

# Let's Do Science

Grade Four

## Waste and Our World



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# Waste and Our World Before You Begin

This unit is a science-technology-society (STS) unit. It deals with a very important issue in our society—waste. Using natural processes as models for effective waste management, students learn how personal action in reducing, reusing and recycling materials can help lessen the waste we accumulate. They also encounter the concepts of non-biodegradable and toxic wastes, and come to understand that both our scientific knowledge and technological know-how have limitations—we may lack satisfactory solutions to problems such as waste. Students will realize the need to make informed decisions about alternative courses of action for dealing with waste produced through human activities. As decisions about waste are taken in a social context, students become aware that perspectives other than scientific and technological—economic, political and ethical—often emerge and can affect the decision-making process.

## Topic A: Waste and Our World

(Suggested time: 5-6 weeks)

This unit does not require expensive materials; in fact, the average neighbourhood will have more waste materials to study than you can use—and all for free! In preparing for the unit you may want to identify some examples of different kinds of natural and human-produced wastes in the local community, and ways in which they are disposed of.

Identification of resource persons can also be helpful: a neighbour who keeps a compost or a vermiculture, a representative of a waste disposal service, a sewage or waste treatment plant, or a company that makes a conscious effort to reduce waste and recycle. All of these are potential sources for guest speakers and field studies.

Some advance thought should be given to ensuring safety for both students and teachers. For the most part, any wastes that are studied should be left where they sit. Individual students may have allergies to particular materials, and some materials may pose biological hazards. For any activities where students classify waste materials at home or at school, the use of disposable gloves should be considered.

## Background Information

The global ecosystem is an intricate system of interdependent cyclical processes. Water recycles, nitrogen recycles, carbon recycles and, in the process, life forms grow, die, decay and these elements or compounds are used again. When we tamper with the elements critical to any one of these cycles, we endanger the balance of the entire system.

Nature has evolved ways to incorporate the waste products of almost all life forms into these cycles. For example, solid wastes generated by plants and animals are *biodegradable*. They are eaten by smaller life forms and then are further broken down by microbes (moulds and bacteria). In this way, their constituent minerals and nutrients are returned to the environment. Humankind is the only life form that generates non-biodegradable waste.

Humans also stand alone in their ability to utilize a wide range of natural resources. We have gained this ability in a relatively short period—far too short a time for natural processes to evolve to compensate for the tremendous amount of waste we create.

Waste management involves numerous social issues and technological challenges. If we look specifically at the science of waste management, we can focus on methods of identifying and quantifying the impact of mankind's waste on our ecosystem, both locally and globally. In this context, there are two basic ways we adversely affect the environment.

1. Through the production of non-reusable, non-recyclable (i.e., non-biodegradable) materials.
2. Through the contamination of our environment with toxic wastes.

As their name implies, *non-biodegradable* materials are not susceptible to the natural biological processes that normally break down dead plants and animals so their constituent nutrients can be reused in the environment. Non-biodegradable products range from the ceramic and glass articles that have been made by man since antiquity to space-age plastics used today. These products allow us to package and protect perishable goods against rodents, bacteria and other germs, water, mechanical damage and variations in temperature and humidity. They provide us vessels in which to store and transport liquids and virtually indestructible media on which to record information.

Scientists can calculate the average amount of non-biodegradable waste generated by every man, woman and child by measuring the relative weight of non-biodegradable to biodegradable waste in city refuse sites. Projects based on collected data show this figure will eventually grow to unmanageable proportions if current trends persist. It is believed we can slow, even reverse, the rate of waste build-up.

The challenge is to REDUCE production of non-biodegradable materials, REUSE existing products in a wider range of applications and develop the

technology to RECYCLE materials once their original purpose is outlived. There are many ways we achieve these goals. We can:

- choose to purchase biodegradable versions of products and buy items that use minimal packaging
- reuse plastic shopping bags
- sort glass jars and bottles, aluminum cans and newspapers and deposit them in community recycling bins
- recycle our biodegradable garbage by composting it
- take numerous other steps to cut back on the amount of waste that ends up at the local landfill

Toxic waste management involves a somewhat different set of goals:

- identifying toxins;
- reducing usage of known toxins;
- developing non-toxic alternatives and toxin neutralization methods; and
- effectively containing existing supplies of toxic waste.

The word *toxic* means poisonous. An environmental toxin is any substance that poisons the environment by changing one or more components so drastically the ecosystem is damaged. Radioactive waste is readily identified as an environmental poison because it kills a wide array of plants and animals. However, some substances are not immediately recognized as toxins. Would you consider warm water to be a toxin? Probably not. Yet in waterways where heated water emitted from nuclear power plants has raised average temperatures several degrees, some species are unable to survive.

Some toxins act so subtly that their effect on the environment is not obvious until later. For example, the release into the atmosphere of chlorofluorocarbons (CFCs) found in aerosol sprays and refrigerants. It took decades before we realized the ozone layer—the biosphere's protection against ultraviolet radiation—was thinning as a result of CFC usage.

Though we must remain forever on watch for ways our waste might change the environment, we must also find ways to deal with existing toxins. At present, used engine oil and leftover paints and solvents can be taken to local fire stations; unused pharmaceuticals can be returned to pharmacies for proper storage and disposal. Bio-hazardous waste is incinerated at hospitals. But what do we do about substances such as radioactive waste, which present unique challenges?

# Elementary Science Program of Studies

## General and Specific Learner Expectations

The following general and specific learner expectations have been taken directly from the 1996 Elementary Science Program of Studies. The specific learner expectations (SLEs) are referred to by number in the second column of the activities table.

### General Learner Expectation

Students will be able to:

Recognize that human activity can lead to the production of wastes, and identify alternatives for the responsible use and disposal of materials.

### Special Learner Expectations

Students will be able to:

1. Identify plant and animals wastes and describe how they are recycled in nature. (For example, plant leaves serve as a source of food for soil insects, worms and other creatures. The wastes of these creatures may then be further broken down by moulds and fungi.)
2. Identify and classify wastes that result from human activity.
3. Describe alternative methods of disposal and identify possible advantages and disadvantages of each.
4. Distinguish between wastes that are readily biodegradable and those that are not.
5. Compare different kinds of packaging, and infer the relative advantages and disadvantages of that packaging. In evaluating different forms of packaging, students should demonstrate the ability to consider the consumer perspective as well as the environmental perspective.
6. Identify methods of waste disposal currently used within the local community.
7. Identify kinds of wastes that may be toxic to people and to the environment.
8. Identify alternative materials and processes that may reduce the amount of waste produced; for example, reducing food wastage, using both sides of a sheet of paper.
9. Identify ways in which materials can be reused or recycled, including examples of things that the student has done.
10. Develop a flow chart for a consumer product that indicates the source materials, final product, its use and method of disposal.
11. Identify actions that individuals and groups can take to minimize the production of waste, to recycle or reuse waste and to ensure the safe handling and disposal of waste.

## Cross-curricular Connections

12. Develop and implement a plan to reduce waste and monitor what happens over a period of time.

### Social Studies

- Document waste in our society and other societies, today (news articles) and yesterday.

### Mathematics

- Weigh and measure garbage—chart.
- Litter survey, graph results.

### Art

- Create “junk” art (collage).

### Language Arts

- Write stories about reducing waste in our daily lives.
- Describe communities in the year 2020.
- L.A. Illustrative Examples, i.e., charts, mind mapping.

## Children’s Alternative Frameworks

Research has been done on children’s conceptions of the natural decay process. For example, Sequeira and Freitas (1986) found that some pupils (aged 8-13) thought germs were involved in decomposition. The children commonly thought matter actually disappeared. Two other common ideas were that matter was eaten or worn out.

Sequeira and Freitas (1987) also investigated students’ ideas about mould. Most children thought that mould was not alive. The cause of mould was variously stated to be the sun, insects or an intrinsic property of bread.

Smith and Anderson (1986) investigated the ideas of 12-year-old children on the cycling of matter in ecosystems. One common idea was that decay does not involve decomposers but that the dead organism just converts to minerals or soil. Another idea was that decay is an inevitable result of the passage of time.

Leach, Konicek and Shapiro (1992) reported five types of responses when children (aged 5-16) were asked what causes the decay of apples. The responses were:

- they are eaten by visible organisms, such as insects and cows;
- they are eaten or attacked by microorganisms, such as germs and bacteria;
- they are affected by physical factors, such as air, sun and heat;

- they decay naturally due to age, lack of food, or not being eaten on time; and
- their skin breaks or bruises.

The teacher can interview students to reveal their ideas about waste resulting from human activity. Some possible questions include the following.

- What does waste (garbage) mean to you?
- What are some examples of waste?
- What do we do with waste in our society?
- Do you think we are doing a good job with waste? Why or why not?
- What could we do with waste that we are not doing now?

Questions can be developed using pictures and objects.

- What examples of waste do you see in this picture?
- Is this object waste? Why or why not?

## Activities

Classroom teachers have identified the following activities that address the Specific Learner Expectations (SLEs) in the Program of Studies. The list is not prescriptive and teachers may select activities that are most appropriate for their students.

Activities have been listed under two headings: Key Activities and Extension Activities. Key activities are supported by authorized resources and identify “powerful and practical” means for achieving learner expectations. Extension activities represent alternative ways of achieving or supporting learner expectations.

### Key Activities

Key Activity	SLE	Print Resources	Essential Materials	Comments
Determining children’s ideas about waste			teacher questions, oral or written (see Children’s Alternative Frameworks for questions to ask)	The aim of this activity is to discover students’ prior knowledge about waste.
Observing fallen leaves	I	<i>Explorations in Science, Level 4, Waste and Our World (How Trees Help)</i> , p. 10	natural treed area in fall, measuring tape, string, pegs	Helps to increase awareness about how much material nature recycles.
Comparing decomposition in compost soil and sterilized potting soil	I	<i>Innovations in Science, Level 4, Waste Not, Want Not (The Rot Race)</i> , p. 15	4-litre pails, potting soil, sifted compost soil, vegetable scraps or fallen leaves, cutting instruments, stirring sticks, newspapers, alcohol thermometers, magnifiers	
Exploring the role of moulds in decomposition	I	<i>Explorations in Science, Level 4, Waste and Our World (Moldy Lemon)</i> , p. 11  <i>Explorations in Science, Level 4, Waste and Our World (Rotters, Rotters Everywhere)</i> , p. 12	mouldy lemon, fresh orange, plastic bags, magnifying lenses  slices of bread, pieces of boiled potato, jars with covers, magnifying lenses	
Examining the role earthworms play in decomposition	I, 3	<i>Explorations in Science, Level 4, Waste and Our World (Worm Garbage Disposal)</i> , p. 14  <i>Innovations in Science, Level 4, Waste Not, Want Not (The Underground Movement)</i> , p. 20	large wide-mouth jar, garden soil, sand, earthworms, old pantyhose, elastics, black construction paper, food for worms  large glass container, aquarium or plastic pail, coffee grounds, soil, 100 worms, various paper and plastic products	

Key Activity	SLE	Print Resources	Essential Materials	Comments
Collecting and sorting through garbage collected at home	2, 8, 11, 12	<i>Explorations in Science, Level 4, Waste and Our World (Garbage at Home)</i> , p. 18	garbage, large boxes, plastic bags, bathroom scale, rubber gloves	Possibly collect for a week rather than just 24 hours.
Collecting and sorting through garbage collected at school	2, 8, 11, 12	<i>Explorations in Science, Level 4, Waste and Our World (Free Exploration)</i> , p. 7  <i>Innovations in Science, Level 4, Waste Not, Want Not (Waste Watch)</i> , p. 8	garbage, large boxes, plastic bags, bathroom scale, rubber gloves  clipboards, survey sheets	Arrange with the caretaking staff not to empty classroom garbage containers for a week. Special consideration will have to be given to food waste.
Building a model of a landfill, comparing the biodegradability of materials and possibly touring a landfill site	3, 4, 6	<i>Explorations in Science, Level 4, Waste and Our World (Planting Garbage)</i> , p. 15	glass or plastic containers, soil, magnifiers, 2 pieces each of cotton, wool, toilet paper, writing paper, newspaper, glossy paper, styrene foam, aluminum foil, orange peel, eggshell, plastic bag, leaves	An ongoing activity.
Tracing the journey of a bag of household garbage	3, 6, 10	<i>Explorations in Science, Level 4, Waste and Our World (Garbage Trail)</i> , p. 20	chart paper	
Conducting a litter survey	7	<i>Explorations in Science, Level 4, Waste and Our World (A Litter Bit Dangerous)</i> , p. 17  <i>Innovations in Science, Level 2, Earthwatch (Litter Hunt)</i> , p. 5  <i>Innovations in Science, Level 2, Earthwatch (Oil and Water)</i> , p. 34	clipboards, litter found on the playground, rubber gloves or plastic bags, garbage bags, newspaper, elastics, chart paper  oil spill, bird feathers, small samples of leather and synthetic fur, natural cleaners such as vinegar, lemon juice, baking soda, non-toxic detergents, strainers, filters, blotters  map, notebook	
Addressing the garbage problem through the four R's	8, 9, 11	<i>Explorations in Science, Level 4, Waste and Our World (There's More than One R in Garbage)</i> , p. 21	paper used on one side, old sock, cloth bag, egg carton, other	Reducing, reusing, recycling and refusing.

Key Activity	SLE	Print Resources	Essential Materials	Comments
Looking at and designing environmentally friendly packaging	2, 5, 8, 9, 11	<i>Explorations in Science, Level 4, Waste and Our World (All Wrapped Up)</i> , p. 23  <i>Innovations in Science, Level 4, Waste Not, Want Not (It's All in the Packaging)</i> , p. 32	packaging collected by students, scales, miscellaneous materials to make new packaging  raw eggs, clean plastic bags and twist ties, packaging materials	
Making recycled paper	9, 11	<i>Innovations in Science, Level 4, Waste Not, Want Not (Turn Over a New Leaf)</i> , p. 23	newspaper, peelings from one potato or carrot, water, measuring cup, blender, large cake pan, window screening, rolling pin, food colouring  waste paper, large tubs of warm water, wooden frames (1/2 with aluminum screening)  beaters, towels, several pieces of cotton sheet, heavy object(s) such as a rock	
Setting up a composter	9, 11	<i>Explorations in Science, Level 4, Waste and Our World (Gold in Our Garbage Cans)</i> , p. 25	plastic garbage can with lid, soil, grass, other organic matter (except meat and bones), pitchfork, worms	The compost needs to be “turned over” regularly.
Researching a product to find its source materials and method of disposal	10	<i>Explorations in Science, Level 4, Waste and Our World (Biography of a Piece of Garbage)</i> , p. 19	pieces of garbage from class collection	

Key Activity	SLE	Print Resources	Essential Materials	Comments
Investigating ways to reduce/reuse/recycle	11	<i>Innovations in Science, Level 2, Earthwatch (One More Time)</i> , p. 11  <i>Innovations in Science, Level 4, Waste Not, Want Not (You Can Recycle!)</i> , p. 12	assortment of litter (2-litre pop bottles, bleach bottles, milk cartons, cardboard tubes, etc.), scissors, fasteners, masking tape, glue  large containers and paper covers, poster paper, surveys (from Waste Watch activity)	Students work in teams of two or more.
Working out a classroom or school waste management system	11, 12	<i>Innovations in Science, Level 2, Earthwatch (Earth, Air and Water)</i> , p. 37		
Looking at disposable and non-disposable items	2, 4, 7, 8, 9, 11	<i>Innovations in Science, Level 4, Waste Not, Want Not (Disposables—Good Buy or Good-Bye?)</i> , p. 26	samples of disposable items, labels, large pieces of stiff cardboard for displaying items	

## Extension Activities

Extension Activity	SLE	Print Resources	Essential Materials	Comments
Creating novel ways to reuse materials	9, 11	<i>Explorations in Science, Level 4, Waste and Our World (Three R's Rodeo), p. 27</i>  <i>Explorations in Science, Level 3, Fantastic Plastic (Functional Junk), p. 25</i>	bring items from home  assortment of plastic items, unwanted plastic toys or tools, epoxy, scissors, utility knife to be used by an adult	
Reusing plastic		<i>Explorations in Science, Level 3, Fantastic Plastic (Creating with Plastic), p. 24</i>	plastic items and packaging, glue, scissors, staplers and other fasteners, paints, felt-tip pens, crayons, styrene foam meat trays, cups, printer's ink, large spoons	
Exploring community issues related to waste	3, 6	<i>Innovations in Science, Level 4, Waste Not, Want Not (Four R's for Us!), p. 36</i>		

## Assessment

For a broader discussion of science classroom assessment techniques, see *Assessing Student Learning* in the introduction of this publication on p. 15. Good places to begin looking for the unit-related ideas are *Explorations in Science* assessment handbooks, *Innovations in Science* teaching notes, Unit tests and Portfolio ideas, Alberta Education sample tests at [www.education.gov.ab.ca](http://www.education.gov.ab.ca) and Alberta Assessment Consortium at [www.aac.ab.ca](http://www.aac.ab.ca)

## Bibliography

- Alberta Environment (a). *A Matter of Waste*. Edmonton: Alberta Environment Education Branch, 1994.
- Alberta Environment (b). *Let's Recycle*. Edmonton: Alberta Environment Education Branch, 1990.
- Alberta Environment. *Let's Recycle Teaching Kit* (includes Teacher's Guide, Colour Posters and Reproduction Masters).
- Alberta Environment. *A Matter of Waste: A Waste Education Program for Grades 4-6* (contains: The Minimizers, teacher's guide, poster panels, activity masters and panel activities), 1994.
- Bosak, Susan V. *Science Is... (Second Edition)*. Richmond Hill, Ontario: Scholastic Canada and The Communications Project, 1991. ISBN 0-590-74070-9.
- CAMP, Classroom Assessment Materials Project, 1997. Alberta Learning.
- Campbell, Steve et al. *Explorations in Science, Level 3, Fantastic Plastic*. Don Mills, Ontario: Addison-Wesley, 1992. ISBN 0-201-88153-5.
- Campbell, Steve et al. *Explorations in Science Level 4, Waste and Our World*. Don Mills, Ontario: Addison-Wesley, 1992. ISBN 0-201-88155-1.
- Explore! A Book of Science*. Addison-Wesley Publishers Limited, 1992. ISBN 0-201-55509-3.
- Ingram, Mrill. *Bottle Biology: An Idea Book for Exploring the World through Soda Bottles and Other Recyclable Materials*. Dubuque, Iowa: Kendall and Hunt, 1993. ISBN 0-8403-8601-X.
- Ostlund, Karen L. *Science Process Skills, Assessing Hands-On Student Performance*. Addison-Wesley Publishing Company, 1992. ISBN 201-29092-8.
- Peturson, Rod and Neil McAllister. *Innovations in Science, Process and Inquiry, Level 2*. Toronto: Harcourt Brace & Company, Canada, 1996. ISBN 0-7747-0189-7.

Peturson, Rod and Neil McAllister. *Innovations in Science, Process and Inquiry, Level 4*. Toronto: Harcourt Brace & Company, Canada, 1996. ISBN 0-7747-0176-5.

Tolley, Kimberley. *The Art and Science Connection of Primary Students*. Don Mills, Ontario: Addison-Wesley, 1993. ISBN 0-201-45547.

Tolley, Kimberley. *The Art and Science Connection for Intermediate Students*. Don Mills, Ontario: Addison-Wesley, 1994. ISBN 0-201-45545-5.

