WHAT’S GOING ON WITH OUR GARBAGE?

CONSUMPTION & RECYCLING

WHAT'S GOING ON WITH OUR GARBAGE?

How Times Have Changed

Sunshine State Standards: SS.B.2.4.1, SS.B.2.4.2
SS.B.2.4.4, SS.B.2.4.6

Objectives

Students will: (1) interview parents, grandparents, or other adults regarding their past lifestyles and (2) compare the waste management impacts of past and present lifestyles.

Method

Students interview adults, compare past and present lifestyles, technologies and values, and discuss the waste produced as a result of past and present lifestyles.

Background

In the past 40 years, Florida's population has grown from 5 million (1960) to almost 16 million (2000). During the past decade, Florida's population grew at a rate of 23.5 percent, greater than all but six other states. In that time, the state's population expanded by an average of 300,000 new people annually, or the equivalent of one new Tampa per year. Florida is projected to have more than 18 million people by 2010.

In spite of efforts to increase awareness about solid waste problems or reduce packaging or other wastes in the state, Florida's continued population growth will result in continued increases in the amount of solid waste generated each year. In 1988, Florida generated 16 million tons of solid waste. In 1998, Florida generated approximately 87 million tons of solid waste. With the projected rate of population growth, Florida will generate almost 107 million tons of solid waste per year by the year 2010.

In addition to changes in the amount of solid waste generated in Florida and the U.S. over the past 40 years, changes in technology, lifestyles and the economy have resulted in changes in the composition of the nation's solid waste. For example, over the past 40 years, the percentages of food and yard waste have declined while the percentages of plastic and paper waste have increased.

Today, we are used to consuming as much as we want and can afford, as well as disposing of old items whenever we want new ones, without considering the consequences of our actions. This "throwaway lifestyle" coupled with our growing population is seriously threatening environmental quality.

The increased consumption of resources and disposal of wastes pollutes our air and water, depletes the soil and destroys the habitats of other organisms with which we share the planet. In order to ensure continued environmental quality in Florida, residents need to examine the impact of their current lifestyles and consider potential changes in their lifestyles.

Materials

SAYINGS AND SLOGANS interview sheet (one per student)
HOW TIMES HAVE CHANGED (student handout or transparency)
Tape Recorder (optional)

Procedure

Ask students to imagine themselves as reporters investigating how times have changed since their parents or grandparents were children. Read the following paragraph to students.

Toys for Us

Toys have changed through the years. At one time, most were made of natural materials like wood or rocks. Then they were made of papier-mâché or were handmade country toys like whirligigs, bean shooters, yo-yos, limber jacks and tops. Over time, commercially manufactured toys became available, like wooden Lincoln Logs and Tinker Toys and metal Erector Sets. Then plastic toys came on the market – toy guns, Frisbees, hula hoops and plastic models. Now, battery-operated and electronic toys, pinball games, video games and computers are popular.

1. Ask students to respond to the following questions and encourage them to think of how their parents or grandparents might respond to the same questions.

   a. What were your favorite toys when you were a child? How many toys did you have?
   b. What were your toys made of? Who made them?
   c. How ling did your toys last? Could they be fixed if they broke?
   d. Would it have been cheaper to fix the toy or get a new one? Why? Could you fix a broken toy at home or did someone else have to fix it?
   e. If broken toys could not be repaired, what did you do with them?
   f. How are toys sold today different from those you have when you were little?

2. Distribute copies of the SAYINGS AND SLOGANS interview sheet. Review the sayings and slogans and discuss student responses to questions 1, 2 and 3 on the interview sheet. Tell students to find a parent, grandparent, guardian or other adult to interview. Instruct them to read the first section of the sheet aloud and then ask the interview questions. Tell students that if the person being interviewed doesn't mind, they can tape record the interview.

3. After all interviews have been conducted, have students share their results with the rest of the class. Define the terms “throwaway lifestyle” and “environmental quality” and conduct a whole class discussion addressing the following questions:

   a. How have lifestyles changed in the past 30-50 years?
   b. How have these changes in lifestyles affected environmental quality?
   c. How can we change our present lifestyle in order to improve environmental quality?

4. Handout or project HOW TIMES HAVE CHANGED and ask students to compare past and present waste volume and composition. Have students identify what types of waste materials have increased, decreased, or remained the same in percentage from 1960 to 1990. Finally, as a class, brainstorm individual actions that could help reduce the volume of waste currently generated.

Evaluation

1. Collect completed interview sheets.

2. Have students write a paragraph comparing the waste management impacts of past and present lifestyles.

More

Have students design their own interview scenario and questions regarding past lifestyles and interview teachers.

Action

Have students inform family members and classmates of the waste management impacts of a “throwaway lifestyle” and note any changes in behavior, which occur over time.

SAYINGS AND SLOGANS

Part 1 – Statements to Start the Conversation

You've all heard sayings like:

"A stitch in time saves nine."
"Waste not, want not."
"An ounce of prevention is worth a pound of cure."
"Built to last a lifetime."

More recently we hear slogans like;

"Quick and easy to use."
"No mess, no bother."
"Disposable."
"Individually wrapped for your convenience."
"They sure don't make 'em like they used to."

Part 2 - Interview Questions

1. What other similar sayings and slogans can you think of?
2. What are these slogans saying about our lifestyles and how they've changed?
3. Which messages point out product quality? Which emphasize product convenience?
4. Are products today built to be durable, convenient to use, or both? Why or why not? What do you think about this?
5. What qualities in products did people appreciate when you were growing up? Has that changed over time? How?
6. Did people take better care of their belongings when you were growing up than they do now? Why? How many pants, dresses or pairs of shoes did you have? What were the clothes made of? When clothes tore or wore thin, were they repaired or were new ones purchased? What did you do with old clothes?
7. Can you show me a family heirloom and describe the qualities that make it so special?
8. Why are we attracted to items that are "new and improved?"
9. Are we more wasteful today? In what ways? Why?
10. What types of things did you throw out in the trash when you were growing up? Were they similar to what we throw out today? What containers did you use for trash? What did you do with trash? Did you have as much trash to throw away then as you do now?

HOW TIMES HAVE CHANGED
Materials Discarded Into The U.S. Waste Stream (1960-1990)
(Percent Of Total Discards)

MATERIAL	1960	1970	1980	1990
Paper and paperboard	30.0	32.4	32.5	36.8
Glass	7.8	11.1	11.0	8.3
Metals				
Ferrous	12.1	11.0	8.7	7.4
Aluminum	0.5	0.7	1.1	1.3
Other Nonferrous	0.2	0.3	0.3	0.2
Plastics	0.5	2.7	5.9	7.9
Rubber and Leather	2.1	2.7	3.2	2.3
Textiles	2.1	1.8	2.0	2.0
Wood	3.7	3.6	3.8	3.6
Food Wastes	14.9	11.4	9.2	8.4
Yard Wastes	24.05	20.6	20.5	19.8
Miscellaneous				
Inorganic wastes	1.6	1.6	1.7	1.9
TOTAL WASTE	**100.0**	**100.0**	**100.0**	**100.0**

(*Totals may not add to 100.0 due to rounding)

WHAT'S GOING ON WITH OUR GARGAGE?

A SEA OF PLASTICS

Sunshine State Standards: LA.C.1.4.1, LA.C.1.4.3, LA.C.2.4.1, LA.C.3.4.1
LA.C.3.4.2, LA.A.1.4.1, LA.A.1.4.4,
SC.D.2.4.1, SC.G.2.4.4, SC.G.2.4.6

Objectives

Students will: (1) identify pertinent information regarding the negative effects of plastic waste on wildlife and (2) determine individual actions which can help reduce the magnitude of the plastic pollution problem.

Method

Students read segments of a magazine article about plastics and wildlife and share pertinent information from their segment with the class. *Plastics at Sea* by D.H.S. Wehle and Felicia C. Coleman is reprinted with permission form Natural History, Vol. 92, No. 2; Copyright the American Museum of Natural History, 1983.

Background

Since the early 1970's, the amount of plastic in the marine environment has increased dramatically. Plastic negatively affects wildlife in a number of ways. Some animals, mistaking plastic for food, eat it. For example, approximately 15 percent of the world's 280 species of sea birds are known to have eaten plastic in the form of pellets, bits of Styrofoam, even plastic toy soldiers. In addition, sea turtles, apparently regarding plastic bags as jellyfish upon which they regularly feed, have been found with balls of plastic in their stomachs. Other animals found to have eaten plastic in one form or another are whales, dolphins, bottom fish, manatees, sea snails, worms and plankton. Another damaging effect of plastic trash on wildlife is the entanglement of animals in everything from six-pack holders to plastic rings, discarded fishing line and nets. In 1975, the National Academy of Sciences estimated that commercial fishing fleets alone dumped more than 52 million pounds of plastic packaging material into the sea and lost approximately 298 million pounds of plastic fishing gear, including nets, lines and buoys. An estimated 14 billion pounds of all types of trash are dumped into the sea each year.

Materials

Plastics at Sea Reading Sections (one copy of assigned section per student)
PLASTIC TRASH AND WILDLIFE worksheet (one per student)
PLASTIC TRASH AND WILDLIFE teacher sheet
Samples of potentially harmful plastic trash (Styrofoam pieces, plastic bags, plastic six-pack holders, plastic fishing nets, monofilament fishing line, small plastic toys)
Dictionary.

Procedure

1. Pass around samples of potentially harmful plastic trash and ask students how such trash might affect wildlife.

2. Divide students into 10 equal-sized groups. Explain that each group will be responsible for reading and discussing one section of a scientific magazine article about plastic trash and wildlife. Each group will then present pertinent information from its section of the article to the rest of the class.

3. Distribute copies of a different section of the reading to each group and assist students with difficult terms if necessary. Encourage students to look up the definitions of unfamiliar terms in a dictionary.

4. When all groups have finished reading and discussing their sections, distribute the PLASTIC TRASH AND WILDLIFE worksheet. Instruct each group to share pertinent information from its section of the reading with the rest of the class. Students should then use this information from each group to answer all of the questions on the worksheet.

5. Conclude the class with a discussion of major concepts addressed in the reading. Stress the following ideas:

    a. The "plastics at sea" problem is a global one, and solving the problem will require international cooperation.

    b. There are many things the plastic industry and consumers of plastic can do to help solve the problem.

    c. The first step in combating the plastic pollution problem is education of industry and the public.

6. Ask students to identify individual actions that could help solve the "plastics at sea" problem (e.g. writing letters to government officials regarding legislation, participating in a beach cleanup, not discarding plastic in waterways, etc.)

Evaluation

1. Collect completed worksheets and compare student responses with those on the teacher sheet.

2. Have students identify at least two individual actions they can take to help solve the plastic pollution problem.

Action

As a class, participate in a statewide Beach Cleanup Day. Information about beach clean-ups is available in a six-page brochure called The Coastal Connection. The brochure is available through the Center for Marine Conservation (CMC), 1725 DeSales Street, N.W., Washington, D.C. 20036. Phone: (202) 429-5609. The CMC also published a book entitled A Citizen's Guide to Plastics in the Ocean: More Than a Litter Problem.

To participate in a statewide beach cleanup day contact the:

Clean Florida Commission
605 Suwannee Street, Mail Station 2
Tallahassee, FL 32399-0450
(904) 488-2756

GROUP 1 READING SECTION

Throughout the 1970's, a number of biologists studying the feeding habits of sea birds in different oceans of the world recounted the same story: the birds were eating plastic. Similar reports of plastic ingestion and of entanglement in plastic debris began to surface for other marine animals – fish off southern New England, turtles off Costa Rica and Japan, whales in the North Atlantic. At the same time, plastic particles turned up in surface plankton samples from both the Atlantic and Pacific Oceans; plastic debris was retrieved by benthic trawls in the Bering Sea and Britain's' Bristol Channel; and plastic pellets washed ashore in New Zealand in such large numbers that some beaches were literally covered with "plastic sand." By the close of the decade, marine scientists around the world had become aware of a new problem of increasing ecological concern – plastics at sea.

Two forms of plastic exist in the marine environment: "manufactured" and "raw." Manufactured plastic material along beaches and adrift at sea is primarily refuse from transport, fishing and recreational vessels. In 1975, the National Academy of Sciences estimated that commercial fishing fleets alone dumped more than 52 million pounds of plastic packaging material into the sea and lost approximately 298 million pounds of plastic fishing gear, including nets, lines and buoys.

Raw plastic particles – spherules, nibs, cylinders, beads, pills and pellets – are the materials from which products are manufactured. These particles, about the size of the head of a wooden match, enter the ocean via inland waterways and outfalls from plants that manufacture plastic. They are also commonly lost from ships, particularly in the loading and unloading of freighters. Occasionally, large quantities are deliberately dumped into the sea.

GROUP 2 READING SECTION

Plastics turn up everywhere. Along portions of the industrialized coast of Great Britain, concentrations of ray particles have reached densities of about 2,000 pieces per square foot in benthic (bottom) sediments. Near Aukland, New Zealand, 100,000 pieces of plastic were found every three lineal feet of beach. Particles have also washed ashore on beaches in Texas, Washington, Portugal, Colombia, Lebanon and at such remote sites as the Aleutian and Galapagos Islands.

Much of what we know about the distribution patterns and abundance of raw plastic in the world's oceans comes form plankton sampling of surface waters. Between 1972 and 1975, for example, the Marine Resources Monitoring, Assessment and Prediction Program, a nationally coordinated program of the National Marine Fisheries Service, recorded plastic particles in plankton samples collected between Cape Cod and the Caribbean Sea. The majority of the particles were found to have entered the ocean from the coast of southern New England and the highest concentrations were usually in coastal waters. Raw plastic, however, was ubiquitous in the open ocean and especially common in the Sargasso Sea. This suggests that winds and currents are instrumental in redistributing and concentrating particles in certain oceanographic regions.

Inevitably, many animals foraging in the marine environment will encounter and occasionally ingest these widely distributed plastic materials. One of the first records of plastic ingestion appeared in 1962 for an adult Leach's storm petrel collected off Newfoundland. Four years later, researchers in the Hawaiian Islands found that the stomach contents of young Laysan albatrosses contained plastic, apparently fed them by their parents.

GROUP 3 READING SECTION

For the most part, these early reports (of plastic ingestion and entanglement) were treated as curious anecdotes included in studies of the feeding ecology of a few sea birds. During the 1970's and early 1980's, however, with the proliferation of such anecdotes, biologists began paying closer attention and were surprised to find how frequently plastic occurred in the stomach contents of certain Procellariids from the North Pacific and the North Atlantic (short-tailed shearwaters, sooty shearwaters and northern fulmars) and alcids from the Northern Pacific (parakeet auklets and horned puffins). Lower frequencies were reported for other Northern Hemisphere sea birds, including phalaropes, gulls, terns and also other procellariids and alcids. The feeding habits of marine birds in southern oceans have not been studied as extensively, but plastic ingestion has been documented for several species of procellariids (petrels, shearwaters and prions) in the South Atlantic, South Pacific and sub-Antarctic water. To date, approximately 15 percent of the world's 280 species of sea birds are known to have ingested plastic.

Sea birds choose a wide array of plastic objects while foraging: raw particles, fragments of processed products, detergent bottle caps, polyethylene bags and toy soldiers, cars and animals. Marine turtles on the other hand, consistently select one item – plastic bags. In the past few years, plastic bags have been found in the stomachs of four of the seven species of marine turtles: leatherbacks for New York, New Jersey, French Guiana, South Africa and the coast of France; hawkbills on the Caribbean coast of Costa Rica, greens in the South China Sea and in Japanese, Australian and Central American coastal waters; and olive ridleys in the Pacific coastal waters off Mexico. Evidence points to plastic ingestion in loggerheads, as well, based on liver samples containing high concentrations of a plasticizer (a chemical compound added to plastic to give it elasticity). Polystyrene spherules have been found in the digestive tracts of one species of chaetognath (transparent, wormlike animals) and eight species of fish in southern New England waters. They have also turned up in sea snails and in several species of bottom-dwelling fishes in the Severn Estuary of southwestern Great Britain.

GROUP 4 READING SECTION

Marine mammals are not exempt from participation in the plastic feast. Stomachs of a number of beached pygmy sperm whales and rough-toothed dolphins, a Cuvier's beaked whale and a West Indian manatee contained plastic sheeting or bags. In addition, Minke whales have been sighted eating plastic debris thrown from commercial fishing vessels. Curiously, plastic has not been found in any of the thousands of ribbon, bearded, harbor, spotted, ringed or northern fur seal stomachs examined from Alaska.

The obvious question arising from these report is, why do marine animals eat plastic? In the most comprehensive study to date, Robert H. Day of the University of Alaska maintains that the ultimate reason for plastic ingestion by Alaskan sea birds lies in plastic's similarity – in color, size and shape – to natural prey items. In parakeet auklets examined by Day, for example, 94 percent of all the ingested plastic particles were small, light brown and bore a striking resemblance to the small crustaceans on which the birds typically feed.

Marine turtles also mistake plastic objects for potential food items. Transparent polyethylene bags apparently evoke the same feeding response in sea turtles, as do jellyfish and other medusoid coelenterates, the major food item of leatherbacks and subsidiary prey of greens, hawkbills, loggerheads and ridleys.

Sea birds, marine turtles and marine mammals all eat plastic. So what? Perhaps ingesting plastic is inconsequential to their health. After all, cows are known to retain nails, metal staples and strands of barbed wire in their stomachs for more than a year with no ill effects. For marine animals, however, the evidence is growing that in some cases at least, ingested plastic causes intestinal blockage. George R. Hughes of the Natal Parks Board, South Africa, extracted a ball of plastic from the gut of an emaciated leatherback turtle; when unraveled, the plastic measured nine feet wide and twelve feet long. There is little doubt that the plastic presented an obstruction to normal digestion. Similarly, a mass mortality of green turtles off Costa Rica has been attributed to the large number of plastic banana bags eaten by the turtles.

GROUP 5 READING SECTION

The 20 dead red phalaropes discovered on a beach in southern California, all with plastic in their digestive tracts, present a less clear cast (regarding the effect of plastic ingestion on animal health). Did the birds suffer an adverse physiological response after eating plastic or were they already under stress because of a reduced food supply and eating the plastic in a last-ditch effort to prevent starvation? The same question applies to other instances of emaciated animals that have eaten plastic. At this time, we don't have an answer.

We do know that plastic is virtually indigestible and that individual pieces may persist and accumulate in the gut. Ingested plastic may reduce an animal's sensation of hunger and thus inhibit feeding activity. This, in turn, could result in low fat reserves and an inability to meet the increased energy demands of reproduction and migration. Plastic may also cause ulcerations in the stomach and intestinal linings and it is suspected of causing damage to other anatomical structures. Finally, ingestion of plastic may contribute synthetic chemicals to body tissues. Some plasticizers, for example, may concentrate in fatty tissues, their toxic ingredients causing eggshell thinning, aberrant behavior, or tissue damage. When highly contaminated tissues are mobilized for energy, these toxins may be released in lethal doses.

Publication of data on plastic ingestion is in its infancy. As the problem gains notoriety, it will certainly be revealed to be even more widespread than is now recognized. There are already several known instances of secondary ingestion, in which plastic consumed by animals feeding at low trophic levels shows up in higher-level consumers. The remains of a broad-billed prion, together with the plastic pellets it had ingested, were found in the castings of a predatory South Polar skua in the South Atlantic; plastic pellets found in the Galapagos Islands were traced from transport vessels in Ecuadorian ports through a food chain involving fish, blue-footed boobies and finally, short-eared owls.

GROUP 6 READING SECTION

A more obvious effect of plastic pollution is the aesthetic one. Whether we venture deep into the woods, high atop a mountain or out on the ocean to escape the trappings of civilization, our experience of the natural world is often marred by the discovery of human litter. Even more disturbing to the spirit is the sight of a young pelican dangling helplessly from its nest by a fishing line, a whale rising to the surface with its flukes enshrouded in netting, or a seal nursing wounds caused by a plastic band that has cut into its flesh. Unfortunately, such observations are becoming more and more common, another consequence of plastics at sea.

During the last 20 years, fishing pressure has increased dramatically in all the world's oceans and with it, the amount of fishing-related debris dumped into the sea. In addition, the kind of fishing equipment finding its way into the ocean has changed. Traditionally, fishing nets were made of hemp, cotton or flax, which sank if not buoyed up. These materials disintegrated within a relatively short time and because of the size of the fibers, were largely avoided by diving sea birds and marine mammals. With the advent of synthetic fibers after World War II, however, different kinds of nets came into use. These new nets were more buoyant and longer-lived than their predecessors, and some of them were nearly invisible under water.

The result of these changes in net materials has been a tragic increase in mortality of air-breathing animals. A few examples are sufficient to give an idea of the magnitude of the problem. During the heyday (1972-76) of the Danish salmon fishery in the north Atlantic, the incidental catch of thick-billed murres amounted to three-quarters of a million birds annually; in 1980, 2,000 sea turtles off the southeastern coast of the United States drowned when incidentally caught in shrimp trawl nets. Incidental catch refers to nontarget animals that are accidentally caught in an actively working net. Another kind of net-related mortality is known as entanglement and refers to any animal caught in a net that has been lost or discarded at sea. Some government officials estimate that about 50,000 northern fur seals currently die in the North Pacific each year as a result of entanglement in fishing gear. Unlike working nets, which fish for specific periods of time, these free-floating nets, often broken into fragments, fish indefinitely. When washed ashore, they may also threaten land birds and mammals; in the Aleutians Islands, for example, a reindeer became entangled in a Japanese gill net.

GROUP 7 READING SECTION

Plastic strapping bands – used to secure crates, bundles of netting, and other cargo – are another common form of ship-generated debris. Discarded bands are often found girdling marine mammals, which are particularly susceptible to entanglement because of their proclivity for examining floating objects. The instances of seal entanglement in plastic bands has increased so remarkably in the past two decades that fur seal harvesters in Alaska and South Africa now monitor the number of ringed animals.

Sea birds that frequent recreational waters or coastal dumps are also subject to ringing by the plastic yokes used in packaging six-packs of beer and soda pop. Gulls with rings caught around their necks are sometimes strangled when the free end of the yoke snags on protruding objects. Similarly, pelicans, which plunge into the water to feed, run the risk of diving into yokes. If the rings become firmly wedged around their gills, the birds may starve.

Not all encounters with plastic prove harmful to marine organisms. Some animals are incorporating the new material into their lives. Algae, hydrozoans, bryozoans, polychaetes (marine worms), and small crustaceans attach to plastic floating at sea; bacteria proliferate in both raw and processed plastic refuse. Plastic provides these organisms with long-lived substrates for attachment and transport; in some cases, hitching a ride on floating pieces of plastic may alter an organism’s normal distribution. Several species of tube-dwelling polychaetes construct the tubes of raw plastic particles present in benthic (bottom) sediments. Other invertebrates such as sand hoppers and periwinkles, find temporary homes in aggregates of plastic particles they encounter on beaches. Marine birds all over the world incorporate plastic litter into their nests, but in this case, the use of plastic may be harmful because chicks can become entangled in the debris and die.

GROUP 8 READING SECTION

Instances of marine animals adapting to this new element (plastic) in their environments do not alter the predominately negative effect of plastics at sea. The problem is global and its solution will require international cooperation. Historically, the high seas have, in many respects, been considered an international no-man's land. Recently, however, perception of the ocean as a finite and shared resource has caused many nations to express concern for its well-being.

In 1970, the U.S. Congress passed the National Environmental Policy Act, which, among other things, pledged to "encourage productive and enjoyable harmony between man and his environment." Subsequently, a number of laws on waste disposal were adopted, two of which affect pollution by plastics: the Federal Water Pollution Control Act (commonly known as the Clean Water Act) and the Marine Protection, Research and Sanctuaries Act (Ocean Dumping Act). The Clean Water Act does not specifically address the problem of persistent plastics but does require all significant polluters of US waterways to obtain a federal permit under which limits are set on, among other things, discharges of solid matter. The Ocean Dumping Act prohibits the deliberate dumping of significant amounts of persistent plastic materials at sea. Having these laws on the books, however, does not immediately solve the problem. Small-scale refuse disposal on the high seas is difficult to regulate; fishermen who claim to have unintentionally lost their nets at sea cannot be held responsible; and illegal large-scale dumping at sea is hard to detect. Granted, laws must be tightened, but enforcement is really the bigger problem.

On the international level, the problems of water pollution and litter in the oceans were highlighted at the United Nations Conference on the Human Environmental held in Stockholm in 1972. The conference, with 110 nations represented, defined the need for international policy on marine pollution among coastal and maritime nations. Treaties to implement such policy soon followed: the 1972 London Convention on the Prevention of Water Pollution by Dumping of Wastes on Other Matter (Ocean Dumping Convention), a part of which specifically prohibits marine dumping of persistent plastic material; and in 1973, London International Convention for the prevention of Pollution from Ships (Marine Pollution Convention), which is broader in scope and regulates the control of oil pollution, packaged substances, sewage and garbage. While neither of these treaties has been adopted by all nations, they represent a start toward global control of marine pollution.

GROUP 9 READING SECTION

In the meantime, the quantity of plastics in the world's oceans will undoubtedly continue to mount. Ironically, the very characteristics that make plastic appropriate for so many uses – its light weight, strength and durability – lead to the majority of problems associated with its presence at sea. As organic material, plastic is theoretically subject to degradation by mechanical, oxidative or microbial means. Owing to the strength of most plastics, however, mechanical degradation by wave action is generally restricted to the breaking of large pieces into smaller ones. Photooxidation and microbial action are limited by plastic's high molecular weight and its antioxidants, ultraviolet light stabilizers and biocide additives, which effectively immunize it against degradation. The longevity of plastics in seawater is not known, but on the beach, particles may last from five to more then fifty years.

Given plastic's long life and projected annual increases in production, one thing is clear – the rate of plastic deposition in the marine environment will continue to be higher then the rate of disappearance. In a study of the accumulation of plastic on the beaches of Amchitka Island, Theodore R. Merrell, Jr., of the National Marine Fisheries Service, recorded that 550 pounds of plastic litter were added to less than a mile of beach in one year. He also found an increase of more than 250 percent in both the number and the weight of plastic items washed ashore over a two-year period.

GROUP 10 READING SECTION

Outside the realm of laws and treaties, solutions to the (plastics at sea) problem can come from both inside and outside the plastic industry. The technology to manufacture degradable plastics is available. In fact, one of the beauties of plastic is that its properties can be altered and its life expectancy prescribed. Alaska (and Florida) have already taken steps toward reducing plastic litter by requiring that plastic six-pack yokes be made of a self-destructing compound. Another, but perhaps less workable solution, given the logistics and expense involved and the degree of business and public cooperation required, lies in recyclable plastics. At the very least, all countries should require that the discharge of raw plastic particles from industrial plants be reduced by filtering outflow before it enters waterways. A recent decline in the uptake of plastic by marine organisms in southwester England has been attributed, in part, to the efforts of one of the major contaminating plants to filter, collect and reuse raw particles present in its effluent.

Consumers share with industry the responsibility to reduce the amount of plastic in the sea. Recreational boaters, beach-goers and commercial fishermen all discard plastic refuse. Preferably, no trash plastic – bands, netting or other debris – should ever be tossed overboard or left on a beach. If six-pack yokes or strapping bands must be discarded at sea, the rings should be cut first so that they pose less of a threat to marine animals.

The first step in combating plastic pollution is to alert both industry and the general public to the gravity of the problem and the need to do something about it soon. Education alone cannot solve the problem but it is a beginning. Public awareness of a problem, combined with the resolve to correct it, can bring dramatic results.

PLASTIC TRASH AND WILDLIFE

Group 1 Questions

1. During what decade did scientists around the world first become aware of the "plastics at sea" problem? ______________________________

2. What are the two forms of plastics found in the sea? ______________________________

3. In 1975, how many estimated pounds of plastic packaging material was dumped into the sea by commercial fishing fleets? ______________________________

Group 2 Questions

4. Where have plastics from the sea eventually turned up? ______________________________

5. Where do the majority of U.S. plastic particles enter the Atlantic Ocean? ________
____

6. What two factors are instrumental in redistributing and concentrating plastic particles in certain regions of the sea? ______________________________

Group 3 Questions

7. What percent of the world's 280 species of sea birds are known to have ingested plastic? ______________________________

8. What type of plastic do marine turtles consistently select to eat? ______________

9. What types of animals have "raw" plastic (polystyrene spherules) been found in?
______________________, ____________________, and ______________________________

Group 4 Questions

10. Name three types of marine mammals that eat plastic. ______________________
______________________________, and ______________________________

11. Why do marine animals eat plastic? ______________________________

12. How can eating plastic harm marine turtles? ______________________________

Group 5 Questions

13. Plastic accumulates in the guts of animals and persists forever because plastic is
____

14. When plasticizers (chemicals in plastic) concentrate in fatty tissues of animals, what harmful effects can they cause? ______________________________

15. When plastic eaten by animals at low levels of the food chain shows up in animals at higher levels of the food chain, it is called ______________________________

Group 6 Questions

16. When non-target animals are accidentally caught and drowned in fishing nets, it is called an ________________________________

17. When animals get caught and die in nets that have been lost or discarded at sea, it is called ________________________________

18. How many estimated northern fur seals die in the North Pacific each year as a result of entanglement? ____________________________

Group 7 Questions

19. How can six-pack rings harm animals? ____________________

20. How do sand hoppers and periwinkles use plastic? ______________

21. How can using plastic litter in nests harm birds? _______________

Group 8 Questions

22. What will be required to solve the plastics at sea problem? ____________

23. What two U.S. laws affect pollution by plastics? ________________

24. What two international treaties address the marine pollution problem? ______

Group 9 Questions

25. What three characteristics make plastic so useful for man and so dangerous for sea life? ________________________________

26. How long may plastic particles on the beach last? _______________

27. On Amchitka Island, how many pounds of plastic litter were added to less than a mile of beach in one year? ____________________________

Group 10 Questions

28. Name one way the plastic industry can help solve the plastics at sea problem?

29. How can consumers reduce the amount of plastic in the sea? __________

30. What is the first step in combating plastic pollution? ______________

PLASTIC TRASH AND WILDLIFE

Teacher's Edition

Group 1 Questions

1. During what decade did scientists around the world first become aware of the "plastics at sea" problem? **1970's**

2. What are the two forms of plastics found in the sea? **Manufactured & raw**

3. In 1975, how many estimated pounds of plastic packaging material was dumped into the sea by commercial fishing fleets? **52 millions pounds**

Group 2 Questions

4. Where have plastics from the sea eventually turned up? **Everywhere**

5. Where do the majority of U.S. plastic particles enter the Atlantic Ocean? **The coast of southern New England**

6. What two factors are instrumental in redistributing and concentrating plastic particles in certain regions of the sea? **Winds and currents**

Group 3 Questions

7. What percent of the world's 280 species of sea birds are known to have ingested plastic? **15**

8. What type of plastic do marine turtles consistently select to eat? **Plastic bags**

9. What types of animals have "raw" plastic (polystyrene spherules) been found in? **Chaetognath**, **Fish**, and **Sea snails**

Group 4 Questions

10. Name three types of marine mammals that eat plastic. **Whales** **Dolphins**, and **Manatees**

11. Why do marine animals eat plastic? **Plastic looks like the animals' natural food**

12. How can eating plastic harm marine turtles? **It can block their intestines**

Group 5 Questions

13. Plastic accumulates in the guts of animals and persists forever because plastic is **Indigestible**

14. When plasticizers (chemicals in plastic) concentrate in fatty tissues of animals, what harmful effects can they cause? **Eggshell thinning, aberrant behavior, tissue damage**

15. When plastic eaten by animals at low levels of the food chain shows up in animals at higher levels of the food chain, it is called **Secondary ingestion**

Group 6 Questions

16. When non-target animals are accidentally caught and drowned in fishing nets, it is called an **Incidental catch**

17. When animals get caught and die in nets that have been lost or discarded at sea, it is called **Entanglement**

18. How many estimated northern fur seals die in the North Pacific each year as a result of entanglement? **50,000**

Group 7 Questions

19. How can six-pack rings harm animals? **Strangulation & starvation**

20. How do sand hoppers and periwinkles use plastic? **For temporary homes**

21. How can using plastic litter in nests harm birds? **Chicks can become entangled and die**

Group 8 Questions

22. What will be required to solve the plastic at sea problem? **International Cooperation**

23. What two U.S. laws affect pollution by plastics? **The Clean Water Act and the Ocean Dumping Act**

24. What two international treaties address the marine pollution problem? **The Ocean Dumping Convention and the Marine Pollution Convention**

Group 9 Questions

25. What three characteristics make plastic so useful for man and so dangerous for sea life? **Light weight, strength and durability**

26. How long may plastic particles on the beach last? **5 to more than 50 years**

27. On Amchitka Island, how many pounds of plastic litter were added to less than a mile of beach in one year? **550 pounds**

Group 10 Questions

28. Name one way the plastic industry can help solve the plastics at sea problem? **manufacture degradable plastic, manufacture recyclable plastics, filter outflow from raw plastic manufacturing plants**

29. How can consumers reduce the amount of plastic in the sea? **Don't discard plastic trash in the ocean or on a beach**

30. What is the first step in combating plastic pollution? **Alert industry and the public to the problem**

WHAT'S GOING ON WITH OUR GARBAGE?
THE DOLLARS AND SENSE OF SODA CONTAINERS

Sunshine State Standards: SS.D.1.4.1
SS.D.2.4.2

Objectives

Students will: (1) compare the consumer costs, energy expenses and solid waste volume of different soda containers and (2) use data from comparisons to determine the economic, environmental and energy use impacts of different forms of soda containers.

Method

Students examine and analyze data regarding the consumer costs, energy expenses and solid waste volume of different soda containers.

Background

In the past, beverages like milk and soda were packaged in refillable thick glass bottles. After each use, the bottles were sterilized before being reused. The first throwaway or disposable glass beverage bottles were developed 1931 but they were not widely used until the late 1950's. The first aluminum beverage can appeared in 1963 and today beverage cans account for the largest single use of aluminum. In 1985, more than 70 billion beverage cans were used; almost 66 billion (94%) were aluminum.

Although disposable glass, aluminum and plastic beverage containers are often more convenient then returnable ones, this convenience has a price. Disposable beverage containers take more energy to produce, cost more to manufacture and have greater environmental impacts associated with disposal than returnable containers.

Materials

Samples of four different types of soda containers (returnable glass bottle, no deposit-no-return glass bottle, plastic bottle, aluminum can)
THE TRUE PRICE OF SODA worksheet (one per student)

Procedure

1. Pass around samples of the four different types of soda containers. Ask students to use their existing knowledge to rank order the four types of containers according to the following criteria:
   - Least expensive to purchase, to most expensive to purchase.
   - Cheapest and easiest to manufacture to most expensive and hardest to manufacture.
   - Least environmental impact to most environmental impact.

Briefly discuss student rankings and ask students to share reasons for their rankings.

2. Distribute copies of THE TRUE PRICE OF SODA worksheet. As a class, complete the calculations for items 1, 2 and 3 on the worksheet and use these calculations to fill in the "cost to manufacture" column of the table. Have students complete items 4 through 10 on the worksheet and briefly discuss the economic impacts of each type of soda container. Students can write their responses to questions on a separate sheet of paper if necessary.

3. As a class, discuss items 11 and 12 on the worksheet. Ask students why it is important to consider the energy expenses of different types of containers.

4. Explain that in addition to economic and energy use concerns, the environmental impacts associated with disposing of soda containers should also be considered. Briefly discuss what happens to soda containers after consumers are through using them. Explain that although most soda containers are recyclable currently, most used soda containers are disposed of in landfills. As a class, complete items 13 though 15 on the worksheet.

5. Finally, ask students to use their new knowledge to re-rank the four types of containers according to the following criteria:

a. Greatest economic impact on consumers (most expensive) to lease economic impact on consumers (least expensive);
b. Greatest to least energy expense to manufacture;
c. Greatest to least environmental impact when disposed of.

Have students answer item 16 on the worksheet.

Evaluation

Collect completed THE TRUE PRICE OF SODA worksheets containing calculations and question responses and check for correctness.

More

1. Have students survey local grocery stores and determine the relative abundance of each type of soda container.

2. Have students investigate how each type of soda container is disposed of in the community (how much of each type is land filled, recycled, incinerated).

3. Have students investigate provisions of the Florida Solid Waste Management Act, which affect beverage containers.

Action

1. Have students write letters to retailers and/or manufacturers regarding the energy use and environmental impacts of different types of soda containers. Students could also request that retailers carry returnable glass soda bottles if they are not currently available.

2. Have students encourage family members and classmates to purchase returnable glass soda bottles if they are available in your area.

THE TRUE PRICE OF SODA

The True Price of Soda (per 16 ounce serving of drink and container)				
CONTAINER TYPE	COST TO CONSUMER	ENERGY TO MAKE, TRANSPORT, ETC. (oz. of gasoline equivalent)	COST TO MANUFACTURE (make, transport)	SOLID WASTE Volume/Crushed (in^3)
Returnable glass bottle	$0.21	1.4 oz.		1.4 in^3
Non-returnable glass bottle	$0.35	6.3 oz.		5.8 in^3
Plastic bottle	$0.40	3.1 oz.		7.0 in^3
Aluminum can	$0.48	8.5 oz.		4.0 in^3

Note: There are 128 oz. in one gallon.

1. What is the current average price per gallon of gasoline in your area? _____ cents per gallon.

2. What is the current average price per ounce of gasoline in your area?

$$\frac{\text{price (cents) per gallon}}{\text{128 oz. per gallon}} = \underline{\hspace{4cm}} \text{ cents per ounce}$$

3. Use the cost per ounce of gasoline to determine the manufacturing cost of each type of container. Enter these numbers in the chart above.

Cost of gasoline *(cents per ounce)* X Energy to make *(oz. of gasoline equivalent)* = Cost to manufacture *(cents)*

Use the data in the completed table to answer the following questions. If necessary, record your answers on a separate sheet of paper.

4. What type of soda container is the most expensive to manufacture? Why?

5. What type of soda container is the least expensive to manufacture? Why?

6. What type of soda container is the most expensive to purchase?

7. What type of soda container is the least expensive to purchase?

8. What type of soda container nets the most profit to the manufacturer?
   (cost to consumer – cost to manufacture = net profit)

THE TRUE PRICE OF SODA

(continued)

9. What type of soda container nets the least profit to the manufacturer?

10. If glass bottles are cheaper to manufacture and purchase than aluminum cans, why are more and more soda manufacturers using aluminum rather than glass?

11. That type of soda container takes the most energy to manufacture? Why?

12. Why do non-returnable glass bottles take more energy to manufacture than returnable glass bottles?

13. What type of soda container has the greatest volume when crushed?

14. What type of soda container has the least volume when crushed?

15. What type of soda container has the greatest environmental impact when disposed of in a landfill? Why?

16. What type of soda container has the least economic, energy use and environmental impact?

WHAT'S GOING ON WITH OUR GARBAGE?

TYPES OF "WASTES" & SOLUTIONS

What are "Solid Wastes"?

- Garbage: decomposable wastes from food
- Rubbish: non-decomposable wastes, either combustible (such as paper, wood, and cloth) or noncombustible (such as metal, glass, and ceramics)
- Ashes: residues of the combustion of solid fuels
- Large wastes: demolition and construction debris and trees
- Dead animals
- Sewage-treatment solids: material retained on sewage-treatment screens, settled solids, and biomass sludge
- Industrial wastes: such materials as chemicals, paints, and sand
- Mining wastes: slag heaps and coal refuse piles
- Agricultural wastes: farm animal manure and crop residues.

What do we do with all the garbage?

- Landfills: the cheapest satisfactory means of disposal
- Incinerators: refuse is burned on moving grates in refractory-lined chambers
- Composting: The refuse is placed in long piles on the ground or deposited in mechanical systems, where it is degraded biologically to a humus
- Recycling: The practice of recycling solid waste is an ancient one. Metal implements were melted down and recast in prehistoric times. Today, recyclable materials are recovered from municipal refuse by a number of methods, including shredding, magnetic separation of metals, air classification that separates light and heavy fractions, screening, and washing.

Chemical Wastes

One reason that chemical wastes are dangerous is because they can cause damage to living organisms by imitating important chemicals in the body. Endocrine disruptors are synthetic chemicals that block, mimic or otherwise interfere with naturally produced hormones, the body's chemical messengers, that control how an organism develops and functions. Wildlife and humans are exposed daily to these pervasive chemicals that have already caused numerous adverse effects in wildlife and are most likely affecting humans as well.

Radioactive Substances

- Radioactive substances are hazardous because prolonged exposure to radiation often results in damage to living organisms.
- Nuclear waste has many dangerous characteristics. A person standing one yard away from an unshielded, 10-year-old fuel assembly, would receive a lethal dose of radiation in less than three minutes. A thirty-second exposure at the same distance would significantly increase the risk of cancer or genetic damage. Plutonium, an element found within this waste is considered one of the most toxic wastes known to humankind.

Possible Solutions for Solid Waste

There are some sustainable solutions, options that let us meet our current needs and provide for future generations as well. The most promising alternatives are waste reduction and recycling.

1. Waste Reduction: Stop Throwing Things Out

   A simple and obvious choice is to cut back on the amount of waste by using and throwing out less in the first place.

2. Waste Reduction: Use Less Packaging

   Packaging is one of the major sources of waste paper and plastics.
   Smart buyers can support the use of environmentally friendly packaging by purchasing products with minimal packaging or with packaging made of recycled or recyclable materials.

3. Recycling: Turning Waste Material into Raw Material: Recycling works, and it does so in several ways.

   - It reduces the monetary and environmental costs of land-filling and incineration.
   - It substitutes used materials for virgin materials, thereby reducing the demand for natural resources.
   - It conserves energy.
   - It creates jobs in the community.

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IT PAYS TO BE GREEN IN FLORIDA

--State's recycling and reuse facilities generate $4.4 billion in annual revenue--

TALLAHASSEE -- Recycling in Florida is not just about environmental protection. It's about sound economics. More specifically, it's about the far-reaching financial benefits Florida garners from its thriving recycling and reuse industry. According to the recently published *Florida Recycling Economic Information (REI) Study*, the state's 3,700 recycling and reuse facilities employ 32,000 workers and generate annual revenues of $4.4 billion.

"This ground-breaking report quantifies the size and impact of Florida's recycling and reuse industry, addressing a long-standing need for economic data," said David B. Struhs, Secretary of the Florida Department of Environmental Protection. "Any Floridians still searching for a reason to support recycling need look no further than the results of this report."

The data is impressive. Recycling and reuse establishments maintain an average payroll of $765 million, which is 10-times higher than that of Florida's convenience store industry. In addition, even though Florida's recycling and reuse industry employs only one-fifth the number of people employed by the fast food industry, its total payroll is more than half that of fast food restaurants. The recycling/reuse business also generates $62.7 million in state government revenues each year. The REI study results are already gaining notice and providing critical information to government decision makers, lawmakers, economic development agencies, entrepreneurs, and financiers.

"Good decisionmaking requires quality data. In many ways, understanding the contribution of recycling to Florida's economy will lead to smarter programs that strengthen the entire industry here," said John Ruddell, director of the Florida Department of Environmental Protection's Division of Waste Management.

For many, the economic results of Florida's REI study merely corroborate a long list of well established benefits of recycling and reuse. By converting waste into valuable raw materials, recycling builds more competitive manufacturing industries, cuts pollution, conserves natural resources, saves energy, and reduces greenhouse gas emissions.

"The utilization of recycled materials -- used drywall, glass, and paper for example -- in our production process has far exceeded anyone's expectations," said Clayton H. Sembler, President CDS Manufacturing, Inc. "At current projections, we anticipate up to a 58% reduction in cost-of-goods-sold. In addition to these internal cost savings, our ability to now promote our products as 'green/sustainable' has opened numerous markets/customers opportunities that were previously closed to us or unknown."

The Florida REI study was completed as part of the *U.S. Recycling Economic Information Project,* a national study of the economic impact of recycling and reuse commissioned by the U.S. Environmental Protection Agency through a cooperative agreement with the National Recycling Coalition.

Primary study results document information such as the number of recycling and reuse business establishments currently operating; total value of goods and services provided; total employment; total wages; and amount of materials collected and processed annually.

Recycling Industry Tries Innovation To Entice Communities

By Paul Nowell
Associated Press Writer

CHARLOTTE (AP) (North & South Carolina) - Shoppers bring back plastic bags to the supermarket. Car repair shops reuse motor oil. Yard waste is churned up and resold as garden mulch. Even the White House makes compost from its office paper.

Recycling is no longer a novelty, with everyone from the First Family to the occupants of tiny studio apartments participating. Large businesses and government agencies have sophisticated recycling programs.

There was plenty of evidence that recycling has become a part of the American fabric as the industry showed off its most creative uses for yesterday's trash at the National Recycling Coalition's 19th annual congress.

Old soda bottles are transformed into golf shirts and knapsacks. Plastic is being used to make posts for highway guardrails, which are more weather-resistant than wooden ones while providing a softer cushion in crashes.

After a generation, though, has recycling reached its peak?

"The capacity to recycle is still only about a half of the amount that is coming in," said Rob Krebs of the American Plastics Council, which is trying to encourage more Americans to recycle milk jugs and other plastic household items.

"The industry can take whatever we give them because the demand for recyclables is so great."

Krebs strode through the Charlotte Convention Center recently, looking for the most innovative uses of recycled soda bottles, tires and beer cans. He doesn't apologize for getting excited about the different forms disposable waste can take with a little human ingenuity thrown in.

"My wife says, 'He's talking trash again,'" he said.

A talk he gave at the conference focused on the plastics industry's efforts to persuade homeowners to place all plastic bottles in their recycling bins. The theory is that the best way to promote participation is to make the effort as simple and painless as possible.

Krebs knows all too well that public interest is the driving force behind any successful recycling campaign.

Recycling Industry Tries Innovation To Entice Communities, page 2

A decade ago, Massachusetts officials predicted the state would be reusing 46 percent of all disposable waste annually by 2000. The state is falling short by about 10 percent.

North Carolina's goal is to cut its disposable waste by 40 percent by 2001, although it is far from meeting that goal. South Carolina wants to recycle 35 percent of its waste by 2005.

Mecklenburg County, home to Charlotte, recycles about a quarter of its residential waste. After a voluntary plan failed, a task force is working on an ordinance that would require businesses to separate cardboard and office paper from other trash.

At the same time, recycling entrepreneurs face financing problems and uncertain markets for environmentally friendly products.

Mitchell Fine, of Direct Access International, was showing off his firm's catalogue of products made from recycled material. Many of the items, including handbags, shirts, and other products, were manufactured specifically for government agencies.

"We'd like to expand our base into retail markets, but one of our biggest obstacles is the fact that we are a domestic manufacturer and we can't compete on price with offshore producers who can make them for a much lower price," he said.

The coalition presented awards at the convention to large companies such as Dell Computer, General Motors and Bank of America.

There also was a "Fashion From Trash" show featuring designs using EcoSpun by Tommy Hilfiger and Oscar de la Renta. Fortrel EcoSpun is fabric made from recycled soda and water bottles used to make clothes and other items. Wellman Inc., which makes the product, boasts that billions of plastic bottles have been spared from the dump because of its work.

Five Major Myths about Garbage and Why They're Wrong

Smithsonian, July 1992
By William Rathje and Cullen Murphy

The mass quantities of garbage in America have led to the creation of five major myths that need to be corrected.

A 20-year study suggests that we know way too little about what we toss out - and about what needs to be done with it.

Would that it were possible to study garbage in the abstract. But, alas, garbage isn't mathematics. To understand garbage you have to touch it, to feel it, to sort it, to smell it. You have to pick through hundreds of tons of it, counting and weighing all the daily newspapers, the telephone books, the soiled diapers, the foam clamshells that once briefly held hamburgers, the lipstick cylinders coated with grease, the medicine vials still encasing brightly colored pills, the empty Scotch bottles, the half-full cans of paint and muddy turpentine, the forsaken toys, the cigarette butts. You have to sort and weigh and measure the volume of all the organic matter, the discards from thousands of plates: the noodles and the Cheerios and the tortillas; the pet food that made its own gravy; the hardened jelly doughnuts, bleeding from their side wounds; the half-eaten bananas, mostly still within their peels, black and incomparably sweet in the embrace of final decay.

You have to comfort sticky green mountains of yard waste, and slippery brown hills of potatoes peels, and ossuaries of brittle chicken bones and T-bones. And then, finally, there are the "fine," the vast connecting mixture of tiny bits of paper, metal, glass, plastic, dirt, grit and former nutrients that suffuses every landfill like a kind of grainy lymph. To understand garbage you need thick gloves and a mask and some booster shots. But the yield in knowledge offsets the grim working conditions. To an archaeologist, ancient garbage pits, which usually can be located within a short distance of any ruin, are among the happiest of finds. Every archaeologist dreams of discovering spectacular objects-the mask of Agamemnon, the Ark of the Covenant-but the bread---and-butter work of archaeology involves the most common and routine kinds of discards. It is not entirely fanciful to define archaeology as the discipline that tries to learn from old garbage.

The Garbage Project, conceived in 1971 and officially established at the University of Arizona in 1973, was an attempt to apply archaeological principles to a modern society; ours. Over the years some 750 people working for the project have processed more than 250,000 pounds of garbage-14 tons of it excavated from landfills (SMITHSONIAN, April 1990), the rest obtained fresh from the truck or the curb. Sorted, weighed, coded and cataloged, it has produced a unique database that yields all sorts of insights and questions about American life. Most notably the question of whether there is a garbage crisis at all.

Five Major Myths about Garbage and Why They're Wrong, page 2

Americans certainly do produce lots of garbage, and we have achieved no consensus about what to do with it. That is a big problem. But the work of the Garbage Project underscores a second problem, one that helps explain why we have been unable to deal with the first problem: much conventional wisdom about garbage and its disposal consists of myths and assertions that turn out, upon investigation, to be misleading-or dead wrong.

Myth No. 1: Fast-food packaging, polystyrene foam and disposable diapers are major constituents of American garbage.

Over the years, Garbage Project researchers have asked people who have never seen the inside of a landfill to estimate what percentage of a landfill's content is made up of fast-food packaging, expanded polystyrene foam and disposable diapers. In September of 1989 this very question was asked of a group attending the biennial meeting of the National Audubon Society, and the results were generally consistent with those obtained from surveys at universities, business meetings, and conferences of state and local government officials.

Estimates of the volume of fast-food packaging fell mainly between 20 and 30 percent of a typical landfill's contents; of expanded polystyrene foam, between 25 and 40 percent; of disposable diapers, between 25 and 45 percent. The overall estimate, then, of the proportion of a landfill's contents taken up by the three types of garbage together range from a suspicious high 70 percent to an obviously impossible 115 percent. The physical reality inside a landfill is, in fact, quite different. Of the 14 tons of garbage from nine municipal landfills that the Garbage Project has excavated and sorted in the past five years, there was less than a hundred pounds of fast-food packaging-that is, containers or wrappers for hamburgers, pizzas, chicken, fish and convenience-store sandwiches, as well as the accessories most of us deplore, such as cups, lids, straws, sauce containers, and so on.

Contrary to popular perceptions, fast-food packages make up far less than 1 percent of most landfills.

In other words, less than one-half of 1 percent of the weight of the materials excavated from landfills consisted of fast-food packaging. As for the amount of space that fast-food packaging takes up-a more important consideration than weight-the Garbage Project estimate is that fast-food packages account for no more than one-third of 1 percent of the total volume of the average landfill's contents.

What about expanded polystyrene foam? The stuff is, of course, used for many things. But only about 10 percent of all foam plastics manufactured during the past decade was used for fast-food packaging. Most foam was (and is) blown into egg cartons, meat trays, coffee cups, lightweight "peanuts" for packing delicate things, and the intriguing molded forms that keep electronic appliances safe in their shipping cases. Judging from the results of detailed landfill excavations, all the expanded polystyrene foam that is thrown away in the United States every year accounts for no more than 1 percent of the volume of landfilled garbage.

Expanded polystyrene foam, nevertheless, has been the focus of many vocal campaigns to ban it outright. It is worth remembering that if such foam were banned, the relatively small amount of space that it takes up in landfills would not be saved. Eggs, hamburgers, coffee and stereos must still be put in something.

When it comes to disposable diapers, some startling numbers do get bandied about. In 1987, the Portland Oregonian reported that disposable diapers made up one-quarter of the contents of local landfills. According to another estimate used by government agencies in recent years, disposable diapers constitute about 12 percent of total trash. These numbers are not, in fact, correct. The Garbage Project has consistently found that, on average, disposable diapers make up no more than 1 percent by weight of a typical landfill's total solid-waste content-and no more than 1.4 percent by volume.

Fast-food packaging, foam and disposable diapers have acquired high visibility because they are so noticeable among casual litter, and people think the components of everyday litter are the same as landfilled garbage. As a result, these items have become powerful symbolic targets. But if they disappeared tomorrow, landfill operators would hardly notice.

Myth No. 2: Plastic is also a big problem.

For the record it should be noted that the item most frequently encountered in landfills is plain old paper-it accounts for more than 40 percent of a landfill's contents; this proportion has held steady for decades and in some landfills has actually risen. Newspapers alone may take up as much as 13 percent of the space in American landfills. A year's worth of copies of the New York Times has been estimated to be equivalent in volume to 18,660 crushed aluminum cans or 14,969 flattened Big Mac clamshells.

There was a lot of talk some years ago about how technology, computers in particular, would bring about a "paperless office"-a risky prediction given the already apparent increase caused by the photocopy machine. Today there are 59 million personal computers in the United States with printers attached. Where the creation of paper waste is concerned, technology is proving to be not so much a contraceptive as a fertility drug. That said, what is the situation with respect to plastic? In landfill after landfill excavated by the Garbage Project, the volume of all plastics-foam, film and rigid; toys, utensils and packages-amounted to between 20 and 24 percent of all garbage, as sorted; when compacted along with everything else, as it is in landfills, the volume of plastics fell to only about 16 percent.

Five Major Myths about Garbage and Why They're Wrong, page 4

Even if plastics' share of total garbage is, at the moment, fairly low, isn't it true that plastics take up a larger and larger proportion of landfill space with every passing year? Unquestionably, a larger number of physical objects are made of plastic today than were in 1970, or 1950. But a curious phenomenon becomes apparent when garbage deposits from our own time are compared with those from landfill strata characteristic of, say, the 1970's. While the number of individual plastic objects to be found in a deposit of garbage of a given size has increased considerably in the course of a decade and a half-more than doubling-the proportion of landfill space taken up by those plastics has not changed; at some landfills the proportion of space up by plastics was actually a little less in the 1980's than in the '70s.

The proportion of space taken up by plastics in some landfills has actually decreased because of light-weighting.

The explanation appears to be the result of what is known in the plastics industry as "light-weighting"-making objects in such a way that the object retains all the necessary functional characteristics but requires the use of less resin. The concept of light-weighting is not limited to the making of plastics; the maker of glass bottles have been light-weighting their wares for decades, with the result that bottles today are 25 percent lighter than they were in 1984.

Using fewer raw materials for a product that is lighter and therefore cheaper to transport usually translates into a competitive edge, and companies that rely heavily on plastics have been light-weighting ever since plastics were introduced. Soda bottles made of polyethylene terephthalate (PET) weighed 67 grams in 1974; today they weigh 48 grams. In the mid-'60s high-density polyethylene milk jugs weighed about 120 grams; today the number is 65. Plastic grocery bags had a thickness of 30 microns in 1976; the thickness today is at most 18 microns. Even the plastic in disposable diapers has been light-weighted, although the super-absorbent material that was added at the same time (1986) ensured that while diapers may enter the house lighter, they will leave than ever. In most cases, when plastic gets lighter, it also gets thinner and more crushable. The result is that many more plastic items can be squeezed into a given volume of landfill space today than could fit 10 or 20 years ago.

Myth No. 3: A lot of biodegradation takes place in modern landfills. Plastic is the Great Satan of garbage: gaudy, cheap, a convenient scapegoat for people who claim we waste and consume too much. Although it is paper more than anything else that is filling up landfills, in paper's defense one frequently hears: Well, at least paper biodegrades; plastic remains inert and will take up space in a landfill until the end of time. Not really.

Misconceptions about the interior life of landfills are profound-not surprisingly, since so very few people can (or would want to) venture inside one. There is a popular notion that in the depths of a typical municipal landfill lies a roiling caldron of fermentation-intense chemical and biological activity. That perception is accompanied by a certain ambivalence. Landfills are seen, on the one hand, as places where organic matter is rapidly breaking down-biodegrading-into a sort of rich, moist brown humus, returning at last to the bosom of Mother Nature. In this view, biodegradation is something devoutly to be wished, an environmentally correct outcome of the first magnitude. On the other hand, coexisting with the romance of biodegradation, there is the view of landfills as environments from which a toxic broth of chemicals leaches into the surrounding soil, polluting groundwater and nearby lakes and streams. What both views have in common is the assumption that a great deal of biodegradation is taking place.

Well, some biodegradation is taking place-otherwise landfills would produce none of the large amounts of methane and trace amounts of other gases that they do in fact produce. In reality, however, the dynamics of a modern landfill are very nearly the opposite of what most people think. Biologically and chemically, a landfill is much more static than we commonly suppose. For some kinds of organic garbage, biodegradation goes on for a while and then slows to a virtual standstill. For other kinds, biodegradation never gets under way at all.

Biodegradation was the target of a major Garbage Project research program. The first question observers set out to answer was: After a period of 10 or 15 years, is there much identifiable paper and other organic debris remaining in a typical landfill? Or has it mostly been transformed into methane and humus? Landfills vary, of course, but when the paper items are combined with food waste, yard waste and wood (mostly lumber used in construction), the overall volume of old organic material recovered largely intact from the landfill excavated by the Garbage Project turned out to be astonishingly high.

For example, at the Mallard North Landfill, outside Chicago, organics represented 50.6 percent of the 10-to-15-year-old garbage excavated. Some 40 percent of 25-year-old garbage at Sunnyvale Landfill, near San Francisco, was organic. And at the Rio Salado Landfill, near Phoenix, organics totaled nearly 50 percent of the excavated garbage that dated back to the 1950s.

Almost all this material remained readily identifiable: pages from coloring books were still clearly that; onion parings were onion parings, carrot tops were carrot tops. In the course of every excavation the Garbage Project has done, whole hot dogs have been found, some of them in strata suggesting an age upwards of several decades. From the newspapers in America's landfills you could relive the New Deal.

The picture of biodegradation that emerges from these and other Garbage Project investigations is something like the following. Under normal landfill conditions-in which garbage is covered with dirt after being dumped, and the landfill is kept relatively dry-the only types of garbage that truly decompose are certain kinds of food and yard waste. And these obligingly biodegradable items account for less than 10 percent of the average landfill's contents. Even after two decades, a third to a half of supposedly vulnerable organics remain in recognizable condition. This portion may continue to experience biodegradation, but at a snail's pace. That finding accords with what is known of the typical life cycle of a field of methane wells, which are drilled to draw gas out of landfills. For 15 or 20 years after a landfill has stopped accepting garbage, the wells vent methane in fairly substantial amounts. Then methane production drops off rapidly, indicating that the landfill has stabilized. Henceforth, it would seem, whatever is in the landfill won't be changing very much.

Well-designed and well-managed landfills, in particular, seem to be far more apt to preserve their contents for posterity tan to transform them into humus or mulch. They are not vast composters; rather, they are vast mummifiers. But no need to panic. This may be a good thing. For while there are advantages to biodegradation, it is unquestionably true that the more things decompose in a landfill, the more opportunities there will be for a landfill's noxious contents to come back and haunt us.

Myth No. 4: America is running out of safe places to put landfills. There can be no disputing the fact that there is, for the time being, an acute shortage of landfills that are still available for deposits, especially in the Northeastern United States. Since 1978, according to the Environmental Protection Agency, some 14,000 landfills have been shut down nationwide (leaving some 6,000 in operation).

Still, as the University of Pennsylvania's waste-management expert, Iraj Zandi, has shown, these figures somewhat overstate the problem. Many of the shut-down "landfills" were actually open dumps being closed for environmental reasons. And whatever the nature of the sites, they have tended to be relatively small, whereas those that remain open are quite large.

In 1988, for example, 70 percent of the country's landfills-the smaller ones-handled less than 5 percent or the municipal solid waste that was landfilled nationwide; that same year, fewer than 500 landfills, or about 8 percent of the total-the bigger ones-handled nearly 75 percent of our landfilled garbage. "It appears," Zandi writes, "that the trend is toward operating fewer but larger landfills. This phenomenon coincides with the trend in the rest of the industrialized world." As of 1990, some 42 percent of all landfills were under 10 acres in size, 51 percent were between 10 and 100 acres, and 6 percent were larger than 100 acres. Regionally, of course, the situation is in many cases dire. In New Jersey (pop. 7.7 million), the number of landfills has dropped from more than 300 to about a dozen during the past 15 years.

The customary formulation of the problem that we face is that within the next five years 50 percent of the landfills now in use will close down. Describing the situation this way makes it seem as if Americans have somehow speeded up the throwaway society. As it happens, it has always been the case that half of all landfills in use at any given time will close within five years. It was true back in 1970 and in 1960, too, because the waste-management industry has never seen the need to maintain excess capacity beyond a certain level. In the past, however, new landfill capacity was rarely hard to obtain. The difference today is not that we're filling up landfills at a rapidly increasing pace, but that in many places used-up capacity is simply not being replaced.

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Why aren't more permits being granted? The reasons usually have nothing to do with the claim most frequently offered: We are running out of room for landfills. Yes, it is sometimes the case that a community or a state has run out of room. In the congested Northeast there is not all that space left for landfills, at least not safe ones. In the nation as a whole, however, there is room aplenty. The United States is a big enormous tracts of empty countryside.

In a study published by the Washington-based think tank Resources for the Future, economist A. Clark Wiseman has calculated that at the current rate of waste generation, all of America's garbage for the next 1,000 years would fit into a single landfill space only 120 feet deep and 44 miles square-a patch of land about the size of three Oklahoma Cities. So vast a landfill is, for any number of reasons, completely impractical, of course. The point here is simply that the total amount of space necessary will not be all that large. Few nations are as substantially endowed with uncongested territory as ours is, and there is appropriate land available even in some relatively populous areas. Recently, Browning-Ferris Industries, one of the nation's two biggest full-service garbage disposal companies, commissioned an environmental survey of eastern New York State with the express aim of determining where landfills might safely be located. The survey pinpointed sites that represented 200 square miles of territory-which constituted only 1 percent of the region's land area. Yet with all this available land, the state has, since 1982, closed down 349 landfills and opened only 6.

The obstacles to new sanitary landfills these days are to some extent monetary-landfills are indeed expensive. But more important, the obstacles are psychological and political. Nobody wants garbage dump in his or her backyard. It is ironic. We have convinced ourselves that our big flaw is that we are wasteful and profligate, while a much more serious flaw goes unnoticed: as a nation, on the subject of garbage, at least, we have become politically impotent.

Myth No. 5: On a per capita basis, Americans are producing garbage at a rapidly accelerating rate.

Not much comparable data is available on garbage-generation rates during different periods of time, but what little there is does not support the view that per capita rates have steadily accelerated. Garbage Project sortings of large amounts of household garbage in Milwaukee during the late '70s found that households there threw out garbage at a rate of about a pound and a half per person per day. Fortunately, data exists on Milwaukee from a period 20 years earlier-1959, specifically. A study done at the time for a doctoral dissertation in environmental engineering by John Bell of Purdue University found that Milwaukee households were throwing away slightly more garbage than were their 1970s counterparts: about 1.9 pounds per person per day. Admittedly, this estimate involved only household waste, not the larger category of municipal solid waste. But household waste is by far the largest contributor to municipal solid waste, and the Milwaukee comparison at least deserves a place in the evidence pile.

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Looking at the matter another way, let us assume that the Environmental Protection Agency is right when it estimates that the average American throws out about 1,500 pounds of garbage a year. That certainly seems like a lot. History reminds us, though, that many former components of American garbage no longer exist-major components whose absence does not even register in the collective memory. Thus, we do not see the 1,200 pounds per year of coal ash that the average American generated from home stoves and furnaces at the turn of the century-and usually dumped on the poor side of town. We do not see the more than 20 pounds of manure that each of the more than three million horses living in cities produced every day at the turn of the century, or the hundreds of thousands of dead horses that cities had to dispose of every year. We do not see all the food that households once wasted willy-nilly because refrigeration and sophisticated packaging were not yet widespread.

It is undeniable that Americans as a whole are producing more municipal solid waste than they did 50 or 100 years ago. But this is largely because there are more Americans than there were 100 or even 50 years ago (63 million in 1890, 132 million in 1940, 248 million now).

These days, debates swirl about the fine points of per capita garbage-generation rates and whether they've been going up slightly year by year in recent decades, and by how much. Certainly, wars, recessions and social innovation (for example, the advent of curbside recycling) cause yearly variations in the solid-waste stream, though in ways that economists and social scientists cannot yet accurately describe. But a long view of American's municipal solid waste would suggest that, on a per capita basis, the nation's record is hardly one of unrestrained excess. Indeed, the word that best describes the situation with respect to overall volume many be "stability."

If the work of the Garbage Project seems somewhat reassuring, the reassurance is an unsatisfying kind: it suggests that we may not be quite as bad as we thought, that our problems are perhaps not quite as terrible as we believed. But the disposal of garbage remains a matter in need of serious attention. And the most critical part of the garbage problem in America may be that our notions about the creation and disposal of garbage are riddled with misconceptions. We go after glamorous symbolic targets rather than the serious but mundane ones. Impelled by a sense of crisis, we make hasty decisions when nothing about the situation warrants anything but calm. We castigate ourselves for certain imperfections but not for the ones that really matter.

And we lose sight of fundamentals. The solid-waste stream has not suddenly become a raging torrent. The means we have for disposing of garbage-in landfills, through incineration, through recycling-have never been safer or more technically advanced. And since the late 19th century, America's record with respect to garbage disposal has been one of gradual improvement. It remains to be seen whether this record can be sustained in the face of not-in-my-backyard outrage that has led to political impasse on solid-waste issues all over the country.

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What should be done? To a certain extent, that depends on where you are. Conditions vary. In the future, a congested place like New York City, hemmed by suburbs, will have to burn its garbage, whereas a place like Tucson, in open country, will probably be able to rely on landfills forever. Whatever the disposal means that are selected, we should be willing to pay prorated fees for the collection and disposal of non-recyclable garbage. Charging a fee for non-recyclable garbage thrown away, while not charging for recyclable refuse, has precisely the effect economic theory would predict: recycling rates improve, and the overall volume of non-recyclable garbage diminishes. This system, tried in cities like Seattle, works. Adopted on a broad scale, the impact will ripple backward, encouraging manufacturers to use less packaging and to make products with ease of recycling in mind.

We should buy goods and packaging with a high recycled content. The biggest problem faced by recycling is not the technological process of turning one thing into another. Anything can be recycled-and would be if demand for what it could be recycled into were great enough. The key, then, is demand, and demand for many recyclables is often soft. Consumers can increase demand of buying wisely. But to do so they will have to become garbage literate, because labels can be deceptive. For example, the word "recycled" on a package generally means not that a product has been made, at least in part, out of something that a consumer once bought and then turned in for recycling, but rather that it has been made in part with scrap left over from the normal manufacturing process-business as usual in any well-run factory. The label one needs to look for is "post-consumer recycled," and ideally the label will include a percentage, as in "30 percent post-consumer recycled." Anything above 10 percent is worthwhile. Finally, the garbage problems that the United States has experienced will have had an unexpected welcome outcome if they drive home a lesson relevant to multiple public policy issues: namely, that public and political notion of our situation and what our situation really is do not match. In many cases they do not even closely approximate each other. This conclusion has emerged time and again form Garbage Project studies. Disdained commodity though it is, garbage offers a useful, if ironic, reminder of one of the fundamentals of critical self-knowledge-that we do not necessarily know many things that we think we know. That is not the usual starting point of most discussions in America, especially political ones. But it is not a bad starting point at all.