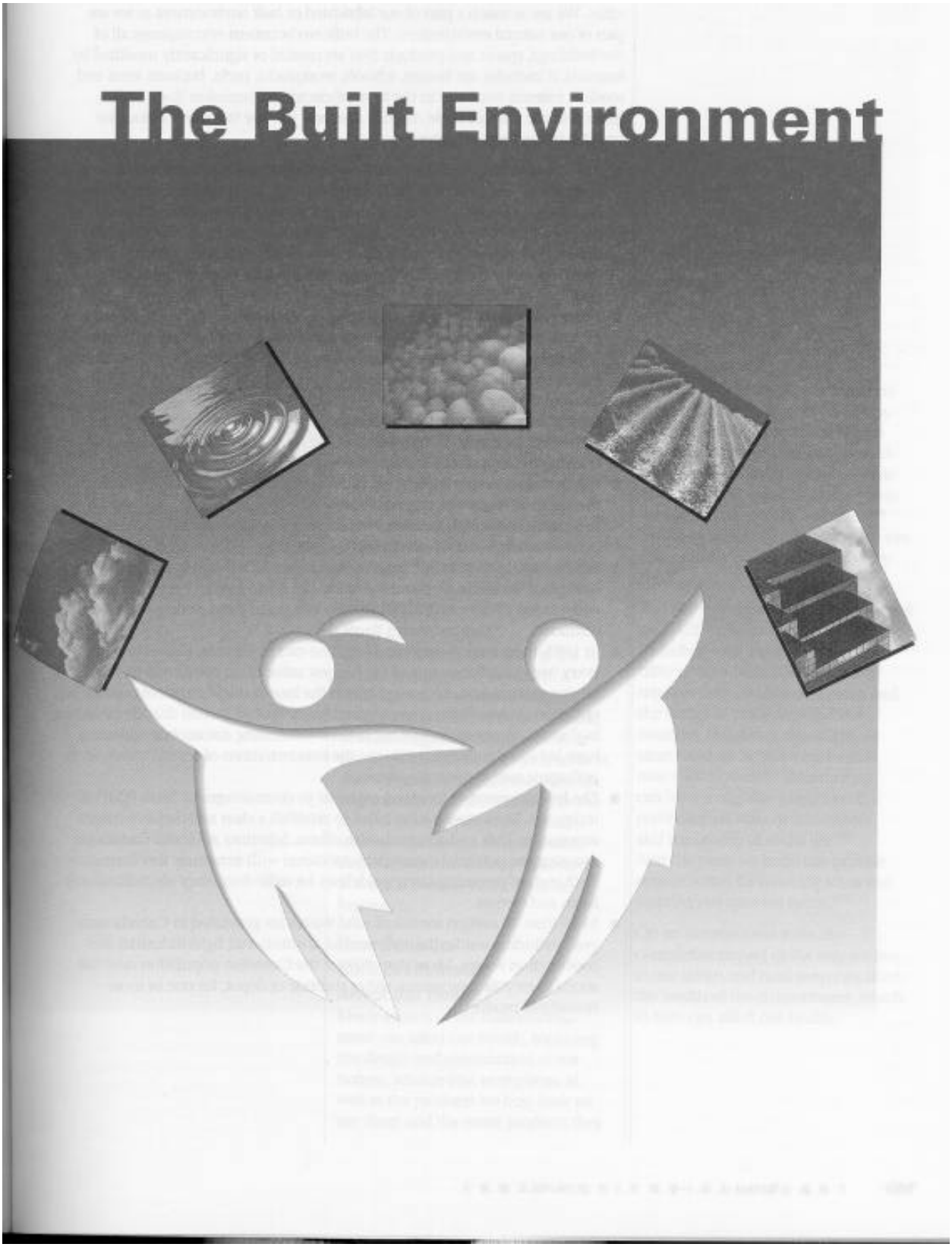
The Built Environment



Chapter Highlights:

Most Canadians spend more time indoors than outdoors and live in or near cities. We are as much a part of our fabricated or *built* environment as we are part of our natural environment. The built environment encompasses all of the buildings, spaces and products that are created or significantly modified by humans. It includes our homes, schools, workplaces, parks, business areas and roads. It extends overhead in the form of electric transmission lines, underground in the form of waste disposal sites and subway trains and across the country in the form of highways.

- In Canada, urban land is generally segregated according to residential, commercial and industrial uses. Canadian cities are spread out over a large area, which discourages walking and cycling, and the construction and maintenance of services, such as public transit, are expensive. Studies have shown that suburban residents drive twice as far, walk and cycle one-third as often, consume twice as much energy and produce twice as much air pollution as their downtown neighbours.
- Noise pollution can come from a number of sources, including road, rail and air traffic, construction and industrial activities, motorboats, snowmobiles and loud music. Environmental noise is stressful, interfering with sleep, communication and relaxation. It is not known whether its effects on our well-being increase the risk of illness.
- Limited access to affordable housing is a common problem in First Nations communities, especially in northern Canada. Overcrowding as a result of housing shortages can accelerate the spread of communicable diseases.
- Injury, not disease, is the leading cause of death in infants and children under the age of 14. Each year, approximately 1000 children die from causes related to unintentional injuries. Motor vehicle traffic accidents are the leading injury-related cause of death in this age group.
- Insufficient lighting in buildings can cause headaches and eye strain. In the workplace, excessive heat and humidity can make employees feel lethargic, whereas insufficient heat and humidity can make them restless and easily distracted.
- In 1993, there were more than 12 million cars in Canada, almost one for every two Canadians—one of the highest ratios of car ownership in the world. Engine exhaust from motor vehicles is the largest single source of outdoor air pollution. Automobiles alone account for 10% of all carbon dioxide emissions in Canada. However, federal regulations controlling automobile emissions have led to a significant decline in the concentrations of several common air pollutants over the past two decades.
- The health impact of low-level exposure to electromagnetic fields (EMF) is unknown. Most studies have failed to establish a clear association between exposure to EMF and adverse health effects. Scientists at Health Canada are assessing the potential cancer risks associated with extremely low frequency EMF and are preparing safety guidelines for radio-frequency electromagnetic fields and devices.
- More than 32 million tonnes of solid wastes are generated in Canada each year, including residential, commercial, institutional, light industrial and construction wastes. More than 90% of the Canadian population now has access to recycling programs, either curbside or depot, for one or more household products.

THE BUILT ENVIRONMENT

Introduction

Most Canadians spend more time indoors than outdoors and live in or near cities. We are as much a part of our fabricated or built environment as we are part of our natural environment. The purpose of this chapter is to discuss how the built environment influences our health.

What Is the *Built Environment*?

The *built environment* is part of the overall ecosystem of our Earth. It encompasses all of the buildings, spaces and products that are created, or at least significantly modified, by people. It includes our homes, schools and workplaces, parks, business areas and roads. It extends overhead in the form of electric transmission lines, underground in the form of waste disposal sites and subway trains and across the country in the form of highways.

How Does the Built Environment Affect Our Health?

Many aspects of the built environment can affect our health, including the design and construction of our homes, schools and workplaces, as well as the products we buy, how we use them and the waste products they generate. For example, the fertilizers and pesticides we put on our lawns, gardens and crops can run off into rivers and lakes or seep into groundwater, where they may contaminate drinking water supplies or the waters we use for recreational activities.[246] Similarly, motor vehicle emissions can affect our air quality and respiratory health.

The way our communities are planned and built can also affect our health, including such aspects as the availability of affordable housing, public transportation and bicycle paths and the design of public spaces.[4] For example, people are more likely to exercise when facilities are located near their homes.[471] Commuting can have a negative impact on the psychological state of commuters and the quality of social life.[472] And the parks we build can provide opportunities for reducing stress and meeting our spiritual needs.[473]

On an international scale, the cumulative impact of the way we live in our urban and rural areas can affect the health of the environment, which in turn can affect our health.

How Healthy Is Our Built Environment?

In Canada, the built environment is generally cleaner and healthier today than it was 100 years ago. Although it still has an impact on our health, the magnitude of the effects is minor compared with what it once was.[474]

In the 1800s and early 1900s, many health problems plagued the towns and cities that developed in Canada. For example, overcrowding and improper sanitation fostered the spread of communicable diseases. Uncontrolled pollution affected air and water quality. Political leaders responded by introducing piped water, sewers and garbage disposal services. Zoning was used to ensure that most new residential areas were kept away from industrial areas.[475] The development of building and fire codes raised housing standards. Such innovations, along with advances in medical treatment and nutrition, resulted in significant improvements in the health of Canadians.

During World War II and the post-war years, the accelerated industrialization of the Canadian economy led to a relative increase in incomes, which was accompanied by further improvements in health status. Notable demographic changes included a population migration from the country to the city; the "baby boom," in which Canada's birth rate soared; and foreign immigration to urban areas.[475] As the prosperity and growth continued, suburbs zoned for residential uses were built further from urban centres. Industries moved to new industrial parks located along major roads, often at the edge of town. In large urban areas, expressways were cut through older residential areas to provide faster access from the suburbs to the downtown area. This contributed to the decline of inner-city housing areas, which were increasingly populated by lower-income families.[475]

One of the main impacts of segregating land according to residential, commercial and industrial uses is an increase in commuting. Vehicular travel is a significant source of air pollution, stress on the driver and preventable accidents.[172,472,476] In areas where public transit is inadequate, people who do not own cars face mobility problems, because walking and cycling are not always feasible alternatives.

Key Issues

The following sections describe a few selected health issues associated with our built environment. The items covered include urban systems; housing and the home environment; work and school environments; transportation; waste management; human-made sources of radiation; and environmental emergencies. However, the list of topics presented here is by no means comprehensive. For example, occupational health and safety issues, while discussed briefly, go beyond the scope of this report.

Urban Systems

Planning and Development

In Canada, most of our built environment is planned, not random. Planning is primarily a municipal responsibility, although it can be influenced by other levels of government and the private sector. Community plans are future-oriented policy documents that indicate the proposed locations of various land uses and major roads. The purpose of a municipal plan, which has some degree of flexibility, is to provide a long-term public policy framework for the ongoing decisions of governments and the private sector. The ultimate goal is a desirable built environment.[477]

An official community plan usually includes maps showing residential, commercial and industrial areas. It may provide further detail indicating the location of schools and parks or the role of shopping centres and downtown business areas. It may also indicate whether the municipal policy is to promote low-density automobile-oriented housing, a mix of land uses in neighbourhoods oriented to walking, cycling and public transit or some combination of approaches. A plan can set noise standards, safe building distances from electric transmission lines or conservation policies. It can establish goals for affordable housing and energy efficiency. It can determine standards for roads, water, sewer and other infrastructures. It can also set goals for a community's environmental, social and economic health. However, a community plan does not normally address indoor environment issues.[477]

Policies affecting the indoor environment are enforced mainly through the building code. In Canada, all building permits must be accompanied by plans that meet the code's standards. The National Building Code sets the minimum standard, and each province or territory may establish higher standards in its code. Building codes cover matters such as indoor ventilation, insulation, plumbing, electricity, lighting and safety.

In Canada, provincial governments give municipalities the legal authority to prepare plans. Some provinces also have broad planning policies that municipalities are required to consider in preparing local plans.[478] The federal government has no direct role in community planning in southern Canada, although it has a major impact on the built environment through its ownership or regulation of airports, railways, ports, national parks and historic sites. In addition, the environmental, social and economic policies of many government departments can affect the built environment. In northern Canada, most of the land is owned by the Crown. Until recently, the federal government did virtually all of the community planning; now, the territorial governments and First Nations have greater involvement in this process.[477]

What You Can Do

Before moving into a new home, you should inform yourself about future plans that affect the neighbourhood. Municipal offices have copies of the official community plan and zoning by-laws. Ask officials if there are any studies under way or any applications for changes pending that could affect those plans. If there is a federally or provincially owned or regulated facility in the area, such as a port or airport, contact it for similar information.

At the municipal level, the process of planning and developing a community is conducted in public. Check your newspaper regularly for notices of zoning changes or community plan preparations. You can attend meetings of the local planning committee or municipal council to obtain information and present your point of view. Many neighbourhoods have community associations that monitor the activities of local government and intervene, where appropriate. In several provinces, municipal council decisions can be appealed, in some cases to a tribunal and in other cases through a petition process. Provincial and federal government agencies usually place newspaper notices and hold public meetings prior to making major decisions affecting the built environment.

Infrastructure

Infrastructure refers to the basic services that are needed to keep a society running. Hard infrastructure includes services that are delivered physically, such as drinking water mains, roads, sewage systems and public utilities.[479] Soft infrastructure includes services that are delivered by people, such as education and recreation. The term can also include police, fire and related emergency services.[479]

Infrastructure has a significant influence on our health. Safe drinking water, sewage treatment and garbage removal services are part of disease prevention. Although these services are taken for granted by many

The Affordability of Municipal Infrastructure

In Canada, municipalities generally pay the entire cost of maintaining and operating their infrastructure.[483] In 1985, the Federation of Canadian Municipalities (FCM) published a landmark study predicting that most municipalities would not be able to maintain their infrastructures at acceptable standards and affordable tax rates for long. The revenue crisis would initially reduce the quality of life and economic performance of urban regions as roads decayed, sewage systems declined and public buildings deteriorated. Eventually, the decline of sewage and water systems could affect our health.[484]

The most effective long-term solution is to reduce infrastructure demand by discouraging the development of low-density residential and business areas, for which it costs significantly more to provide such services as water pipes, roads, snow removal and public transit.[485] An alternative strategy that takes advantage of existing infrastructure is to locate new developments within existing developments, either by *infilling* vacant lands or replacing single-family dwellings with multiple-housing units. These solutions are now being reflected in planning documents and growth strategies.[486,487]

Other options include reducing the minimum standards of roads and other infrastructure. For example, low-traffic roads with low speed limits can be built narrower, and storm water can be carried in shallow ditches rather than sewer pipes.[479,488]

Health Canada, in partnership with *Go for Green!*, completed a discussion paper exploring linkages between the built environment and active living, including how urban and transportation planning influences opportunities for active modes of transportation.[472]

Canadians, the lack of such services in some developing countries is the leading cause of infant death.[480,481] In addition, hard infrastructure indirectly supports our health by contributing to the economy. For example, a good road system allows goods to move efficiently, and a reliable telephone system allows rapid communications. Similarly, soft infrastructure indirectly supports our health by raising our quality of life. Examples include parks and recreation facilities that encourage fitness and community meeting halls that support social networks.[15,479,482]

Open Spaces

Public parks and natural areas can help maintain our health and well-being. Green spaces provide opportunities for people to engage in recreational and contemplative activities.[488,489] People who spend time in parks and open spaces experience less stress. Indeed, some studies have shown that a window overlooking a green area improves the health of people who are confined, such as hospital patients and prisoners.[473] In another study, patients staying in rooms with a view of natural scenery had shorter hospital stays and took fewer pain killers than patients with a view of a brick wall.[490]

The space surrounding a building, such as a private yard or shared greenery, can also enhance the health of its occupants. For example, trees filter pollutants from the air, provide shade, serve as windbreaks, alleviate the effects of noise and enhance privacy. The psychological impact of trees, shrubs and flowers is generally positive. Vegetation is pleasing to the eye and attracts birds and animals. An attractive environment also encourages pedestrians and social interaction.[491,492]

Naturalization and Environmental Design

Lawn chemicals sprayed on open spaces and parks may pose a risk to human health if improperly used or stored. The use of fertilizers and pest control products can be reduced with more environmentally friendly approaches, such as:

- naturalization, a way of designing and maintaining parks by converting maintained open spaces to more naturally evolving landscapes, thus supporting ecological diversity. Local plant species growing in natural conditions generally need less fertilizer or pest control than imported species growing in isolation[493];
- integrated pest management, which combines cultural, biological, genetic and chemical methods to control pests more effectively. For example, environmental turf management is a way of physically and organically conditioning soil to achieve healthy grass and reduce weeds.[488] Health Canada's Pest Management Regulatory Agency is currently working with other federal and provincial government departments, park and landscape managers, landscape service providers, research agencies, pesticide manufacturers and environmental groups to develop a national strategy that promotes the use of sustainable pest management practices in urban areas; and
- environmental design, which recognizes that parks and open spaces should contain more than just flat, green grass. Where possible, they can include natural features such as streams or ridges. This approach demands that when wetlands or woodlots are preserved, a sufficiently large area must be set aside so their integrity is maintained.[488]

Personal Security

In Canada, both crime and the *fear* of crime can have a direct impact on our health. Indeed, more people are victimized by the fear of crime than by crime itself. Fear is a significant source of stress, which can adversely affect our health and quality of life. For example, some people—particularly women—change their routine out of concern for personal security. They may refrain from going out at night or keep children away from public parks.

Did you know?

One in four Canadians feel unsafe walking in their own neighbourhood at night: 10% of men and 42% of women.[494]

Fear of crime is influenced by media coverage and the visibility of police presence on the streets.[482] The rising fear of crime and violence in our society and the perception that it is becoming more common generally exceed any increases in the actual crime rate. In fact, most types of crime pose little risk to Canadians: over 50% of crimes are committed against property, and only 10% are violent.[495] According to several statistical indicators, crime rates are decreasing for Canada as a whole, and Canada is a relatively safe country.[488,496] Since 1991, the overall crime rate has dropped by 13%, although it is higher today than in 1986.[497] From 1991 to 1996, the number of homicides committed in Canada declined from 756 to 586, or less than 2 per 100 000 people.[498]

Did you know?

*Reducing the **fear** of crime is an important part of the job of protecting communities. To reassure the public, many police forces are increasing their community presence by reinstating foot patrols.*[482,499]

The crime rate is influenced primarily by socio-economic factors, such as poverty, drug use, the social cohesion of communities, the availability of social services and the justice system.[500] However, the design of our built environment can influence the probability that a crime will or will not take place in a given location.

One of the best ways to discourage crime is to increase the chance that anyone who attempts a crime will be reported and caught. Many solutions involve improving visibility and

encouraging casual surveillance by the general public. Thus, doors, windows and yard vegetation should provide clear sight lines for building occupants and pedestrians. In enclosed environments, such as parking garages and transit stations, surveillance cameras and direct-line telephones serve as deterrents.[500]

Neighbourhood layouts that encourage pedestrians—such as the presence of corner stores, benches, trees, flower beds and recreational facilities in residential areas—discourage crime. Another deterrent is the presence of mixed housing for a variety of lifestyles and age groups. For example, elderly individuals tend to be home and on the street during the work day. In neighbourhoods served by public transit, the buses serve as an informal security patrol.[501,502]

What You Can Do

Here are some tips to help prevent crime in your neighbourhood:

- Install adequate exterior lighting that covers a wide area but is not too intense. Dark spots on your property can hide intruders, whereas bright lights can disturb neighbours.[503] Ensure that any entrances and pathways are properly lighted and unobstructed by vegetation or other visual barriers, so your neighbours can see intruders on your property.[501,503]
- Inside your home, consider installing window locks, light timers and electronic security systems. "Street-proof" your children: teach them when and when not to talk to strangers.
- Establish or join a neighbourhood watch or other crime and security program in your area to improve neighbourhood security and build community spirit.
- Conduct a neighbourhood safety audit with neighbours, co-workers or other concerned citizens.[504] This exercise, which helps identify local security needs, can be conducted with the assistance of local government or transit authority officials.
- Support actions in your community that encourage civic pride and social cohesion, such as investment in downtown areas and removal of graffiti from public places.[495,505]

For more information, contact your local police department.

Noise

Noise is any undesirable sound that annoys people, interferes with communication, disturbs sleep or rest or causes loss of hearing. In Canada, noise pollution has become a serious environmental issue as a result of the increasing number of noise sources, such as road, rail and air traffic, construction and industrial activities, motorboats, snowmobiles and loud music.[30]

Did you know?

Using social surveys, environmental planners estimate the amount of noise-related annoyance in a community from the proportion of the population that is highly annoyed by a noise. In general, the degree of annoyance associated with a daily average outdoor noise level of 55 dB or less is relatively minor. Studies have shown that the two main sources of environmental noise annoyance are road and air traffic.[506]

Noise and sound are measured in decibels (dB). An audible whisper registers about 10 dB, and normal conversation is about 60 dB. The noise level is about 75 dB on a major traffic artery and approximately 80–90 dB on an expressway.[507] Occasionally, the noise level near an airport may reach 100 dB when a jet aircraft flies overhead shortly after take-off. However, the outdoor noise level averaged over a day in the vicinity of a major airport rarely exceeds 75 dB.

Except for people who work with loud equipment on a regular basis, loud outdoor noise is unlikely to cause permanent hearing loss, although it can cause temporary hearing loss. The risk of permanent hearing loss depends on the daily average level of exposure, the number of years of exposure and the susceptibility of the individual. For example, exposure to 75 dB of noise for eight hours each day should not result in any measurable hearing loss, even after 30 years. Exposure to 80 dB of noise for eight hours each day would cause a barely noticeable hearing loss. And exposure to 90 dB of noise for eight hours each day over a 30-year period would cause serious hearing loss in some people—about 10% of the exposed group would have frequent difficulty understanding normal conversation.[509]

In addition to hearing loss, noise can cause stress. Like other sources of stress, it can temporarily affect the heart rate and blood flow in the skin. Some studies have suggested that it may also affect the immune system and biochemistry of the blood, although the results were not conclusive. Other studies have examined the relationship between long-term exposure to noise and stress-related illness—including cardiovascular disease, mental illness and abnormal pregnancy. However, it has not been possible to detect an increased risk of these outcomes reliably.[510,511]

Reducing Environmental Noise

In Canada, responsibility for the control of environmental noise is shared by all levels of government. For example, the provinces and territories regulate the outdoor noise levels of motor vehicles and other equipment. Municipalities control environmental noise through land-use plans, zoning by-laws, noise by-laws, traffic management and noise barrier programs.

At the federal level, Health Canada addresses community noise issues through the *Canadian Environmental Assessment Act*. Health Canada also provides information to the public on the health effects of noise and advice to other government agencies involved in assessing and controlling

environmental noise. Towards this end, the Department has published *National Guidelines for Environmental Noise Control* and developed databases, contacts and a research program on the health effects of environmental aircraft noise. In addition, Health Canada is developing comprehensive guidelines for environmental aircraft noise.

Transport Canada regulates aircraft noise under the *Canadian Aeronautics Act* and the sale of noisy motor vehicles under the *Motor Vehicle Safety Act*. Transport Canada also publishes guidelines on land use in the vicinity of airports; it is mandatory to follow the guidelines on all lands owned by the federal government. Similarly, the Canada Mortgage and Housing Corporation (CMHC) has published guidelines on soundproofing housing against environmental noise, including noise from airports, railways and roads.

What You Can Do

Here are some tips you can follow to reduce your exposure to loud noise:

- Consult land-use guidelines for environmental noise if you are planning to move to a neighbourhood where noise levels may be a concern. If you are building a new home or renovating, use double-glazed windows to block out outdoor noises.
- Refer to your municipal by-laws and register complaints if the noise levels in your neighbourhood are offensive.
- If you operate a machine or equipment outdoors, take steps to minimize your exposure to the noise and the annoyance to neighbours. In domestic and recreational situations, people-powered equipment may be a healthy alternative.
- If you cannot reduce the noise levels or the amount of time you spend in a noisy environment, ear plugs may provide some relief.

Noise Pollution and the *Canadian Environmental Assessment Act*

Under the *Canadian Environmental Assessment Act* and the guidelines it replaced, a full-scale environmental assessment must be conducted prior to the construction or expansion of a federal airport. Increased noise and its impact on human health were major concerns prior to the expansion of Lester B. Pearson International Airport in Toronto. During the environmental assessment hearings, Health Canada experts presented advice on the health effects of exposure to aircraft noise. In authorizing the airport's expansion, the federal government required the implementation of measures to minimize the noise impact of the new runways, including restrictions on night operations, particularly of older and noisier aircraft; and restrictions on the use of new runways, to minimize the noise levels in nearby communities.

Housing and the Home Environment

Affordability and Adequacy

Access to decent housing is a basic human need. Good housing should provide us with shelter from the elements; proper sanitation and waste disposal; potable water and breathable air; hygienic food storage, preparation and cooking facilities; a safe and secure space for playing, sleeping, recreational pursuits and household tasks; a place in the community; and comfort, privacy and tranquillity—a refuge from stress. In addition, a home should be affordable, so that people have enough money left over for food, clothing and other needs.

The accepted norm in defining affordability is as follows: housing costs should not exceed 30% of family income.[512] In 1991, 15% of Canadian home-owners paid over 30% of their annual household income for housing, 35% of tenants paid over 30% and 15% of tenants paid over 50%—excluding farms and First Nations reserves.[513] People in lower income brackets often find themselves in substandard housing conditions. In 1991, 8% of Canadian homes were in need of major repairs, which means that their occupants were at higher risk of injury and illness.[514]

Did you know?

The federal government provides financial assistance through a variety of programs to tenants in about 650 000 housing units across Canada. The government also provides assistance for home renovations through programs such as the Rehabilitation Assistance Program and Home Adaptations for Seniors' Independence.[515]

Housing Canada's First Nations

The population of Canada's First Nations is growing at a faster rate than the national average, and many communities have a small land base or few natural resources to support economic development. Lack of affordable housing is a common problem, because many households have low incomes, and in some areas the unemployment rate exceeds 50%. In addition, the remote location of some communities increases the transportation costs of construction materials. Overcrowding as a result of housing shortages is common and can accelerate the spread of communicable diseases, such as hepatitis A.[516]

Since the 1970s, the Department of Indian Affairs and Northern Development and the Canada Mortgage and Housing Corporation (CMHC) have provided assistance for the construction of housing on reserves. The CMHC also provides assistance for housing repairs.[518,519]

Indoor Air Quality

The quality of indoor air in most homes in Canada is relatively high[30] and is probably much better than in the days when home heating was provided by open fireplaces.[520] However, we are still exposed to many potential hazards because of such trends as the increasing presence of chemicals and synthetic materials, the popularity of wood stoves and the tendency to construct airtight, energy-efficient houses. Moreover, contaminants in outdoor air can enter the indoor environment through cracks and leaks, which are common in older, less energy-efficient houses and buildings.

Indoor air contains a wide variety of contaminants with the potential to affect our health. Tobacco smoke is the main source of indoor air pollution caused by human activity and affects both smokers and non-smokers. Moulds and mildew, which thrive in basements and unventilated areas, can also affect the quality of our indoor air. Household dust may contain pollen, micro-organisms and physical irritants that cling to draperies, rugs, furniture coverings and clothing. Pets can add to air quality problems by shedding fur and animal dander or hosting bacteria and insects. Major renovations can expose insulation, mildew and other contaminants that are normally hidden inside walls, floors or ceilings.[133]

Fireplaces, furnaces, stoves and kerosene heaters can also release airborne contaminants, especially if they are not properly ventilated or maintained. Gas stoves release combustion by-products. Other sources include mechanical air circulation systems and the heating ducts of forced-air furnaces, which collect dust and circulate it throughout houses.[133]

The household environment also contains a vast array of airborne chemicals. Our homes are filled with appliances, electronics, sports equipment, toys, tools, furniture, carpets, clothing and other products that are made primarily of synthetic materials. Some synthetics are inert, but others release small amounts of gases and particles into the air. Wood laminates, particle board, glues and other construction materials also emit vapours, as do paints and solvents. As well, many chemical products normally associated with work environments may be used at home through hobbies and crafts or during repair work.[30,521] The gases, fumes, vapours, mists and dusts released by such items may enter our body through the skin and lungs. Prolonged exposure to relatively low levels of some contaminants may produce delayed toxic effects.[521]

Protecting Our Health

The Government of Canada has taken a variety of steps to improve air quality in indoor environments. In 1987, Health and Welfare Canada published the *Exposure Guidelines for Residential Indoor Air Quality*.[30,133] The CMHC has published guidelines on how to build homes that protect indoor air quality.[520,522] Similarly, Health Canada's Healthy Environment Program helped the Canadian Lung

Carbon Dioxide in Indoor Air

Indoor sources of carbon dioxide include tobacco smoke, gas stoves, fireplaces and kerosene heaters, furnaces and other combustion devices. At the levels typically found in Canadian homes, carbon dioxide is unlikely to affect our health. However, elevated levels may indicate poor ventilation.[109] Carbon dioxide is sometimes used as an indicator of general air quality in buildings where there are significant metabolic or combustion sources of carbon dioxide.[133] Exposure to very high levels of carbon dioxide can cause headaches and drowsiness.[85]

Indoor Air Quality in Public Buildings

Offices, factories, commercial buildings, schools and public buildings are normally much larger than homes. They generally hold more machinery, equipment, chemicals and synthetic materials than household environments and rely on mechanical means for heating, ventilation and air conditioning. The average person generally has less control over the school or work environment than the home environment. Air quality may vary within large buildings, and achieving localized control for individuals or a group of employees is a common problem.[134] In Canada, office building and workplace air quality is controlled by the Labour Program of Human Resources Development Canada in establishments under federal jurisdiction and by the Workers' Compensation Boards in each province and territory.

Association develop its C.A.N. DO (The Movement for Clean Air Now) program, which suggests ways to improve the air quality in your home.

What You Can Do

Almost all indoor air quality problems can be improved with ventilation, although it is more effective to eliminate a source of pollution than to try to remove it after the fact.[522]

Ventilation

Every building needs a good supply of fresh air. In tightly sealed, energy-efficient houses, it may be necessary to take remedial steps to ensure adequate ventilation:

- Use exhaust fans in bathrooms and kitchens to reduce humidity during cooking and showering.
- Ensure that your clothes dryer is vented to the outdoors.
- Ensure that your home has an adequate fresh air intake to replace the air removed by exhaust fans and dryers and to prevent furnaces and stoves from releasing gases backwards into the home.
- Ensure proper ventilation of crawl spaces, eaves, unfinished attics and basements to prevent the growth of mould and mildew.
- Never leave the engine running if you park your car in an indoor garage.
- Routinely examine all vents, filters and air ducts for blockage, and clean them as required.[133,522]

Prevention

- During home construction or renovation, building materials that give off vapours should be sealed with paints or varnishes. Purchase only the amount of paint (or chemicals) that you need to finish the job, and trap vapours by keeping the lids on cans of paint, solvents and other volatile liquids.[521] Ensure adequate ventilation when using such products.
- Keep your house clean to reduce dust and dirt. Vacuum all surfaces, including draperies and rugs.
- Wash new textile materials prior to use to reduce the gases, such as formaldehyde, that they may emit later.[523]
- Wash your pets regularly.
- Evaluate the need for humidifiers, and use only if required.
- When using household cleansers, read the label carefully. Avoid combining ammonia cleansers and chlorine bleach, which together produce toxic chlorine gas.

Avoidance

Before buying or renting a home, inspect the premises thoroughly, and question your vendor or landlord about potential air quality problems. Trust your instincts: your own senses may detect problems that could affect you.[507] Here are some other tips:

- Where possible, consider using alternatives to chemical cleansers, such as homemade or natural cleaning solutions made from ingredients like vinegar or baking soda.[30,52]
- Avoid smoking in your home.

Safety

Safety in the home is a concern for everyone, particularly children and the elderly. Of particular concern are falls, fires, poisonings and other injuries.

Falls

While common in children, falls are especially dangerous in the elderly, who tend to have brittle bones and less flexible joints. Factors that increase the likelihood of falls include slippery floors, area rugs, obstacles that cause people to trip, poor lighting and potentially dangerous activities (e.g. climbing on chairs or other furniture). Ice, snow and mud make front porches, steps and yards more dangerous.[503]

Fires

During fires, the greatest health hazards are reduced oxygen levels and the production of smoke, which can injure or kill people in their sleep. Some synthetic materials increase the toxicity of smoke. Common causes of fire include poorly maintained furnaces, improper use of portable heaters, overloaded electrical circuits, grease fires in kitchens, unextinguished cigarettes (especially smoking in bed) and incorrect use or storage of flammable liquids.[503]

Environmental Sensitivities

Some people are unusually sensitive to chemicals and other substances in our environment, a condition known as *environmental sensitivity* or multiple chemical sensitivities.[524] Such people are sensitive to low levels of natural or manufactured irritants present in a variety of sources, such as food, water or air.[520] Environmental sensitivity sometimes arises in individuals exposed to relatively high doses of chemicals; afterwards, they become sensitized and react to much lower levels.[525] In some cases, environmental sensitivities are severe enough to force sufferers to become isolated in order to avoid exposure to contaminated environments.[525]

Although many different hypotheses have been put forward to explain the cause(s) of environmental sensitivity, these theories have not been adequately supported through well-controlled scientific studies. Similarly, many of the new diagnostic tests and treatments employed have not been supported by controlled clinical studies and thus have not been endorsed by the medical community at large.[526]

Given the existing uncertainty concerning diagnosis, causation and treatment of environmental sensitivity, and particularly the importance of environmental versus psychological factors, it has been generally recommended that clinicians should perform the necessary clinical assessment (including standard patient history, physical examination, psychiatric/psychological assessment and laboratory tests) on patients to rule out any medical or psychiatric/psychological conditions that require specific treatments. This approach has been recommended in the two workshops sponsored by Health Canada in 1990 and 1992,[527,528] respectively, and has been echoed at a recent (1996) World Health Organization Workshop on Multiple Chemical Sensitivities.[529]

As with allergies, identifying and avoiding substances that trigger reactions among people with environmental sensitivity are very important. Mechanical air filtering may be the solution for some people. Controlling other triggers, such as sudden changes in temperature and humidity, can also be helpful. Many environmentally sensitive people seem to benefit from clean air and water and food grown without chemicals. As allergies, allergy-like reactions and sensitivities may result from exposure to high levels of various chemicals, reducing exposure as much as possible could significantly reduce the risk of adverse reactions.[525]

Poisoning

Many consumer products used at home are dangerous and should be kept out of the reach of children. Potential hazards include cleansers and other disinfection products, medicines, alcohol, solvents, cosmetics and moth balls. Garages and basements often contain items such as paint or paint thinner, bottled or liquid gas, glues, gasoline and other automotive products,[503] all of which can cause harm if swallowed, and some of which can cause harm through skin contact.

Injuries

Injuries and their resulting effects are the leading cause of death for infants and children under the age of 14. Approximately 1000 children die each year of causes related to unintentional injuries.[530] Motor vehicle traffic accidents are the leading injury-related cause of death in this age group.[531]

One in five Canadians over the age of 15 suffers an injury each year.[532] More than 3000 seniors die from injury-related causes, which is three times the death rate in the rest of the adult population.[533] Many of these injuries occur at home.

Injuries are the second most expensive health care problem ($11.2 billion) in Canada. In 1993, the estimated health care, property and other social costs related to injuries involving consumer products (e.g. ladders, knives, stools) were approximately $2.8 billion.[532] Each year, consumer products are involved in some 230 000 injuries in Canada, resulting in approximately 2000 deaths, 47 000 cases of illness and 219 000 injuries.[532]

Seniors account for 50% of all injury-related days in hospitals. As our population continues to age, the number of deaths and total health care costs related to injuries are expected to increase.[533] The products most often involved in injuries to seniors treated at emergency departments are ladders, tables, beds, knives, stools, bathtubs, saws and walking aids or mobility devices.[534]

Protecting Our Health

Health Canada's Product Safety Bureau helps Canadians maintain and improve their health by preventing product-related death and injury. One of its key instruments is the *Hazardous Products Act*, which gives Health Canada the authority to control the sale, advertising and importation of dangerous or potentially dangerous consumer and industrial products. Health Canada can also ban a consumer product if the risk posed to Canadians is considered unacceptable.

The *Hazardous Products Act* applies to:

- consumer products that are poisonous, toxic, flammable, explosive, corrosive, infectious, oxidizing or reactive;
- products intended for domestic or personal use, gardening, sports or

other recreational activities, life-saving purposes or children's play—such as toys, games and equipment—that pose or are likely to pose a hazard to public health and safety because of their design, construction or contents; and
- workplace hazardous materials under the Workplace Hazardous Materials Information System,

but does not apply to food, drugs, cosmetics, medical devices, pesticides, radioactive substances, tobacco or products controlled under the *Explosives Act*.

The Product Safety Bureau also promotes the safe design of products to Canadian manufacturers through the development of new testing methods and educates and informs consumers about their role in ensuring the safety of children and seniors. Specific initiatives include the KidsCare National Program and the Seniors Injury Prevention Program.

Other federal initiatives include:

- the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP), a computerized information system—maintained by Health Canada's Laboratory Centre for Disease Control—that collects and analyses data on injuries of people seen at emergency rooms of 10 pediatric and 6 general hospitals across Canada. CHIRPP was launched to help reduce the number and severity of injuries to Canadians of all ages, particularly children; and
- the Interdepartmental Working Group on Childhood Injury Prevention, composed of representatives from Health Canada and other government departments. The Working Group has been active in a variety of issues, including playground safety, car seats and farm safety.

What You Can Do

Regular inspections of your home environment can help prevent injuries to you and your family. Checklists are a useful resource, although they cannot cover every possibility. Every home should have a fire extinguisher, preferably in the kitchen, and a smoke detector on every floor. You should discuss home safety issues, including what to do in the event of an emergency, with all family members. If your community does not have a "911" service, post the numbers of your local fire department, poison treatment centre and related services near your telephone. For more information about injury prevention, contact Health Canada, the Canada Safety Council or insurance departments, fire departments and public utilities in your community.

Work and School Environments

The majority of Canadians spend more time at work or school than anywhere else outside the home. As a result, the quality of these environments can affect our health and well-being. This section focusses on the relationship between physical factors —including accessibility, lighting, temperature and humidity—and our health. The text also touches briefly on workplace safety.

Did you know?

Social networks can have a significant role in reducing work-related stress,[15] and pleasant spaces, such as attractive cafeterias, courtyards and casual seating areas, can encourage socializing behaviour. The scale, colour and lighting available have a psychological effect on people and their social relationships, as do the acoustical properties of common areas. Restful colours, comfortable furnishings and sound-absorbing materials can help to improve the well-being of people who use these spaces.

Accessibility

Visiting public buildings is an important part of community life. People who are deprived access to public places because of limited mobility have less control over their environment and less opportunity to work or participate in social networks, both of which are essential to good health.[4] In 1981, the International Year of Disabled Persons, attention was focussed on barriers to access, such as stairways at the entrances to buildings, doors too narrow for persons in wheelchairs, elevator control panels located at the eye level of standing adults and other obstacles.[535]

Since 1981, most Canadian public buildings have been renovated to include such features as entry ramps, automatic doors, accessible elevator buttons and wheelchair access in washrooms. Building codes now require such measures in new buildings. Public transit stations are

equipped with elevators, and some buses have steps that lower to the sidewalk. In many communities, sidewalks are now tapered to meet the road surface at intersections.[536] These improvements benefit people of all ages, including parents with baby strollers, patients recovering from leg injuries and elderly people with mobility limitations.

Lighting, Temperature and Humidity

Sunlight, or natural light, appears colourless, but it is actually a blend of colours. Sunlight also contains wavelengths that are invisible to the human eye, such as infrared and ultraviolet. Common sources of indoor lighting include ordinary light bulbs, which generate incandescent light rays, and fluorescent tubes, which are more economical but generate colours and wavelengths that are not as natural in appearance. Fluorescent lighting also tends to flicker more than incandescent lighting.[503,507]

In Canada, lighting level and quality are addressed by the National Building Code, the Labour Code and some Canadian Standards Association standards. According to the Canadian Centre for Occupational Health and Safety, the five most common problems associated with indoor lighting are insufficient light, glare, improper contrast, poorly distributed light and flicker. The most common health effects are headaches and eye strain. Poor lighting may also cause adverse behavioural effects in some workers, lowering their productivity. To help ensure sufficient light, the Centre recommends different lighting levels for various work activities and settings. People who use computers may find that the interplay of window light, room light and computer terminals can cause excess glare. The Centre publishes diagnostic procedures for this and other computer-related lighting problems.[537,538]

Like lighting, temperature and humidity levels can affect our health, comfort and productivity. Excessive heat and humidity can make us feel tired and lethargic, whereas insufficient heat and humidity make us feel restless and easily distracted.[541] Based on the National Building Code, the Canadian Centre for Occupational Health and Safety recommends maintaining indoor temperatures of 23–27°C in summer and 20–23°C in winter. Similarly, the relative humidity should be kept between 30 and 50%.[541,542]

Ergonomics

Ergonomics is a science that studies the relationship between people and their working environment in order to maximize comfort, efficiency and productivity. In schools and workplaces, poorly designed furniture and tools can increase fatigue and injury. For example, many of the problems associated with video display terminals or computer monitors, such as headaches, eye fatigue and bodily discomfort, are related to ergonomic issues such as posture, lighting conditions and repetitive typing motion.[543–547] For more information, contact the Canadian Centre for Occupational Health and Safety.

Workplace Safety

Some 13 million Canadians spend approximately half of their waking hours at work, where they may be exposed to workplace hazards. For example, workers in industrial, medical, research and other environments who handle or transport chemical, radioactive or biological materials are at increased risk of exposure to hazardous substances or products. In the construction, manufacturing, farming and mining industries, the use of heavy equipment and machinery puts workers at higher risk of injury. Other factors can also affect the health, safety and productivity of the work force, such as stress, physical activity, organization of work, flexible hours for parents and caregivers and good communication in general.[548] Interested readers should consult the specialized literature on these subjects.

Did you know?

In 1994, there were more than 800 000 work-related injuries in Canada, of which 429 000 resulted in time off work and compensation to injured workers.[549] More than a third

Seasonal Affective Disorder and Light Therapy[539,540]

Seasonal affective disorder (SAD) is a type of depression that occurs on a cyclical basis. It normally begins in October or November when daylight hours decrease and ends in March or April when the days get longer again. Common symptoms include extreme fatigue and an increased need for sleep in fall and winter, increased appetite and weight gain, difficulty concentrating, sadness or anxiety and withdrawal from friends and family. Children who have the illness may experience irritability, trouble getting out of bed and problems at school.

Studies have shown that patients with SAD may improve following exposure, for 30 minutes or more per day, to artificial light that is 5–20 times brighter than regular indoor lighting—possibly because light has a biological effect on brain hormones and function.

of all work-related injuries are caused by overexertion and repetitive movements.[550]

Protecting Our Health

In Canada, the federal, provincial and territorial governments have enacted legislation concerning occupational health and safety within their jurisdictions. Each government has the responsibility to inspect workplaces, publish information and conduct training programs.

Did you know?

Canadian occupational health and safety legislation ensures that, as a worker, you have the right to know the actual and potential dangers in your workplace and to refuse unsafe work. If you are an employer, it is in your interest to maintain worker productivity by providing a safe environment and responding quickly to any complaints. Effective communication between employers and employees can help resolve any problems that may arise.[134]

At the federal level, Human Resources Development Canada administers the Labour Code and Occupational Health and Safety Regulations and enforces the requirements of the Workplace Hazardous Materials Information System, which was developed by government, labour and industry to ensure that workers are aware of potentially hazardous substances in their work environment and know how to handle them properly.[551] Health Canada is developing guidelines for machinery noise emission, related to workplace noise reduction. The Canadian Centre for Occupational Health and Safety provides information on chemical substances, radiation, noise, workplace design and many other topics.[548] The Industrial Accident Prevention Association, a non-profit organization established in 1917, provides training and work-site evaluations and produces publications, videos and a newsletter.

Transportation

Motor Vehicles

Most Canadians enjoy a high degree of mobility and personal freedom, thanks primarily to the automobile. In 1950, only about one person in seven owned an automobile, and the average person who had access to public transit took about 250 trips per year. By 1990, there were nearly half as many automobiles as people in Canada, and the average Canadian with access to transit service took only about 100 rides per year.[131] In 1993, there were more than 12 million cars in Canada, almost one for every two Canadians. This is one of the highest ratios of car ownership in the world.[488] For many people, the car is not only a convenient means of transportation, but also a status symbol.[472]

However, our love affair with the car comes with a price. The widespread and frequent use of automobiles reduces our air quality. Despite major advances in reducing vehicle emissions, there are now more vehicles on the road than ever before, and air quality problems persist in many cities, particularly during the summer months.[554] Traffic congestion creates stress, and car crashes can wound and kill. Unlike walking and cycling, the automobile does not enhance our physical health. Moreover, it can increase our social isolation. According to the Environmental Monitor, 42% of Canadians and 46% of Americans believe that their health problems will increase during the next 10 years because of pollution from automobile emissions.[557]

Outdoor air quality has a significant impact on respiratory health and other medical conditions. Engine exhaust from cars, trucks, buses, recreational vehicles and other machines is the largest single source of outdoor air pollution.[172] The transportation sector accounts for 26% of greenhouse gas emissions, and automobiles alone account for 10% of all carbon dioxide emissions.[555] It is estimated that about $1 billion a year in health care costs would be saved if low-emission vehicles became common and sulphur and benzene levels in fuel were reduced.[78]

Motor vehicle crashes account for nearly half of the accidental deaths in Canada each year. They are the third leading cause of death after heart disease and cancer and the most common cause of death for people under 35 years of age.[476,556] The automobile accounts for more than 9 out

Sick Building Syndrome

Health complaints such as headaches, nausea, fatigue, drowsiness and eye, nose and throat irritation that appear to arise from indoor air contamination are often called *sick building syndrome*.[552] These multiple symptoms, which are related to chemical, particulate or biological air contaminants, usually cannot be traced to a specific cause but are alleviated when the occupants leave the building or when the ventilation in the building is improved.[134] The U.S. Environmental Protection Agency has estimated that at any one time, 10–25 million people in 0.8–1.2 million commercial buildings in the United States have symptoms characteristic of sick building syndrome.[553] There are currently no similar statistics available for Canada.

of 10 motor vehicle deaths, with most of the others resulting from off-road and recreational vehicles.[476]

What You Can Do

Here are some ways to reduce your dependence on the automobile:

- Try walking, cycling or roller blading part or all of the way to work.
- Choose a neighbourhood where shopping and other services are within easy walking distance.
- Shop at stores that offer home delivery.
- Consider telecommuting. Computer modems and other telecommunication devices make it easier for more people to work at home some days, rather than commute.
- Participate in public meetings where decisions are made regarding transportation in your community —have a voice!

Alternative Transportation/ Active Living

Did you know?

In a typical week, 41% of Canadians say that most of their personal driving time is spent getting to and from work. Another 25% say that shopping and errands make up most of their personal driving time.[557]

It has been said that every journey begins with a single step. Unfortunately, at least from a health perspective, many Canadians walk only as far as the driveway and then get into their car. It has been suggested that the average distance North Americans are willing to consider "walking distance" might be only approximately 200 m.[592] Since World War II, life in Canada has been characterized by increasing mobility, easy access to motor vehicles and a corresponding decrease in physical activity.[472] Most new housing in Canada is in suburban communities, which further increases our reliance on the automobile.[488] In the long run, the health effects of a more sedentary lifestyle include an increased risk of cardiovascular and other diseases.[514]

A recent review of the Official Plan of the Regional Municipality of Ottawa-Carleton compared older neighbourhoods in central Ottawa with newer neighbourhoods in the suburban community of Kanata. It found that Kanata residents drive twice as far, walk and cycle one-third as often, consume twice as much energy and produce twice as much pollution as residents of downtown Ottawa.[567]

While most Canadians prefer to use the automobile for at least part of their travel, surveys show that many people are interested in using alternative forms of transportation, where possible.[557,558] Some alternative forms of transportation are described below.

Did you know?

Many Canadian municipalities have taken steps to encourage the use of alternative modes of transportation. For example, Calgary's official plan calls for transit service within a 450-m walking distance of all homes and requires the construction of footpaths where necessary to achieve this goal. Montreal has introduced bus-only lanes on major bridges and on-street bicycle lanes. Ottawa has a vast network of bike and walking paths and has started building bicycle lanes on major streets and bridges. Vancouver encourages higher concentrations of residential development near skytrain stations, so the skytrain is accessible to more people.[492]

Walking and Cycling

Walking and cycling are two of the most popular physical activities in Canada.[594] Over short distances, walking and cycling offer the same freedom as the automobile, have a lower environmental impact than public transit and provide significant health benefits from the exercise.[476] For distances up to 5 km, cycling is recognized as the fastest of all modes of transportation from door to door, including walking, private automobiles and transit.[593]

According to some public opinion surveys, Canadian drivers would be willing to walk or cycle more often if the conditions were favourable.[557] One reason why they are not more favourable is that Canadian cities have, over the last 50 years, been designed for motorized transportation. For example, streets have been widened at the expense of sidewalks and rarely include bicycle lanes. Some street designs that speed the flow of traffic—such as the practice of setting buildings back from the road or removing trees—increase the exposure of pedestrians and cyclists to the

elements. Parking lots located between buildings and streets are convenient for drivers but force pedestrians to walk farther. The amount of land dedicated to the needs of vehicles spreads communities over larger distances, making them less walkable. This increases the social isolation of non-drivers, especially seniors, youth and people with disabilities.[172,472]

Public Transit

For the 35% of Canadians who live in rural areas and small towns, there is no realistic alternative to the automobile under current economic and social conditions. However, for the remaining 65%, public transportation may be an option. Most cities have bus systems. The six largest urban areas, those with populations of over 700 000, also have some form of busway, subway or commuter rail.[492]

Public or mass transportation can be very efficient. When many people travel in one large vehicle, that vehicle emits less exhaust, consumes less energy, generates less waste and uses less land area than the automobile on a per person basis.[488,492] People who use public transportation normally walk to and from the bus stop or transit station at either end of their journey, gaining from the regular exercise.[560] Public transit vehicles that run on rail lines or dedicated roadways often travel faster than automobiles, particularly when the major arteries are congested. For individuals, public transit is a more affordable option than purchasing, maintaining and operating an automobile,[561] even after the costs of occasionally taking a taxi, renting a car or paying for delivery services are factored in.

For some trips, however, public transportation is less convenient than the automobile for many Canadians, especially when travelling as a family, in the evenings and in the suburbs. Public transportation systems are designed mainly for a daily commute between the suburbs and the downtown area, which is the route most riders travel. The extent to which employment, shopping, services and leisure activities are separated increases the barriers to alternative modes of transportation, such as walking, cycling and transit.

Protecting and Promoting Our Health

Over the past two decades, federal regulations controlling automobile emissions have led to a significant decline in the concentrations of several air pollutants, including lead, particulates, carbon monoxide, nitrogen oxides and sulphur dioxide. On January 1, 1999, additional measures will take effect to reduce the amount of benzene and sulphur allowed in gasoline and diesel fuel. In some cases, automobile manufacturers have voluntarily upgraded vehicle emission standards. For example, the Automotive Pollution Prevention Program is a joint initiative of the Motor Vehicle Manufacturers' Association and the federal and Ontario governments to develop strategies for reducing pollution in the automobile industry.

The Transportation Association of Canada (1996) has developed a new vision for urban transportation, which calls for compact, mixed land-use development that makes alternative transportation more feasible. In addition, the Canadian Institute of Planners has published a detailed guidebook to help communities integrate bicycles into their transportation and land-use planning.[562]

Health Canada, in partnership with key non-governmental organizations such as *Go for Green!*, the Federation of Canadian Municipalities, provincial/territorial governments and other federal departments, has undertaken several initiatives to promote active modes of transportation.

Health Canada in partnership with *Go for Green!* has developed a guide entitled *Retrofitting Communities for Sustainable and Healthy Active Transportation*, for use during the construction and reconstruction of urban and rural communities to make them friendlier to pedestrians and cyclists.[563]

Waste Management

Humans have always produced waste, but the amount we generate is growing at an alarming rate and is threatening to exceed the capacity of our environment to absorb it. On a per capita basis, Canadians rank among the top producers of garbage in the world, although our output per person declined from 380 kg in 1990 to 330 kg in 1993.[246,564] According to the Office of Waste Management of Environment Canada, more than 32 million tonnes of solid wastes are generated in Canada each year, including residential, commercial, institutional, light industrial and construction wastes—or about 1 t per person.[238,246] Canadians also produce liquid and gaseous wastes, which include motor vehicle exhausts, chimney gases and other products that are released into the air.

Did you know?

Hazardous wastes include any solids, liquids or gases that are harmful to human health or the environment because of their toxic, radioactive, flammable or infectious properties. Hazardous wastes include household products with labels marked ***corrosive***, ***reactive***, ***toxic*** *or* ***flammable****. Many municipalities operate depots for household hazardous wastes, which should be removed and treated separately from other household waste products.*[30,246]

Waste Disposal

Wastes that are not reduced, reused, recycled or recovered must be disposed of. In Canada, more than 80% of the municipal garbage we produce ends up in landfills, although some communities operate incinerators instead. In most landfills, the garbage is piled in layers, with few precautions to

prevent leaching of liquid residues into the surrounding soils or groundwater.[238] However, a growing number of communities operate sanitary landfills, which employ techniques to minimize the risk of environmental contamination, such as the collection of landfill gases and leachate.[565]

Did you know?

Scientists have identified some 260 communities in Canada, with a total population of 2.25 million, that may be exposed to contaminated water via old landfill sites.[284] In addition to the potential for direct health impacts, some studies indicate that people living near landfill sites experience significant stress (essentially, fear of the unknown).[566] Under the National Contaminated Sites Remediation Program, which ran from 1989 to 1995, the clean-up of many hazardous sites was initiated.

Liquid wastes normally end up in sewage collection and treatment systems. In some cases, municipalities discharge untreated sewage directly into nearby water bodies, although far enough away from drinking water sources to avoid contamination.[243] However, there can be localized health risks associated with this practice. Chemical liquid wastes generated in industrial and institutional settings are normally treated and disposed of through separate processes.

Protecting and Promoting Our Health

In Canada, a variety of programs have been launched to improve the management of residential and industrial wastes. For example:

- In most communities, the disposal of municipal waste is governed by provincial statutes and regulations. To protect the health of First Nations communities, the Medical Services Branch of Health Canada provides a range of inspection services designed to help improve the design, operation and maintenance of local waste disposal facilities.
- The Canadian Waste Materials Exchange provides a matching service that links generators and potential users of specific waste products.[568] The Exchange also operates a matching service for recycled products. In some cases, demand for recyclable materials has exceeded the supply.[569]
- More than 90% of the Canadian population now has access to recycling programs for one or more household products.[570,571] In 1994, almost 70% of Canadian households had access to curbside recycling programs or recycling depots for paper, compared with 52.6% in 1991. Over the same period, access to glass recycling programs increased from 50% of all households to 67.4%.[564]
- Governments and private industry are working together to improve the recycling of used automobile parts. Some provinces have introduced fees on new car parts to fund recycling projects. Approximately 75% of the materials in old vehicles can now be recycled.

What You Can Do

Here are some ways to reduce the amount of waste you send to municipal landfills:

- Purchase products that have little or no packaging, such as bulk goods or products sold in refillable containers.
- Compost vegetable scraps, lawn clippings, leaves and garden wastes.
- Participate in local recycling programs.
- Use jars, tins and plastic containers to store leftovers, bulk foods and household items.
- Carry your lunch in reusable containers.
- Purchase durable, high-quality products that will last, and try repairing any broken items before

Sewage Treatment

In 1983, about 18.2 million people, three-quarters of the total population of Canada (including all city residents), were served by sewage systems, and 72% of these were also served by some form of sewage treatment. By 1994, the number served by sewers had risen to 21.2 million, of which 19.6 million, or about 93%, were also served by some form of sewage treatment.[243] For the remaining population with collection systems, untreated sewage was released directly into nearby water bodies.[243] However, the proportion of homes with connections to sewage treatment facilities is steadily increasing.

The level of sewage treatment varies considerably between regions because of differences in provincial/territorial regulations. Primary treatment involves the mechanical removal of solid wastes, whereas secondary treatment uses bacteria to degrade dissolved organic material. Tertiary treatment is a chemical process designed to remove such contaminants as phosphates, nitrates and heavy metals. Tertiary treatment is required to return water to an approximation of the pristine condition.[131] Municipalities in Ontario and the Prairie provinces have the highest levels of secondary and tertiary treatment.[238,243]

The "4 Rs"

The best way to manage waste is for society—including government, industry and individuals—to produce less, by following the "4 Rs": reduce, reuse, recycle and recover.[572]

Reducing our consumption of goods is the most effective waste management strategy, because it results in less waste and consumes less energy. The usual target of source reduction programs is excess packaging, because packaging accounts for about half of our municipal solid waste by volume. According to Environment Canada, each of us throws away, on average, approximately half a kilogram of packaging every day.[573]

Reusing products is the next best option. Examples of this strategy include returnable beer and soft drink bottles, garage sales and second-hand furniture and clothing outlets operated by commercial businesses and goodwill or charitable organizations.[238] Although there are some costs associated with the reuse of products, such as empty glass bottles, the amounts of raw materials and energy needed to produce the glass are reduced, and the disposal costs are eliminated.[238]

Recycling involves using material from old products to make new products. Commonly recycled materials include newspapers, metal cans, glass bottles, plastics, cardboard and used auto parts.

Recovery involves the harvesting of energy or economically worthwhile components from waste materials. Industrial-scale examples include heat energy generated from the incineration of solid wastes and methane gas recovered from composting organic wastes. It is estimated that backyard composting could reduce the volume of residential waste in Canada by 40–60%.[574]

you replace them. Consider renting items that you use infrequently.
- Purchase reusable products, such as rechargeable batteries.
- Donate or sell good used clothing, and consider buying used clothing and sports equipment.
- Share your newspapers, magazines and books, or borrow them from the library.
- Take hazardous wastes, including used art supplies, batteries, pesticides and wood preservatives, cleaning products, paints and solvents, pharmaceutical supplies, swimming pool chemicals and motor oil, to the municipal collection depot.[30,572,573]
- Explore the use of non-toxic alternatives to household hazardous products.

Radiation

Nuclear Technologies

Nuclear technologies have a daily impact on the lives of Canadians. They are used for medical diagnosis and treatment, in nuclear power and in various consumer and industrial applications. In the process, they generate significant quantities of radioactive waste that must be safely managed. Because of the potential risks associated with ionizing radiation, laws governing the use of radioactive materials and radiation-emitting devices—and limiting radiation exposures—exist at both the federal and provincial levels.

Did you know?

Radiation doses resulting from medical and dental applications, such as X-rays and radioactive materials used in medical diagnosis or treatment, are not subject to legislated limits, but vary according to the needs of each patient. When patients are exposed to radionuclides, they expect to receive some direct personal benefit that outweighs the potential risks to their health. However, this can be properly assessed only by their medical advisors, based on detailed knowledge of the patients' condition.

Despite the safety measures employed at nuclear power facilities, there is always the potential for a serious accident that releases large amounts of radioactivity into the environment and contaminates air, soil, food and water supplies. While the risk of such an event is much less than the risks associated with other natural and human-made hazards, emergency plans have been established to deal with any conceivable accident (see "Emergencies," below).

Did you know?

Our principal source of exposure to radiation is naturally occurring radionuclides, particularly radon gas, which can enter buildings through cracks and holes in their foundations. Although background radiation from natural sources is not covered under the ***Atomic Energy Control Act*** *or the* ***Radiation Emitting Devices Act****, Health Canada and the provinces have set guidelines for exposure to natural radioactivity.*

The International Commission on Radiological Protection (ICRP) has recommended dose limits of 20 mSv per year for occupational exposures and 1 mSv per year for public exposures.[575] The public dose limit is about half the average exposure to radiation from natural sources. The Atomic Energy Control Board (AECB) is in the process of adopting the latest ICRP recommendations on dose limits. Beyond the legal limit, exposures must be kept *a*s *l*ow *a*s *r*easonably *a*chievable (the ALARA principle), taking into account economic and social factors. As a condition of licensing, the AECB requires nuclear power facilities to keep exposure to members of the surrounding population to less than 0.05 mSv per year, by using the ALARA principle.

Protecting Our Health

Radioactive waste includes any waste materials that contain or are contaminated with artificial or technologically enhanced natural radionuclides for which no use is foreseen, such as wastes from nuclear reactors; uranium mines and mills; and hospitals, research laboratories and industries. In Canada, the AECB regulates the management of radioactive waste to ensure that it poses no hazard to the health and safety of Canadians or to the environment.[576] Low-level radioactive wastes are now stored at 21 licensed waste management facilities located in five provinces. There are also radioactive waste management facilities associated with Atomic Energy of Canada Limited's Chalk River Laboratories in Ontario, the Whiteshell Laboratories in Manitoba and uranium mining and milling operations. High-level radioactive waste is mainly unprocessed spent reactor fuel, which is currently stored under water or in dry concrete containers at nuclear reactor sites until a permanent storage or disposal facility becomes available. In March 1996, the AECB launched public hearings as part of an environmental assessment on a proposal to bury high-level wastes in stable, underground rock formations in the Canadian Shield.[576]

The AECB also regulates nuclear facilities and non-medical uses of nuclear materials under the *Atomic Energy Control Act*. Health Canada administers the *Radiation Emitting Devices Act*, which applies to specific classes of radiation-emitting devices used both occupationally and in the home, such as X-ray equipment, ultrasound therapy devices and microwaves. Under this Act, Health Canada establishes safety codes for these devices and prepares regulations governing their advertising, design, construction and performance. However, the provinces are responsible for controlling the use of radiation-emitting devices, as well as non-nuclear fuel cycle activities that result in occupational exposure to radionuclides.

Epidemiological Studies Using the National Dose Registry[577]

Since 1951, Health Canada's National Dose Registry has recorded the dose levels of all Canadians exposed to radiation in the workplace, including dentists, radiologists, nuclear power station employees and uranium miners. This database provides a wealth of information on the health effects of radiation.

The National Dose Registry contains records for 520 000 Canadian workers; some of the records date back to the early 1950s. The Registry is used to help regulatory authorities control occupational radiation exposures, monitor long-term dose trends and provide dose histories for use in radiation exposure planning and worker compensation claims. It is also used in epidemiological studies on the long-term effects of radiation, such as:

- the Paternal Radiation Exposure and Childhood Leukaemia Study, which found no link between radiation exposure levels in workers prior to the conception of their children and the incidence of leukemia in their children; and
- the Cohort Mortality Study, launched by Health Canada in the 1980s, which is examining the relationship between radiation doses and cause of death in 5430 workers.

What You Can Do

To minimize your exposure to radiation, you can take the following steps:

- Discuss the risks and benefits of X-rays with your medical advisor, and avoid duplication by informing your doctor or dentist of X-rays that you have previously had taken elsewhere.
- If you work in a high-risk occupation, find out the risks involved and the precautions you should take.

For more information about the health effects of ionizing radiation and radiation levels in the environment, contact Health Canada or the AECB.

Electromagnetic Fields

Electric fields are created by the voltage (strength) of an electric charge. Magnetic fields are created from the current (motion) of the charge.

Together, they are called *electromagnetic fields* (EMF). EMF occur naturally in thunderstorms and lightning.[547] They can also be found wherever there is an electric current or a battery.

Human exposure to EMF has risen dramatically this century because of our increasing use of electricity.[578] High-voltage power transmission lines produce the strongest fields likely to be encountered by most Canadians, but they normally have little permanent impact on us, because they rapidly decrease in strength the farther they are from the source.[30,579] Almost everyone is exposed to weaker EMF associated with household wiring, lighting, computers, hair dryers, can openers, vacuum cleaners and electric shavers.[579]

Considerable research has been conducted on the health effects of exposure to low-level EMF, but there is no conclusive evidence that EMF are harmful. For example, no definitive relationship has been established between EMF exposure and cancer. Although some studies have found links between EMF exposure and cancer incidence rates in children who live close to high-voltage power lines and in workers in certain occupations, other similar studies have found no such links. Laboratory studies have shown that EMF can cause biological effects in animals and living cells, including subtle biochemical and behavioural changes. However, the implications of these findings to human health are not yet clear.[578,579]

Protecting Our Health

Scientists in the Radiation Protection Bureau of Health Canada are assessing the potential cancer risk associated with extremely low frequency EMF and are preparing safety guidelines for radio-frequency electromagnetic fields and devices.

Emergencies

Nuclear Accidents

Accidents at nuclear reactors may have serious consequences through the release of radioactive material into the environment. Notable nuclear accidents have included those at the NRX reactor in Chalk River, Ontario, in 1952, the Windscale reactor in Great Britain in 1956, the Three Mile Island reactor in the United States in 1979 and the Chernobyl reactor in the Ukraine in 1986, which was the most serious of them all.

Besides reactor accidents, environmental contamination may result from accidents involving nuclear-powered vessels and satellites or accidental nuclear weapons detonations. Accidents occurring in other countries could expose Canadians to elevated levels of radiation as a result of the atmospheric transport of airborne contaminants or the importation of contaminated foods. The ultimate impact depends on the amount and type of radioactive material released, its environmental fate and the proximity of the accident to populated areas. For example, after the Chernobyl accident, some contamination was detected in Canada, although the actual doses that Canadians received were very low.

As well as health effects, nuclear emergencies can have profound psychological, social and economic consequences. For example, the fear or stress triggered by a major accident often has a greater impact on human health than the actual radiation exposure. Psychological trauma was the principal health effect after the Three Mile Island accident,[580] while psychological stress was widespread after the Chernobyl accident, particularly among people living in contaminated regions of the former Soviet Union. The effect of the Chernobyl reactor fire on agricultural practices, food production and consumption was and continues to be more widespread than its direct impact on human health.[581]

Protecting Our Health

In Canada, responsibility for nuclear emergency planning is shared by public utilities and the municipal, provincial and federal governments, which hold exercises to ensure the reliability and completeness of existing plans. The AECB requires reactor operators to prepare on-site emergency plans to protect the general public and station personnel. Responsibility for off-site plans rests with the provinces and municipalities.

In 1984, the Federal Nuclear Emergency Plan was developed to help the Minister of Health respond to peacetime nuclear emergencies occurring at home or abroad. Its goal is to protect the public from immediate and delayed health effects caused by exposure to uncontrolled sources of radiation and to reduce the environmental impacts of a nuclear

emergency. Health Canada is the lead federal agency under the Federal Nuclear Emergency Plan.

Under the Federal Nuclear Emergency Plan:

- Three nuclear planning advisory committees have been established by Health Canada to help implement the Plan. These committees—which involve representatives of federal, provincial and territorial departments and the U.S. government—co-ordinate mutual assistance and co-operation arrangements, joint nuclear emergency preparedness activities and arrangements, nuclear emergency exercises and other related issues.
- A Canada/United States Joint Radiological Emergency Response Plan was completed and signed on July 27, 1996.
- Health Canada is helping to establish protective actions following a nuclear emergency.
- Radiation exposures and human health risks are assessed using data and samples collected by the National Radioactivity Monitoring Network.

Chemical Spills

Industrial accidents are an inevitable part of our society. For example, chemical spills can result from highway accidents involving trucks, train derailments or shipping, as well as from industrial processes or accidents. Fortunately, most of the estimated 10 000–15 000 spills that occur each year in Canada are relatively minor and rarely result in permanent injury.[582]

Protecting Our Health

In the event of a serious failure of safety systems, deaths can occur. For example, in 1984, a chemical tank in Bhopal, India, leaked methyl isocyanate gas, killing more than 3300 people. To prevent such a disaster from happening in Canada, the federal government, in partnership with industry and other stakeholders, has created the Major Industrial Accidents Council of Canada. The Council's main objective is to minimize the risk of accidents by helping industry associations and individual firms develop plans that stress prevention, preparedness and response.

Emerging Issues

Sustainable Development

The global population is growing rapidly, and the material standard of living of many countries is also increasing. Both put increasing pressure on the Earth's resources, thus reducing their capacity to sustain our health and well-being.[583] The population of Canada is growing at a slower rate than the global population, although our resource consumption is rising quickly. For example, in 1951, there was one dwelling for every four persons; in 1991, there was one dwelling for every three persons or less.[584] Today, Canadians and people in other industrially developed countries generate about five times as much waste as people in developing countries.[480]

In some ways, our built environment is currently unsustainable. For example, the typical urban development in Canada:

- sprawls over large distances, thus increasing the infrastructure cost per home and the amount of time people spend travelling;
- segregates land uses by category (residential, commercial, industrial);
- is centred upon the automobile, which requires non-renewable resources to manufacture and operate;
- creates large amounts of wastes that are buried or incinerated; and
- replaces or degrades agricultural land and environmentally sensitive areas.

A more sustainable form of development would strive to:

- increase population density in urban areas, reducing infrastructure costs;
- include mixed land uses where compatible;
- facilitate walking, cycling and increased use of public transit;
- reduce waste volumes through the 4 Rs: reduce, reuse, recycle and recover;
- plan expansions to minimize the destruction or alteration of natural habitats; and
- preserve more environmental areas and open spaces in a natural state.

The Canadian Environmental Industry Strategy

In September 1994, Environment Canada and Industry Canada, in partnership with provincial governments and industry, launched the Canadian Environmental Industry Strategy to promote economic growth, job creation and a cleaner environment. Today, the environmental industry is involved in environmental monitoring, auditing, assessment, pollution prevention, pollution control, environmental clean-up and restoration—activities that are key to helping Canada achieve its sustainable development goals. The Strategy is designed to help improve the environmental industry's access to government programs and services, foster success in the growing Canadian market and increase exports.[587]

Canada is an international leader in efforts to foster healthy, sustainable communities by encouraging participation of community members. For example, sustainable development round tables are a Canadian innovation. Here, multiple stakeholders, such as governments, industry and environmental groups, attempt to reach consensus on decisions affecting the environment, the economy and social equity.[585,586]

In Canada, some attempts have been made to create healthier and more environmentally sustainable communities.[588] For example, Health Canada recently launched a community-based assessment of the built environment in Sydney, Nova Scotia. The aim of this project is to help Sydney residents identify and implement appropriate changes in municipal policy and the physical environment through a consultative process. The knowledge gained in this initiative will be shared with other community leaders across Canada.

The Ouje-Bougoumou Cree Nation[589]

Winner of a United Nations award for sustainability, the Ouje-Bougoumou Cree Nation of northern Quebec is the first community in North America to install a village-wide district heating system, which itself is the first to be fuelled by biomass. The district heating system—which serves community buildings, the band office, the community centre and residential houses—generates energy from the mountains of sawdust produced by a local sawmill. The heating system provides numerous benefits for the Ouje-Bougoumou Cree Nation, including:

- making houses more affordable by reducing heating costs;
- recovering energy from industrial wastes;
- lowering local energy consumption; and
- keeping money spent on energy within the community.