomes the government's obligation to prove that it is a problem. This is the political reality despite the Code of Federal Regulations statement "the burden of persuasion that a pesticide product is entitled to registration or continued registration ... is always on the proponent(s) of the registration." The issue is clouded now that yanking a pesticide may be considered a constitutionally forbidden "taking" of private property.

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) enacted in 1947 protects species not targeted for pesticide control. The basic tenet of FIFRA is that a pesticide may be used only if benefits outweigh risks. So the question of course becomes whose benefits and whose risks? Do benefits to corn and sugarcane outweigh the risks to migratory songbirds for example? Is pesticide registration working? Are the safeguards in place to advise people how to use pesticides and fertilizers properly? The lack of clarity fuels the debate.

Also fanning the flames of debate are the animal studies used to make determinations about the safety of petrochemical products. The government funds roughly 65 rodent studies at 15 different laboratories at the cost of about $2 million each. These studies have been the government's most important diagnostic tool for regulation (Brinkley 1993). Such tests have come under increasing fire because evidence is accumulating that chemicals frequently have wholly different effects in animals and humans. A panel of toxicology experts convened by the Health Sciences Institute to study the agency's toxicology research program found that two-thirds of the substances that proved to be cancerous in animal tests would present no danger to humans in normal doses.

All this confusion and debate seems to have sparked an environmental back-lash of sorts. Farmers, homeowners, corporations, and others are upset by the growing costs of regulations that don't appear to bring any measurable benefits. This backlash has unclear consequences. Environmentalists are concerned though that claiming that environemntal policy is off track might lead to legitimizing pollution. As Daniel F. Becker, director of the Global Warming and Energy Program at the Sierra Club, warns, "There are powerful forces who have an economic stake in de-emphasizing environmental damage."

On the other extreme: can we, or should we, make dirt safe to eat?? ☺ *(Lida Durant, Editor)*

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Worldwatch admits it is possible that these new crop varieties, and others, may boost land productivity and that improvements from biotechnology may be forthcoming, yet warn that such gains are double-edged. They urge us to remember that "the irrigation, chemicals, and high-yield crop varieties that made the Green Revolution possible have also depleted and contaminated water supplies, poisoned wildlife and people, and encouraged monoculture cropping; the huge driftnets which boosted fish harvests have also contributed to overfishing and depletion of stocks" (Postel 1994).

"The experience of recent decades of overfishing and overgrazing gives a sense of the limits to the carrying capacity of fisheries and rangelands." Lester Brown

The National Audubon Society also cautions us about being too exuberant about solving a growing population's needs with technologically-boosted crop yields alone. Population growth drives up the demand for such things as firewood. Firewood currently supplies the energy needs of about 2 billion people worldwide. The FAO estimates that at least 1.5 billion people are cutting firewood faster than the trees can grow back. Outside the Amazon region, about 80 percent of all the wood cut in developing countries is used for fuel (NAS 1991). Former World Bank economist, Herman Daly is also wary about biotechnology and, what he calls, the "nontraditional export bonanzas currently being advocated as technical fixes," and expresses disappointment with the lauded potentials of both nuclear power and the green revolution. Daly is skeptical about the ability of "technology" to offer general fixes and fears assumptions about its perceived capabilities. He recommends asking ourselves "what kinds of biotechnology could contribute specifically what kinds of products in the next 25 years. And what nontraditional exports, other than cocaine, could make a difference over that time period?" (1990). Others (Caldwell 1985, Hardin 1987, Daly 1990, Brown 1994, etc.) are concerned because technologies which potentially enlarge the responsive capacity of the environment (e.g., fertilizers and pesticides) may also impair ecosystem functioning. Russell A. Mittermeier (1991) of Conservation International is even more sober in his predictions, "If steps are not taken to stabilize population growth, all our efforts in conservation will have little or no impact" (NAS).

"There is not material enough, energy enough, or enough elbow room on earth to nourish forever the compound interest growth of technology of the past 2 centuries." Garrett Hardin

Experts will continue to argue about the degree to which technological progress can eliminate resource constraints, but the bottom line is that there is still an enormous amount of uncertainty about the impacts of energy and resource constraints. Robert Costanza (1991), editor of *Ecological Economics*, argues "because of the large uncertainty about the long-term impacts of population growth on ecological sustainability, we should at least provisionally assume the worst."

Question: So what can we do? What needs to be done? How many people can the earth support at a given level of consumption?

Comments: There simply are no direct answers. Berle (1993) suggests that we adjust our consumption habits and start developing and utilizing more sustainable technologies. But as behavioral and technological adjustments happen slowly, he favors working now to slow population growth because it is one of the many factors contributing to environmental degradation, and one which we can begin to address today. Worldwatch's Brown (1994) agrees stressing the need to include basic ecological concepts into population policies. He links growing numbers of people to accelerated environmental degradation: such degradation ultimately limits the number of people the planet can support—its carrying capacity. In his words, "Perhaps the greatest gap in formulating population policy has been the failure to consider [ecological] carrying capacity."

Sustainable development could offer hope to the billions living in poorer nations, but raising the standard of living by emulating the industrialized countries could mean using more resources for each person.

CARRYING CAPACITY is defined as the largest number of any given species that a habitat can sustain indefinitely without degradation of the environment—that is without lowering the carrying capacity (Hardin 1987). When that maximum sustainable number is surpassed, the resource begins to decline and sometime thereafter, so does the population (Postel 1994). The earth's carrying capacity is determined by the amount of solar energy converted by plants during photosynthesis into biochemical energy, minus the energy those plants use themselves. This converted and usable energy is called the earth's net primary productivity (NPP), and it is the basic food source for all life. The concept of carrying capacity is basic to the science of ecology and is used to analyze population/environmental dynamics. Understandably, calculating the carrying capacity for humans is far more complex than for other species: carrying capacity calculations have to account for standards of living, economic growth, technology, and the extent of trade (Daly 1990). For other species these variables do not apply or are constant over time. Despite this, Daly finds that "The concept of carrying capacity still remains useful because these four variables do not change discontinuously, unpredictably, or beyond all limits. There is inertia and there are ultimate limits."

Question: What do we need to sustain us—not only ourselves but also our activities? How can we meet our needs today without compromising the ability of future generations to meet their needs? How do we avoid lowering the Earth's carrying capacity?

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Comments: The Earth's capacity to support humans is determined by several things including our basic food requirements, resource consumption, the amount of waste we generate, and the technologies we choose. According to Postel (1994), humans use nearly 40% of the earth's NPP, but she cautions, "We have appropriated the 40 percent that was easiest to acquire, it may be impossible to double our share. Yet theoretically that will have to happen if our population grows at projected rates. And if standards of living do rise elsewhere in the world as they need to, consumption rates would be even greater." Our survival also depends on the many environmental services provided by all the natural systems—from forests' regulations of the hydrological cycle to wetlands filtering of pollutants. The concern among environmentalists (Hardin 1987, Berle 1991, Train 1991, Brown 1994, Postel 1994, etc.) is that as we destroy, alter, or appropriate more of these natural systems for our exclusive use, these environmental services are compromised.[1] They assert that global problems like global warming and ozone depletion underscore the danger of overstepping the earth's ability to absorb our waste products. Overstepping is a concern *in addition* to the consequences of exceeding the sustainable *supply* of resources.

"You can always blame any particular difficulty on something that is not overpopulation" says Dennis Meadows. "Nobody ever dies of overpopulation. They die of famine, pestilence, and war. There's always some proximate cause." *The Atlantic Monthly*

Yet not all researchers agree with this analysis of the earth's carrying capacity. Fred L. Smith, Jr. (1994) researcher at Competitive Enterprises Institute, a pro-market, public interest group, questions whether we even have a carrying capacity crisis. He argues that "carrying capacity reflects the institutional framework with which we manage resources, rather than demand [for resources] alone." He harkens to the time of less governmental regulation, when "vast numbers of poor and uneducated immigrants from disparate cultures swiftly became productive Americans, producing far more than they consumed." Donald Plucknett (1994) of the Consultative Group on International Agricultural Research also questions concerns about the supposed carrying capacity crisis and concludes, "there is no evidence of a slowdown in the rise in grain yields." After examining both longer-term yield trends and those from 1980 to 1990, he found that yields have increased in every country (Brown 1994). Avery (1993) agrees pointing to modern tillage methods which drastically reduce topsoil erosion as well as increase output. "Conservation tillage uses shallow disc plowing and leaves crop residues on the soil surface, cutting erosion by 50%. No-till farming never leaves the soil bare and ... cuts erosion by 98%" (Bailey). The 1993 *Forbes* article predicts that "high-yield farming will do more to protect wildlife than an army of wardens"—the implication: such practices will ultimately enhance rather than harm the environment by conserving wilderness while growing food for an expanding populace.

Still others (Caldwell 1985, Hardin 1987, Brown 1994, etc.) say that carrying capacity encompasses more than just enough food to eat and how it is produced. They site our dependence for survival upon sustainable economic and environmental systems as a critical reason to interrelate trends among population, resource availability and environmental quality. Cornell University ecologist, David Pimentel (1994) also agrees that depletion of natural resources (and their services) is one important limit on the number of people the earth can support. Other limiting factors they consider in addition to cropland are water, forests, rangeland, and fisheries. According to the Worldwatch Institute's Postel (1994), signs of water scarcity are pervasive and water constraints appear to be slowing food production. "Right now today 26 countries do not have sufficient water supplies within their own territories to meet the needs of a moderately developed society at current population size ... and population is growing." She goes on to say that irrigated croplands "play a disproportionate role in meeting the world food needs—the 237 million hectares of irrigated land account for only 16 percent of total cropland but more than a third of the global harvest." Pimentel carries the argument further claiming that the global population of 6 billion is "at least three times what the Earth's battered natural resources and depleted energy reserves will be comfortably able to support in 2100" (Raeburn 1994). Comfortably support by his definition is close to current First World standards with more energy efficiency and wiser use of natural resources.

Although 94% of the population growth is occurring in Third World nations, developed nations place disproportionately greater demands on global resources. For instance, Americans make up less than 5% of the world's population, but we consume 23% of the world's energy. *Worldwatch Institute*

Disparity in standards of living is another important factor in the carrying capacity equation. Such differences mean that the global carrying capacity for industrialized nations is much lower than that of other nations. Citizens in industrialized countries with more affluent life-styles consume more resources with fewer people and are also believed to generate over 50 percent of greenhouse gases through their use of fossil fuels (Brown 1994).[2] For this reason some groups claim that concern about population growth is just a way for industrialized countries to shift the blame for their own environmental degradation onto the developing world (Audubon 1991). Charles Mann (1993)

1 The extent to which the overall scale of economic activity damages the earth depends largely on the technologies used and the amount of resources consumed in the process. One example: electricity generated by burning coal very contributes as much to economic output as an equal amount generated by wind turbines, but burning coal causes far more environmental harm. Economic growth is most damaging when powered by extraction and consumption of fossil fuels, water, timber, minerals, and other resources. In our efforts to feed, clothe, house, and otherwise satisfy our ever-growing material desires, we have drastically converted diverse and complex biological systems (ecosystems) into simple ones that are managed for human benefit. In the we have usurped much of the earth's productive capacity (Postel 1994).

2 This trend is expected to change over the next several decades as living standards improve in poor countries. Of course, this can be either very good news or alarming given the belief that even if these standards increase only modestly, population increases in numbers and change have a significant impact on global systems. According to Brown, "If current trends in population and energy consumption continue, the United Nations estimates that developing countries would release some 16 billion tons of carbon dioxide annually—four times the 1990 annual emissions by industrialized countries."

"Population" continued on next page

writing for *The Atlantic Monthly* says "Children are the Social Security of traditional cultures everywhere, a form of savings that few can afford to forego." In such cases the costs of big families (mass illiteracy, low wage jobs, overused public services, environmental degradation) are spread across society, whereas the benefits (income, old-age insurance) are felt at home. The outcome, entirely predictable, according to Mann, is a rapidly growing population. In addition, economic disparity and unbalanced development encourages migration. According to Nafis Sadik (1992) executive director of the United Nations Population Fund, by moving, migrants "seek to restore economic balance in a world in which the division of the world's wealth has grown more, not less, unbalanced." Undeniably, the growing number of migrants crossing national boundaries have created tensions in many parts of the world. Sadik predicts that current population trends will increase the pressures to migrate. A case in point: the United States is the fastest growing industrialized country in the world, in part, because of immigration, and also low mortality rates. "In the next 60 years the nation's population is projected to increase by 128 million people—the equivalent of adding 103 cities the size of New Orleans" (ZPG 1992).

The labor force will not increase in North America between now and 2025 except through immigration.
The United Nations Population Fund

Question: Can we continue to expand the human economy to accommodate ever-increasing numbers at ever-increasing levels of consumption? Can we ignore the pressure of numbers of people upon natural limits assuming that we can continue to expand them indefinitely?

"If the U.S. cannot even pass a reasonable gasoline or water use taxes to discipline unsustainable consumption, is it realistic to expect other countries to control population?" *Herman Daly*

Comments: Probably not. But deciding how to come to grips with these questions brings us right around to the original dilemma. Whether the global carrying capacity for the human population is 2 billion or 5 billion or 55 billion is perhaps less important than the reality that there is a limit. All arguments about technology, conservation, and immigration aside, if we accept the ecological premise of carrying capacity, we will have to devise policy to ensure we don't exceed the limits of the earth to support us. If we do not, those limits may be imposed upon us by the forces of nature (disease, famine, environmental degradation) or society (poverty, war, exploitation). Such external impositions reduce our options, an ultimately our freedom.

CONCLUSION Opportunities to expand our use of essential natural resources (water, forests, fisheries, rangeland, cropland) are uncertain and may be more, or less, limited than existing estimates suggest. We just do not know. We are uncertain if these resources are gaining or losing productivity. Unlike energy systems, of which a technically feasible shift from fossil fuels to solar-based sources can be envisioned, there are no identifiable, substitutes for biological and water resources. These resources are *essential for life*—essential for our life. There seems to little alternative to living sustainably within the limits of these resources. The United Nations General Assembly's World Commission on Environment and Development (1987) suggests that the keys to living sustainably include "equitable growth in impoverished countries; adoption of lifestyles that are within the planet's ecological means (by reordering our priorities among other things); and education which emphasizes individual responsibility and the value of conservation. All students need to be made aware of the dynamic relationships and the balance required among the environment, our energy needs, and our economy" (Sadik 1992). To the critical need for education, Daly adds the need for equitable population policies "Women with no education often have the highest fertility rates by several times. Birth control is often already practiced by the upper and urban classes, and what is lacking is a democratization of birth control—both attitudes and techniques." A birth control policy *does not* mean repressing millions of poor people because their survival is less important than the survival of trees and birds and undiscovered species. Far from being repressive, a birth control policy would, according to Daly, "serve to spread to the lower classes the attitudes and practices of the upper class [by tending to] equalize the distribution of per capita income by reducing the number of heads among which a wage must be shared, in the short run, and by permitting wages to rise by moving away from an unlimited supply of labor, in the long run." Of course, population pressures on the environment are not confined to overpopulated and underdeveloped countries. These pressures have destructive and ramifying effects elsewhere (e.g., southern California). Also, according to the United Nations (1992), progress has been made in developing countries not only to formulate population policies and programs, but also to expand accessibility to voluntary family-planning services to those who desire them.

"Environmental quality could be sustained by a radical and disciplined change in lifestyle or by a severe reduction in population. Neither being acceptable, a progressive degrading of the environment is slowed by increasing regulation and the search for less damaging technologies." *Lynton Caldwell*

Considering the uncertain consequences of failing to limit the number of humans on the planet, working towards a population policy which promotes sustainability and encourages

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nities have enacted bans on specific types of packaging, but this strategy can meet with legal opposition as it did in Suffolk County, New York, whose ban on polystyrene food containers was invalidated in a challenge by the plastics industry (Lewis 1993).

How else can we reduce our trash load? Biodegradable natural materials are ideal for composts, whether in the backyard or in a community space. Composting, as you remember, is microbial decomposition of organic matter (e.g., food scraps, leaves) in the presence of oxygen, and is nature's way of recycling organic material into humus, which returns nutrients to the earth. Yard clippings, leaves and grass, food scraps, as well as shredded newspaper, wool and cotton rags, and fire place ashes are all good compost materials. Of all the garbage we generate (estimates range between 4 and 6 pounds per day), roughly half is organic matter (Raloff 1993). Some studies indicate that 67 percent of residential waste is either compostable or recyclable, and about 40 percent of all the garbage (municipal solid waste) destined for landfills could be composted or recycled.

Although recycling has popular support, consumer and business demand for many recycled products is low.

Can composting work for a large city? Like the backyard compost heap, municipal composting relies on bacteria to break down food scraps, wood, and paper. Most of these programs collect compostables mixed with other household trash. Waste programs then cull the materials to be composted at a central facility. Although maintaining a relatively high humidity and temperature (50 to 60 C for at least three days) kills many pathogens while speeding breakdown of the wastes, no proven means exists for reliably removing many contaminants from clean compostables once they have been mixed. Consequently, worrisome levels of toxins frequently lace resulting composts (Raloff 1993). In a study conducted by Donald Lisk of Cornell University's Toxic Chemicals Laboratory, 26 different municipal programs were surveyed for contaminants. Invariably their contents contained polychlorinated biphenyls, as well as measurable levels of toxic heavy metals. These concerns have brought a cloud of skepticism about the efficacy of this fairly new waste reduction management strategy. To counter the problems caused by mixing compostables, supporters of this concept suggest source separation programs which require homeowners to segregate compostables from household garbage before collection. Barry Commoner found that if household wastes are separated into four categories (food debris and soiled paper, clean paper, metal and glass, everything else) an amazing 84 percent of it could be sold or recycled. This in-home trash segregation departs significantly from the majority of programs now in place and goes a long way in ensuring a cleaner, "greener" product.

What about recycling to reduce waste? As much as half of the waste stream of many municipalities can be captured in well-planned recycling and composting programs at a lower cost than it takes to burn or bury it, according to Rathje (1992), and the success of most recycling programs does not depend on a 100 percent participation. If the program is simple and efficient, 65 to 80 percent participation will result in savings. Yet recycling, while more popular than incineration and better known than composting, has its own share of problems. Recycling is less efficient than incineration at reducing the amount of trash needing landfilling, for example. Certainly a sizeable portion of what we throw away contains valuable resources (e.g., metal, glass, paper, wood, plastic) that can be reprocessed. But, recycling is more than the separation and collection of post-consumer materials—waste contents and source must be analyzed, materials must be reprocessed or remanufactured; existing markets for recovered materials and the possibility of finding new ones must be explored; and only when the materials are reused is the recycling loop complete. Recycling is not just a matter of recovering recyclable material, it's a total economic system. It is in this system that some analysts (Schaumburg 1994, Biddle 1993) contend we are not doing well. One important fact to keep in mind is that recycling is essentially a money-making effort which tends to focus on the high-revenue, steady market materials such as aluminum and glass. Low value materials such as mixed paper, the major trash in landfills, and mixed plastics are usually avoided. This impacts the economic feasibility of projects for municipalities, and makes adding a new recycling component to an existing municipal solid waste disposal system a challenging process. This is one reason why local officials

Recycling Success Stories

Bell Atlantic is using recycled paper for its telephone directories, and it has also extended these resources by making the phone directories themselves recyclable.

American Airlines has saved over $100,000 by converting to 100% recycled paper in its computer division and an additional $33,000 by printing its annual report on recycled paper.

Recycled Plastics Marketing (RPM) of Seattle produces a backyard composter made from milk jugs recovered from the city's recycling program. The composter is sold to the city and distributed free to residents to encourage composting. RPM receives a predictable flow of materials for its product and the city guarantees payment on a large number of composters which reduces its city waste management costs. A cooperative partnership best.

Image Carpet makes both industrial and residential carpets out of 2-liter plastic soda bottles and sells them for less than most other carpets.

The Buy Recycled Business Alliance, a 33 member business coalition committed to buying recycled-content products and materials. In less than one year, they are responsible for $3 billion in purchases of these products.

Aluminum cans and virtually all products made with steel contain a high percentage of recycled content. These two industries benefit from the heavy input of recycled material and can serve as models for the lagging paper and plastics industries.

Source: Harvard Business Review, 1993

often consider recycling programs too costly. They also may not consider recycling a reliable way to handle municipal waste, because success in recycling depends heavily on markets for secondary materials as well as public participation levels, both of which can fluctuate widely. This can make recycling efforts costly, but Biddle (1993) reminds us, "all solid waste management is expensive, regardless of the method used."

Road Blocks to Recycling

Myths: Recycled products are expensive, of inferior quality, less predictable, and more subject to contamination.

Slowly evolving technologies: We are far behind the more sophisticated European waste management infrastructure.

Supply/demand discrepancies: We need to create markets for recycled goods. You and I need to buy recycled goods.

Landfill tipping fees are too low: Even though they are on the rise, it is less expensive to haul waste to the dump than to reuse it.

Source: Harvard Business Review, 1993

Is recycling working, and if not, why not? Primarily because of the current lack of markets for recycled goods, recycling has led to a surge in supply of some types of recycled goods. This surplus has overwhelmed the ability of industries to process and use them (Lewis 1993). Paper is one example. Newsprint paper is an ideal material to recycle - it is the major item in curbside collection, consumes the most space in landfills (34 percent), and is readily reprocessed. Yet as with other recycled materials, it competes on the open market with virgin stock paper. It often loses because the cost of collecting and processing recyclable materials drives their prices up. Even if prices are brought down and adequate markets are found, just how much newspaper can be economically recycled is unclear. According to a Harvard Business Review (1993) report, "many garbage experts believe that no more than 60 to 70 percent of newsprint can be recycled. We already recycle 44 percent." These problems are compounded by a current over-capacity in virgin newsprint. This is why some efforts to institute mandatory recycling programs are greeted unfavorably. To demand recycling without creating markets for the goods could produce exactly opposite effects of those intended. Some analysts question whether recycled goods can recoup costs competitively (Berss 1991). It is here, according to opponents of mandatory recycling, that the economics of recycling falls apart. While there is the need for more markets, competition and regulations will likely drive them into place. A study released by Tellus Institute, a nonprofit research organization in Boston (Rathje and Murphy), reports that most industries have found that using recycled materials is technologically feasible, and that this has reduced toxic pollutants, greenhouse gases, and ozone-depleting emissions. The American Paper Institute reports that paper mills using recycled materials were five times more profitable last year than those using virgin fiber (Rathje and Murphy). According to Biddle (1993), some analysts feel that it is just this market uncertainty which can be harnessed by companies to turn the growing demand for recycled products into a competitive advantage. Similarly, the stimulus of environmental regulations can encourage manufacturers to invest in new technologies which can make them more competitive in the long run, as has occurred in Germany. This may be important in light of the fact that as recently as the late 1980s, most large companies were still investing in plant upgrades for handling virgin natural resources. In order to produce recycled products of equivalent quality and price, industry must now invest heavily in new technologies. R&D investment on this scale will occur for only two reasons: anticipated profits and the threat of competition (Harvard Business Review (1993). The success of recycling in the long run, it seems, will not depend on how much land fill space is saved, but on whether or not it makes economic sense.

So what about our dilemma? Any plan to stem the rising tide of garbage needs to focus on ways to maximize waste-source reduction while focusing intensively on developing integrated, municipal recycling and composting programs. While curbside recycling collection may be costly, the success rate may make it worthwhile, especially in populous areas. Mandatory programs yield more recyclable materials than voluntary programs. We will still need to bury or burn the remainder of our trash. What can be done about the poor markets for recyclable materials is less clear. Consumers need to be made aware that, in general, the durability and consistency of today's recycled products are far superior to those on the market just three years ago. This debunks some of the myths believed responsible for consumer hesitation to buy them. So, the question then becomes—"Are you buying recycled/recyclable products when given the option?" Because for all the disagreement about which waste management technology is best, experts generally agree that unless consumers buy recycled products the system falls apart.

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CURRICULUM AIDS

EPA's *Solid Waste Awareness* Curriculum Guide

by Tara Regan

There are many critical environmental issues facing our society today. One of the most important topics being addressed is recycling. Educators are continually searching for up-to-date materials with fresh, new ideas. There are many curriculum and activity guides available through private, non-profit and government agencies. ***Let's Reduce and Recycle: Curriculum for Solid Waste Awareness*** was developed by the U.S. Environmental Protection Agency in 1980 and revised in 1990. This curriculum guide deals with the household waste issue in our disposable society using hands-on, creative activities which may be tied into various subject areas, such as science, art, english, and mathematics. Many of the topics addressed correspond to state and local science and environmental guidelines and may be implemented in the classroom to satisfy these conceptual areas.

Let's Reduce and Recycle was first published in 1980 after testing the topics and activities in Somerville, Massachusetts. The purpose of the program was to inform residents about recycling through their children with hopes enhancing local recycling efforts. The curriculum guide is divided into two grade categories; elementary (K-6) and secondary (7-12) with unit topics and activities which are age appropriate. Each grade level is divided into five units with topics such as *"What Is Waste?"*, *"Where Does Waste Go?"*, *"How Does Waste Affect Our Resources?"*, *"How Can We Produce Less Waste?"*, and a conclusionary unit: *"What Can We Do About Waste?"*. Within each unit are activities designed to make learning fun while stressing the importance of recycling and conservation. Each activities objective is clearly stated and a brief introduction to the subject matter is given. Activities vary from conducting a "litter hunt" on the ride to and from school to starting a school recycling program to constructing mini-landfills. Sample questions are available to enhance to activity and initiate future discussions in these areas. The topics are easily integrate into other subject areas. Aids such as vocabulary lists help in this process. Group and individual activities ie. games and crafts, promote class participation. Follow up activities and field trips are suggested to continue the learning process in this important area.

The curriculum guide is accompanied by a comic book for students focusing on the liter problem and some solutions which may be implemented in individual schools. Also included is a Users Index which suggests ways to tie recycling into other subject areas.

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conservation seems reasonable and necessary. To paraphrase the United Nations Population Fund, the benefits for the environment and for the economy of reducing the rate of population growth and limiting our global population derive not from slower population growth itself, but from all factors associated with it, including improvements in education, health, access to family planning, women's status, and women's access to the labor market. Living sustainably means using the best available, energy-efficient technologies, conserving resources, and embracing ecological concepts which help us determine the boundaries of our existence.

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Over all, ***Let's Reduce and Recycle: Curriculum for Solid Waste Awareness*** is easy to use, comprehensive, and up-to-date with interesting topics and activities. The units and activities are clearly labeled and easily organized. The simple organization allows for the development of individualized activities for a variety of ability levels in the same classroom. This assists educators by keeping an entire class interested, whether on a lower level or a more advanced level. The curriculum guide is easily intergrated into the classroom curriculum and current events.

To order this and associated publications at no cost from EPA, contact:
The RCRA Information Center (OS-305), U.S. EPA
401 M Street SW,
Washington DC 20460.

CONSTRUCTING AN EXPONENTIAL PROGRESSION

Exponential (or geometric) progression is a difficult concept for some students to visualize. Use a sheet of paper to illustrate exponential increase of a population that doubles with each generation. Ask students how many times they think they can fold a sheet of paper (in half with each fold). Have them try it. Then ask them how thick the paper will be with each folding if a single sheet is 0.001 inches thick (8 doublings would make the paper 0.256 inches thick). Ask them to guess how thick a single sheet of paper would be if they could make 53 doublings (obviously, the sheet would need to be pretty wide to begin with in order to make the folds). Write their guesses on the board. Do they have a good grasp of exponential progression of population doublings? The paper would be 140 million miles thick (larger than the distance from the Earth to the Sun)!! Do the calculations on the board. Lead a discussion of the consequences of a population doubling for each of 53 generations. At present annual growth rates, the world population will double in 39 years.

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