Dilemmas! You Make the Decision

Students will read and analyze a given litter dilemma. They will propose a solution by reviewing it from the perspective of a specific audience.

Level(s): 6-7

Subject(s): Social Studies; Life Science

Virginia SOLs: 6.7 a; 6.9 a,d; LS4 c; LS12 e

Objectives:
Students will be able to discuss sources of litter and associated challenges. They will be able to analyze reasons for litter problems and bring a generated solution to consensus.

Materials: Dilemma Cards

Estimated Time: 45-60 minutes

Background Information:

Disposal of Solid Waste, p.143.

*Enduring Litter***,** p.154.

*Plastics at Sea***,** p.155.

Preparation: Copy and cut enough dilemma cards to give one to each student.

Procedure:

1. Encourage students to consider how to design an advertising campaign to appeal to a particular segment of the population. For example: Who watches Saturday morning cartoon shows? What is their "target audience". Would they expect to see a luxury car commercial during this time frame? Why or why not? What type of product might they expect to see advertised during that time frame? During what time frame and during what kind of television show would you expect to see an advertisement for a luxury car? Consider advertising in magazines as well.

2. Divide students into six groups. Give each group copies of one of the dilemma cards and instruct them to make a decision based on the type of group they represent. Explain that all members of the group must agree before a decision can be reached. Have each group design an advertisement illustrating their decision, taking into consideration the group towards which the advertisement is targeted. It should include a poster, slogan, radio or TV public service advertisement or button that will be shared with the class.

3. Give the groups 20-30 minutes to discuss their litter issues, agree on their solutions and develop their advertisements.

4. Have each group come forward and share their dilemma and solution. When all groups have participated, discuss how the the advertisement was designed to influence the targeted audience in each scenario.

Assessment Opportunities:

1. Have students list three sources of litter, discuss what problems they each cause to the environment, and suggest how they can best be recycled or disposed of.

2. Have students write about the various points of views raised during their discussion of their group's dilemma, and summarize how a decision was reached.

Extensions:

1. Assign one of the articles in the "Background" section above and have students discuss and/or write about questions raised in the article.

Dilemma Cards

The city wants to build a ballpark for a local soccer team in an empty field. A baseball stadium in a nearby city has had huge problems with people not placing their trash in trash cans. Many concerned citizens are worried this new soccer field will have the same problem. You are the town council and must make a decision regarding the building of the soccer field. Should you allow the soccer field to be developed? If you do, how would you reassure the citizens that the soccer field will not have the same litter problems?

Smith Elementary School is having their 10th anniversary celebration with a picnic. The plans include lunch, cake, and giving each student a helium-filled balloon to release as he band starts playing "Happy Birthday". The school is located 50 miles from the bay. The bay is rich with marine life. The currents will carry the balloons high up into the atmosphere and over the bay. It is known that balloons will explode due to pressure and changes in temperature. Fragments of bright-colored balloons will float on the water and look like food to many animals living in the bay. The school ecology club wants to stop the balloon release. The final decision has been passed to you, a group of school officials. If you decide not to release the balloons, you need to suggest an alternate activity.

Your town park has a large lake with a healthy population of ducks. Many families go to the lake on weekends to feed the ducks and use the playground. Every Monday, park personnel spend several hours cleaning all the litter and debris left from the weekend. Due to recent budget cuts, the personnel that have been taking care of the litter are needed for other assignments. As members of the local Friends of the Park organization, the park officials have asked you to help find a solution to the litter problem.

As a member of the high school Athletic Association you are attending an emergency meeting to solve a litter problem. Several of the visiting sports teams have been leaving large amounts of trash in the parking lot and in the locker room. Other schools have been complaining that your teams are guilty of littering their parking lots and locker rooms, too. What type of solution can you suggest that would prevent this type of littering problem?

You are the members of the church council. There has been a bus stop in front of your church for the area's students for many years. Recently you have been having a problem with the students cleaning out their backpacks and leaving litter all over the front yard of the church. You need to come up with a solution that will provide a safe bus stop for the students and, at the same time, keep your church yard clean.

You are the owners of a new boutique and do not have a lot of money to spend on advertising. You cannot afford newspaper and radio advertisements, so you have been making fliers and having them distributed on car windshields. People in the community have begun to complain that your fliers are littering parks and neighboring yards. You investigate and find that drivers are simply tossing the fliers on the ground. What can you do to advertise on a very low budget, or keep the fliers from being a litter problem?

from **Pollution Solutions**, pp. 35-36

Disposal of Solid Waste

from **The No Waste Anthology**, p. 98

Because solid waste is concentrated in highly populated areas, it must be removed quickly and efficiently to prevent health problems. In the past, dumps were used which were simply piles of uncovered waste. They attracted rodents and insects, and were unsightly, smelly, and a health threat. Sanitary landfills replaced these dumps in the 1970's, but it wasn't; until 1981 that the burial of hazardous waste was banned in these landfills.

There are several methods currently in use for disposal of solid waste. These methods include landfills, incinerators, and recycling. In the United States, less than 10% of solid wastes are recycled, more than 5% are incinerated, and 80% are disposed of in landfills (Environmental Task Force, 1986).

Landfills

When we "throw away" something, it does not just "go away" – most of it goes into a landfill. A sanitary landfill is a site where solid waste is disposed on land to prevent public health and safety hazards. Landfills have strict guidelines for placement. They must be constructed in areas where the possibility of contamination if groundwater will be minimal, with a series of pipes to remove leachate beneath a clay liner. Garbage must be compacted and covered with six inches of soil daily, and land must be reclaimed as landfill operations are completed.

Landfills are running out of room. Landfills are becoming "landfulls". Each day Americans throw away 400 million pounds of food, junk 20,000 cars and discard 18,000 TV's. The United States has 5% of the world population, but it produces 30% of the world's garbage.

Leaks from landfills can contaminate groundwater. These are called leachates, which are liquid wastes and can be formed when water mixes with buried waste. Leachates may contain a variety of hazardous materials, including household hazardous wastes.

Many of the materials buried are nonbiodegradable and will remain intact for centuries. Not only are the nonbiodegradables such as plastic unchangeable, but the things they contain, even though biodegradable, cannot be acted upon by decomposers and will also remain essentially unchanged for generations.

Incineration

Incineration (the burning of waste) reduces the amount of waste by about 30 – 40%. With recycling, incineration can at best reduce the amount of waste by about 80%. Incinerators can also be used to produce lasting electricity, by generating steam with the burning waste, and using the steam to turn turbines. There are concerns about the need for air pollution controls to keep particulate matter from escaping into the air. Also, the ash remaining must be buried in a landfill, and this residue often contains toxic metals and dioxins, which are classified as hazardous wastes.

Recycling and the Need for Resource Recovery

Natural resources contained in wastes are growing more limited and more expensive. We can no longer afford to waste energy or to discard valuable resources that are still usable.

The Three R's

Reduce. Everyone can help reduce the amount of waste produced in this country. Buy products that last longer, and only buy the amount of a product needed for the job. Support businesses that use less packaging.

Reuse. Reuse products instead of buying new ones, and swap with others products that are no longer being used.

Recycle. Take paper, cardboard, used motor oil, batteries, certain plastics, construction materials, etc. to recycling centers. Compost kitchen scraps and yard wastes.

Recycling Paper

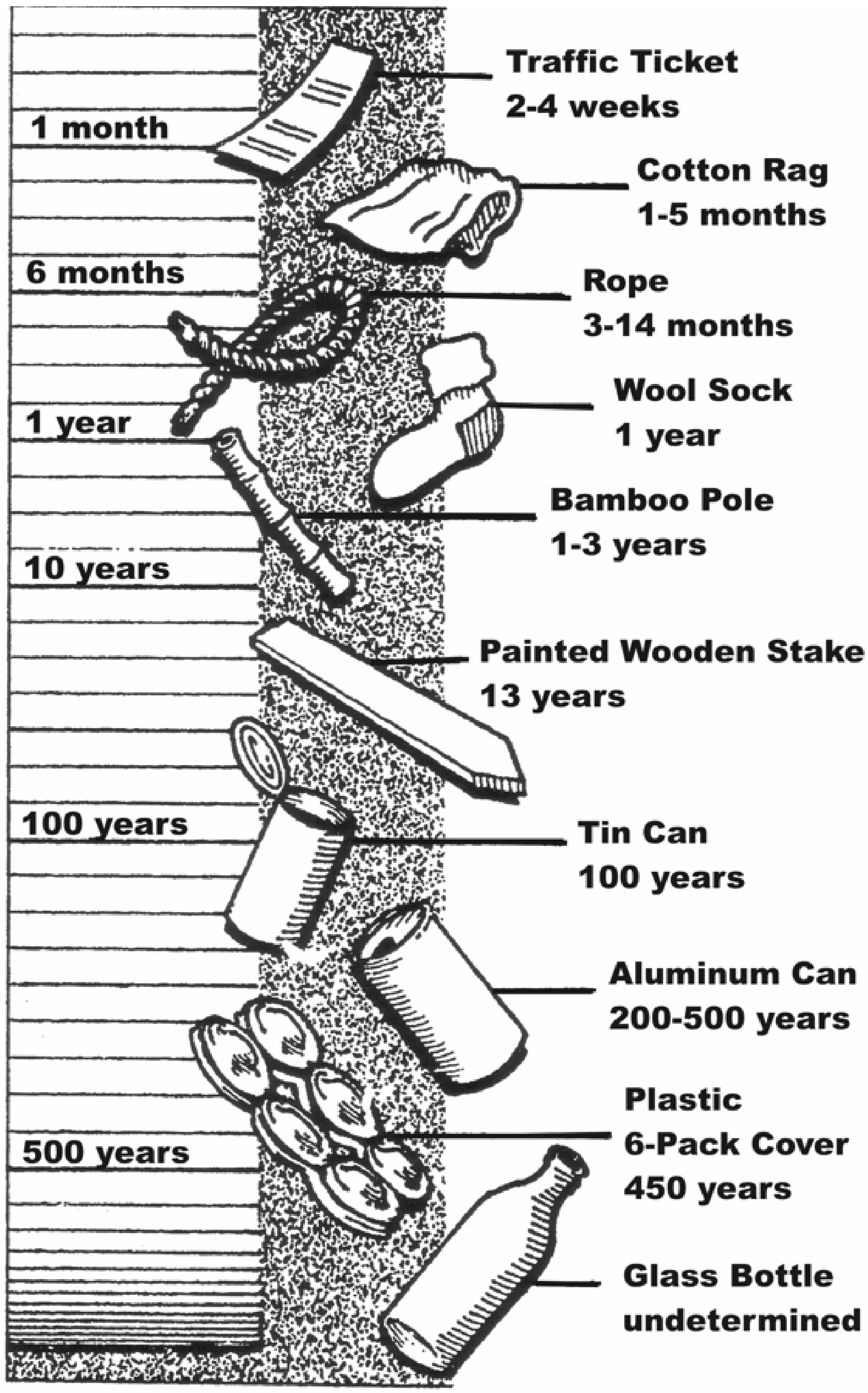
- Recycling old paper uses 50% less energy compared to making paper from trees.
- Each ton of paper that is re-cycled replaces and preserves an acre of harvestable trees.

Recycling Aluminum

- Making aluminum out of recycled aluminum uses 90-95% less energy than making aluminum from bauxite ore, yet only 54% of all aluminum cans were recycled in 1981.
- EPA and the General Accounting Office studies estimate that a national container deposit law would have a number of desirable effects, including saving consumers at least $1 billion annually. Roadside beverage container litter would be reduced by 60-70%, saving taxpayer's money now used for cleanup.

Enduring Litter

Litter at the roadside is ugly, and dangerous to some wildlife. How long will it stay before decaying may be an ugly surprise.



Plastics at Sea

by D.H.S. Wehle and Felicia C. Coleman
from **The No Waste Anthology**, originally printed in **Natural History Magazine**, 1983

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 recovered from 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 in "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 materials 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.

Much of what we know about the distribution patterns and abundance of raw plastic in the world's oceans comes from plankton sampling of surface waters. Inevitably, many animals foraging in the marine environment will encounter and occasionally ingest these widely distributed plastic materials.

Sea birds choose a wide arrange 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 marine turtles. 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 Severn Estuary of southwestern Great Britain.

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. 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 seal stomachs examined in Alaska.

The obvious question arising from these reports 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 ingestions 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 plastic particles ingested 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.

Seabirds, 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 mammals, 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.

The 20 dead birds discovered on a beach in southern California, all with plastic in their digestive tracts, present a less clear case. 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 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 the 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.

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 been cut into its flesh. Unfortunately, such observation 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 and birds and 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. 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. 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 threaten land birds and mammals: in the Aleutian Islands, for example, a reindeer became entangled in a Japanese gill net.

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 girding marine mammals, which are particularly susceptible to entanglement because of their proclivity for examining floating objects.

Sea birds that frequent recreational waters or coastal dumps are also subject to ringing by the plastic yokes that are 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 bills, 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, marine worms, and small crustaceans attach to plastic floating at sea; bacteria proliferate in both raw and plastic refuse.

Plastic provides these organisms with a long-lived substrate 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 tubes of raw plastic particles present in benthic substrates. 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.

Instances of marine animals adapting to this new element in their environments do not alter the predominantly 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.

Decomposition Experiment: Planting a "Reverse" Garden

Students will perform an experiment on rates of decomposition for various items over a period of time.

Level(s): 6-8

Subject(s): Life Science

Virginia SOLs: 6.9 b; LS7 a, b, d; LS9 a, d; LS12 e; PS1 b-d, f-i; PS2 d-f

Objectives:

1. Students will be able to rank a list of common materials in the order of how fast they decompose.

2. Students will be able to distinguish some biodegradable materials from non-biodegradable ones.

Materials:

- several shovels
- a bucket or watering can
- something to mark the location of buried items
- items to bury:
  - ❑ piece of 100% cotton
  - ❑ an old nylon stocking
  - ❑ a pencil
  - ❑ apple core
  - ❑ a newspaper
  - ❑ a magazine
  - ❑ slice of bread
  - ❑ piece of tissue paper

Estimated Time:

- 40 minutes to set up
- 40 minutes to finish
- 30-day interval in between

Background Information:

Enduring Litter, p.154; *Disposal of Solid Waste*, p.152.

Preparation:

- locate a plot of ground where various items can be buried for 30 days
- alternatively, acquire an aquarium or large plastic containers that can be used to bury items

Activity Procedure:

1. Discuss decomposition with the class: how organisms such as bacteria break down biodegradable materials, and the role of decomposers in an ecosystem. Discuss how biodegradable items differ from those that break down though oxidation. What type of items are non-biodegradable? What type of items can be degraded by ultraviolet (UV) light from the sun?

2. Write a list on the board of the items to be buried. Ask students to make a hypothesis regarding the extent of decomposition of each item after being buried and watered for 30 days. Have them arrange the list in order from the items which will decompose the fastest to those which will decompose the most slowly.

3. Divide the students into 8 groups. Assign one of the above items to each group.

4. Have the groups bury their item 12 cm (~5 inches) under the ground and mark the location. They should water their "garden" plot regularly (at least twice a week) for 30 days. If burying items outdoors is not practical due to lack of space or cold weather, an aquarium or some plastic containers can be used indoors instead.

5. Have the students dig up their items after 30 days and report on what they have found, describing the state of decomposition. Have them compare the results with their initial predictions.

Assessment Opportunities:

1. Have students rate a list of items in order of their rates of decomposition. Have them pick out non-biodegradable items from the list.

2. Have students design an experiment that would test rates of decomposition under water or in the open air. Have them hypothesize how he results would differ from those in the "reverse" garden.

3. Have students explain why decomposition would occur much more slowly in winter. Or how refrigerators help preserve food items.

Extensions:

1. Have students perform the experiment described in #2 above.

2. Have students suggest other variables to introduce in their experiment, such as leaf litter instead of soil, comparing rates of decomposition of items buried but not watered or performing the experiment in winter.

From **The Mountain to the Sea**, p.38.

How Long Will It Be There?

Students predict how long it takes specific items to decompose and then compare their predictions to the correct times.

Level(s): 6-8

Subject(s): Social Studies; Life Science

Virginia SOLs: 6.7 a; 6.9 a,d; LS4 c; LS12 e

Objectives:
Students will be able to rank various items in the order in which they will decompose.

Materials:

- A picture of each of the following items:
  - apple core
  - newspaper
  - cigarette butt
  - aluminum can
  - item made of plastic
  - rubber tire
  - a cotton T-shirt
  - a wool sock
- Velcro strips
- Copies of "ballots" for each student
- One set of time cards

Estimated Time: 30-45 minutes

Background Information:
*Enduring Litter***,** p.154.
Disposal of Solid Waste, p.152.
Plastics at Sea, p.155.

Preparation:

1. Prepare a display board by gathering pictures of various items that can be seen as roadside litter, such as a glass bottle, aluminum can, item made of cotton cloth, magazine, newspaper, tire, item made of wood, cigarette filter, apple core, an item made of plastic, etc.

2. Next to or below each picture attach a piece of the fuzzy part of a Velcro strip.

3. Make signs that give the length of time it takes each item to decompose and attach the hook part of the Velcro to the back of these signs. Students can attach the time cards to the picture they think it matches.

4. Make paper ballots by writing the names of the items on the display board with a space next to it for the students to predict how long it takes for the item to decompose.

Activity Procedure:

1. Discuss the process of decomposition and the role bacteria play in the process.

2. Have students predict how long it might take items on your display board to decompose. Have each student fill out a "ballot" and fold it in half and write their name on the outside.

3. Collect the ballots.

4. Divide the students into teams of 3-5. The teams will have 5-10 minutes to make their predictions and record their answers. The teams will then take turns taking the time cards and attaching them next to the picture of the item that takes that long to decompose so that the other teams can see their predictions. Record each team's predictions on the board or overhead.

5. Tell the students the correct answers and discuss the accuracy of each team's predictions. Hand back the ballots with the initial predictions for each group to discuss.

6. Have students discuss how these items could have been littered and what they can do about it. Discuss what is biodegradable and what is the best disposal method for these.

Assessment Opportunities:
Give students a list of common items discarded as litter and have them put them in order of the time it takes them to decompose.

Extensions:
1. Perform an experiment on the decomposition time of different biodegradable items. Make predictions and leave them to decompose under various conditions: in the open air, buried under soil, submerged in water. Compare the decomposition time for different items under different conditions.

2. Organize a class litter pickup along a stretch of road or stream. Count and categorize the items picked up.

3. Assign the article *Plastics at Sea* and discuss the effect that certain types of litter have on wildlife.

1-6 weeks	2-4 weeks
1-5 months	1 year
13 years	200-500 years
500 years	never

From **Pollution Solutions**, pp.33-34.

Nurture Some Nature

From the **No Waste Anthology**, p. 97

By keeping an area in a park or other location free of litter students will become aware of their responsibility and ability to help solve the problem of litter

Level(s): 6-8

Subject(s): Life Science; Social Studies

Virginia SOLs: 6.7 a; 6.9 a,d; LS4 c; LS12 e

Objectives:

- Students will be able to explain why litter is a problem.
- Students will have a hands-on experience in cleaning up litter
- Students will be able to identify materials that can be recycled, and where they can take such materials to be recycled.

Materials:

- litter bags (available from local groups such as the AAA, recycling centers, local park districts)
- disposable rubber gloves
- scale or balance
- tape measure

Estimated Time: two class periods

Background Information:

*Enduring Litter***,** p.154; *Disposal of Solid Waste*, p.152.

Preparation:

- hand out a pair of disposable gloves to each student
- make copies of article(s) above if you plan to have students read them
- collect information about local recycling opportunities

Activity Procedure:

1. Optional: Assign background reading for homework.

2. Instruct students to pick up 1 piece of litter on the way to school, or on the school grounds. **Caution** students to use gloves, and to be careful with items such as broken glass. Have each student hold it up in class and identify it. Discuss:

- What litter is.
- What most commonly is discarded as litter.
- Who litters, when, where and why?.
- What do they feel about litter.
- Are there any dangers associated with litter? Any fines?
- Have students establish categories for litter based on their collection (i.e. glass, paper, aluminum, etc) and list them on the blackboard.

3. Discuss facts about litter and recycling from the Solid Waste and Recycling Background materials.

4. Divide the class into teams, giving each a litter bag. Conduct a 5-10-minute litter hunt contest on the school grounds. Use a whistle or some other method to signal the end of the hunt.

5. Gather students in to a circle or return to the classroom to see which team picked up the most litter. Have awards for quantity, volume and/or weight. Have students decide if they found anything that could be recycled. Discuss where in the local community such items can be recycled.

Assessment Opportunities:

1. Ask students to write about the *what*, *where*, *when* and *who* of litter as discussed during the activity.

Extensions:

1. Have students adopt a portion of land on the school ground, or at a local park, streamside or other part of town where they will agree to be responsible for keeping the area free of litter.

2. Consider joining Virginia's Adopt-a-Stream Program to conduct a yearly trash pickup along a local stream (call the Thomas Jefferson Soil & Water Conservation District at 975-0224 for more information).

From **The No Waste Anthology**, p.97.