

## Biodiversity Basics

Imagine for a moment that you are looking at a hand-made quilt made of individual patches with contrasting colours, textures, shapes and sizes. They are smoothly stitched together to present a beautiful, complex and unique quilt.

You can think about the forest environment in the same way. The patches of the quilt represent the diversity of life found in the forest. Removing one patch will not destroy the quilt, but it will take away some of its strength and beauty. Remove too many patches and the quilt will fall apart.

Nature's quilt design is stitched together by a series of complex and overlapping relationships and interactions that are constantly changing in time and space. Its patches are trees, mice, voles, fungus, water lilies, eagles – the diversity of life that makes up the biodiversity of our earth. Remove one patch, and you damage this biodiversity. Remove too many patches, and you risk destroying the forest environment.

Canadian Biodiversity Information Network  
[www.cbin.ec.gc.ca/cbin/html/](http://www.cbin.ec.gc.ca/cbin/html/)

This teaching kit will explore some of the many ways we risk unravelling the delicate quilt of biodiversity – things like habitat fragmentation, invasive species and climate change.

## Biodiversity at a Glance

Biodiversity combines two terms – biology and diversity. Put simply, it refers to the variety and complexity of all living things and the way they interact within ecosystems.

Technically speaking, however, biodiversity is a lot more complex. It refers to the totality of genes, species, and ecosystems in a region, and the interactions between those genes, species and ecosystems.

We cannot maintain an assortment of species without ecosystem diversity, the ecosystem cannot function as well if it loses a species, and a

broad genetic base is needed to help species adapt to changing conditions.

Let's consider as an example a species that we may not especially appreciate, like the mosquito. As we cover ourselves with repellent or anti-itch creams, we may dream of a world without mosquitoes.

But a world without mosquitoes may also be a world without some species of birds, fish or amphibians that dine on these pesky insects.

We can never know the outcome if a species like the mosquito disappeared tomorrow. It could turn out that they had a vital role in maintaining another species or the integrity of an entire ecosystem.

On top of that, our knowledge and understanding of forest ecosystems is not complete. Aldo Leopold, considered the father of wildlife ecology, warned of the dangers involved in tinkering with a system you do not fully understand. It is far wiser to keep all the parts because they may be more important than we yet appreciate or understand.

Biodiversity World Map  
[www.nhm.ac.uk/science/projects/worldmap/](http://www.nhm.ac.uk/science/projects/worldmap/)

## Why is Biodiversity Important to Canadians?

While most Canadians live and work in or near urban centres, we still hold a special appreciation for our natural environment. It is vital that we find ways to encourage children and youth to realize the critical role nature and the natural environment play in maintaining life on earth.

Helping students understand biodiversity close to home makes them better equipped to appreciate how it affects them as individuals, and how they can affect it – locally and globally.



Canada's First National Report to the Conference of the Parties to the Convention on Biological Diversity, entitled *Caring for Canada's Biodiversity*, pointed out that there are many biodiversity-related challenges facing Canadians:

"A few ecosystems have almost been completely lost as a result of human development and settlement patterns. In some instances, harvest rates have exceeded the capacity of stocks to regenerate themselves. Each year, the number of threatened and endangered species in Canada grows."

Virtual Exhibit on Amphibians  
<http://collections.ic.gc.ca/amphibians/>

## **Who is Responsible for Maintaining Biodiversity?**

Far from being bystanders to biodiversity, humans are part of all of earth's ecosystems. We have a special responsibility to maintain and, if possible, enhance biodiversity. Our role can be as simple as reducing our consumption of non-renewable resources or as complex as helping to ensure the survival of a species at risk.

After endorsing the United Nations Convention on Biological Diversity in 1992, Canada developed its own biodiversity strategy.

The Canadian Biodiversity Strategy outlines the roles and responsibilities of each jurisdiction in the country and recognizes the critical role of non-governmental organizations and individuals.

Canadian Biodiversity Strategy  
[www.eman-rese.ca/eman/reports/publications/rt\\_biostrat/intro.html](http://www.eman-rese.ca/eman/reports/publications/rt_biostrat/intro.html)

## **Engaging Canadians in Planning and Decision Making**

If we can help Canadians understand the importance of maintaining and enhancing biodiversity, we may be able to make positive changes in the protection our natural environment.

Encourage your students to explore how individuals and groups can make a difference. Enrich your school grounds by planting some native trees or shrubs. Start a recycling program or reduce the amount of electricity used in your school.

There are many government and non-government organizations carrying out important work that benefits Canada's forests, such as Canada's Model Forest Network. You can help make a difference by working with these groups. And don't forget that environmental activities are important to both rural and urban environments.

BioBlitz  
[www.biodiversityonline.ca/BioBlitz/intro.htm](http://www.biodiversityonline.ca/BioBlitz/intro.htm)

## **Canada's Forests and Biodiversity**

Forest biodiversity is more than a collection of different ecosystems, species and genes. It involves a complex interrelationship of all these things across landscapes and over time. Renowned U.S. naturalist John Muir put it well: "When you try to change any single thing, you find it hitched to everything else in the universe."

The connections that hitch everything together in the forest are like the stitching in the quilt we discussed earlier. It includes the bacteria in the soil, the birds nesting in the highest canopy, and everything all around them.



Forests change naturally over time through ecological processes involving fire, insect infestations, disease and climate change. We can conserve native forest biodiversity only by conserving a diversity of forest types, age structure, functions and patterns across the landscape.

Canadian Forest Service  
[www.nrcan-rncan.gc.ca/cfs-scf/national/portals/index\\_e.html](http://www.nrcan-rncan.gc.ca/cfs-scf/national/portals/index_e.html)

## Biodiversity Themes

We have identified seven biodiversity themes, and have used these as the basis for the lessons in this teaching kit. There are eight lessons – one introducing biodiversity and seven more based on the themes.

### 1) Introduction to Biodiversity

We are only just beginning to understand how complex, multi-layered and amazing our natural environments are, and how we must all help to conserve biodiversity. Our conservation efforts start when we integrate our activities with the natural processes and natural changes in the landscape.

Most Canadians live in or around urban areas so their ideas about biodiversity often reflect their interactions with wild species found in urban ecosystems. Students can learn the basics of biodiversity by studying the arrangement of wild species, both flora and fauna, in their schoolyard, and at the same time understand why it is important to live in a way that maintains the greatest variety of species.

### 2) Science and Technology/ Biotechnology

Biotechnology is a short term for biological technology – techniques that allow us to analyze and use living things, such as plants, fungi or bacteria, in ways that have the potential to benefit humans or the environment. People involved with biotechnology know it is important to conserve endangered habitats and species to avoid losing genetic resources.

Genetic diversity comes from the natural processes of changing and exchanging DNA, the genetic blueprint for life. New species emerge when nature blends DNA sequences, altering and

## Canada's Model Forest Network

Initiated in 1992 by the Canadian Forest Service, Canada's network of model forests stretches from the temperate rainforests of British Columbia to the boreal forests of Newfoundland and Labrador. There are 11 model forests covering over 22 million acres of land and representing all of Canada's forest regions:



Long Beach Model Forest, BC  
McGregor Model Forest, BC  
Foothills Model Forest, AB  
Prince Albert Model Forest, SK  
Manitoba Model Forest, MB  
Lake Abitibi Model Forest, ON  
Eastern Ontario Model Forest, ON  
Waswanipi Cree Model Forest, QC  
Bas-Saint-Laurent Model Forest, QC  
Fundy Model Forest and Nova Forest Alliance, NB/NS  
Western Newfoundland Model Forest, NF  
[www.modelforest.net](http://www.modelforest.net)

recombining DNA from living species. This process of evolving genetic diversity is an important part of biodiversity.

Biotechnology is both amazing and simple. An example that most people are familiar with is the breeding of purebred dogs. Breeders choose to breed dogs that are most likely to exhibit popular features. Like biotechnology, this means combining the best genes with the goal of creating an exceptional species.

An example of how biotechnology is used in our forest is DNA fingerprinting, a biotechnological tool used to measure genetic variation between individuals of a species and among populations of a species. In the forest, DNA fingerprinting can be used to nab tree thieves, measure genetic diversity in trees, including species at risk and identify disease and insect resistant trees.



Another example is the development and use of baculoviruses, viruses that occur naturally and sometimes attack certain insects. One virus kills spruce budworm by spreading in the insect's tissue. Eventually the insect becomes sick, stops feeding and dies.

Naturally occurring baculoviruses take a long time to stop the budworm. If we can speed up the process by adding or removing a gene, we can increase the effectiveness of the natural virus, with minimal impact on other forest species. An added benefit is that we can also reduce the use of chemical pesticides.

Biotechnology is giving us science-based tools that can help us conserve biodiversity and promote sustainable development. But in developing and using this technology, we need to maintain a connection with and respect for the natural processes that make it possible.

Natural Resources Canada  
[www.nrcan-rncan.gc.ca/cfs-scf/science/](http://www.nrcan-rncan.gc.ca/cfs-scf/science/)

### 3) Pests – Natural and Introduced

Natural forest pests such as the spruce budworm are part of the complex quilt of biodiversity. While they sometimes present problems that must be managed, they are a natural part of the ecosystem.

Invasive or introduced species such as the zebra mussel or purple loosestrife are a different story altogether. Native species often have no defence against them, which allows intruders to spread quickly.

For example, the brown spruce long horn beetle, which is native to Europe, made its first appearance in North America in Halifax's Point Pleasant Park, probably arriving in wood-packing material on ships. The beetle began to attack red

spruce trees in the park, which have no natural defence against this alien species.

Brown Spruce Long Horn Beetle  
[www.atl.cfs.nrcan.gc.ca/index-e/what-e/publications-e/afcpublications-e/s\\_twatch-e/december2000-e.html](http://www.atl.cfs.nrcan.gc.ca/index-e/what-e/publications-e/afcpublications-e/s_twatch-e/december2000-e.html)

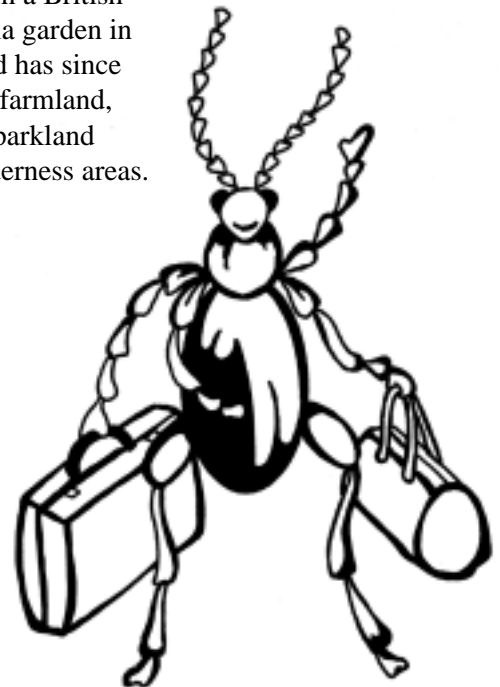
Compare this with a natural infestation. British Columbia's interior is currently in the midst of the biggest mountain pine beetle infestation in its history. The infestation is due primarily to a series of mild winters that allowed the beetle population to explode. Two extremely cold winters in a row should stop the infestation in its tracks.

Mountain Pine Beetle  
[http://www.for.gov.bc.ca/hfp/bark\\_beetles/](http://www.for.gov.bc.ca/hfp/bark_beetles/)

There are many examples of introduced species creating serious problems, including American tent caterpillar, gypsy moth, starlings, purple loosestrife and Scotch broom.

The first outbreak of the American forest tent caterpillar, which defoliates hardwoods such as sugar maple, oak, black gum and aspen, occurred in the late 1700s. Outbreaks typically occur every six to 16 years, and last from three to as many as six years, depending on weather conditions, food supply and natural enemies.

Scotch broom, a shrub native to the Mediterranean region, was first planted in a British Columbia garden in 1850 and has since invaded farmland, forests, parkland and wilderness areas.



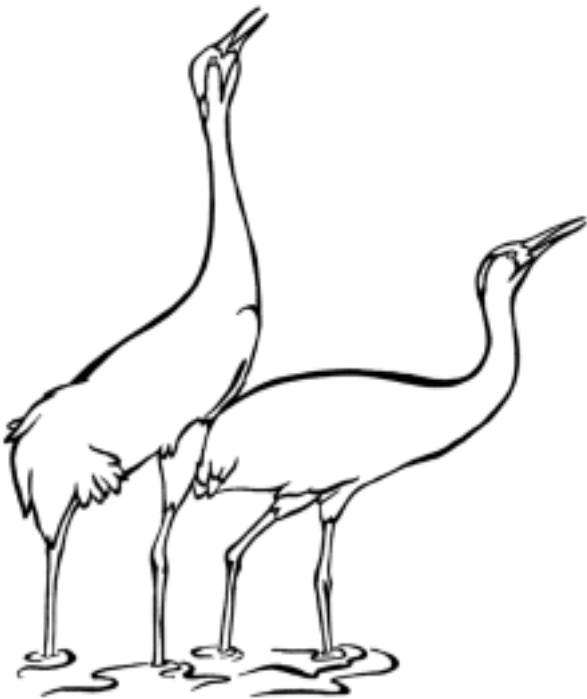
The National Forest Week Biodiversity Poster included with this kit features some of the insects of Canadian forests, such as the mountain pine beetle and spruce budworm.

#### Forest Pests

[www.nrcan-rncan.gc.ca/cfs-scf/science/prodserv/pests/pests\\_e.html](http://www.nrcan-rncan.gc.ca/cfs-scf/science/prodserv/pests/pests_e.html)

### 4) Species at Risk

The diversity of life that makes up each ecosystem includes individual species – plant or animal – with their own ecological niches, places where they live, eat, breed and flourish. If their environment is altered, some species cannot adapt fast enough and their numbers decline to a point where their survival is threatened.



Habitat loss and fragmentation are major contributors in putting some species at risk. Climate change, disease, environmental contamination, over harvesting, and invasive species can also create problems.

The Committee on the Status of Endangered Wildlife in Canada, or COSEWIC, has been advising governments on the status of wildlife species in Canada for 23 years.

COSEWIC's role is to assess the level of risk of extinction for wildlife species, using the best science, information and knowledge available, including traditional knowledge from Aboriginal peoples.

The COSEWIC Web site provides updates on the status of species at risk in Canada.

COSEWIC Web site  
[www.cosewic.gc.ca](http://www.cosewic.gc.ca)

In 1987, COSEWIC formally designated the American chestnut as a threatened species. American chestnut was a dominant forest tree species in northeastern North America before populations were devastated by the introduction in 1904 of a fungal disease which causes chestnut blight. American chestnut still survives in small populations. In 2000, a recovery plan was developed through COSEWIC with the goal of restoring American chestnut to self-sustaining populations throughout its range in Canada.



There have been some successes in helping listed species recover, including the wood bison, swift fox and whooping crane.

Whooping cranes were designated as endangered in 1978. Although their populations were never large, they had been widespread in central and western North America. Numbers began to decrease in the early 1900s due to over-hunting, egg collection, and habitat disturbance including draining of large, isolated marshes. In 1941, there were 21 wild and two captive birds left.

The recovery plan has involved protecting habitat, establishing a captive breeding program, conducting research into new reintroduction sites, and teaching the captive-raised birds to migrate with the use of guide birds and ultra-light aircraft.

The swift fox disappeared from Canada in the early 1900s as a result of habitat destruction, strychnine poisoning and trapping in predator control programs. COSEWIC designated the fox as an extirpated species in 1978. This means it was extinct in the wild in Canada but occurred elsewhere. Captive breeding programs initiated since then have been successful. The swift fox was down-listed from extirpated to endangered in 1998.

Species at Risk  
[www.speciesatrisk.gc.ca](http://www.speciesatrisk.gc.ca)

## 5) Habitat Loss and Fragmentation

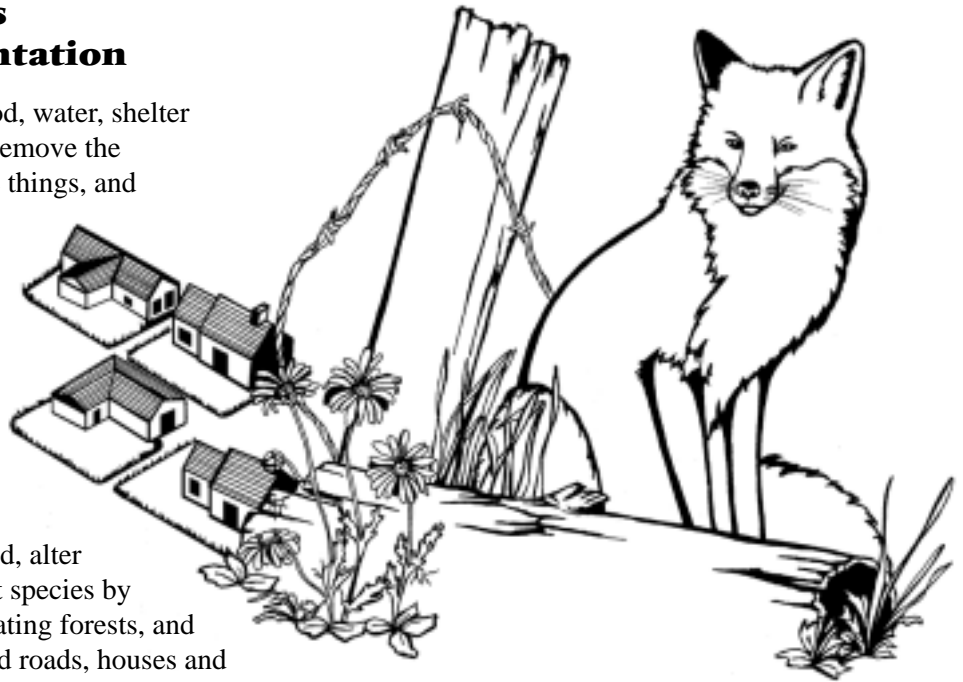
A species needs food, water, shelter and space to survive. Remove the habitat that offers these things, and you risk losing the species, which in turn limits and threatens the biodiversity of the region.

People affect habitats in a number of ways. We turn forests and grasslands into farmland, alter the distribution of plant species by harvesting and regenerating forests, and we fill wetlands to build roads, houses and factories.

Habitat fragmentation involves breaking a habitat into small pieces. This can occur naturally as a result of forest fires, insect infestations or floods, but it also occurs as a result of human activities. Logging roads, electrical power lines, and pipelines can fragment habitats, creating distances between populations and disrupting interactions among species.

Habitat fragmentation also creates new forest edges. While this may at first appear to increase the diversity of an ecosystem, it can also accelerate natural processes, leading to more predation, parasitism and competition within and along the edge of the habitat fragments.

National Atlas of Canada  
<http://atlas.gc.ca/site/english/maps/freshwater/distribution/wetlands>



## 6) Protected Areas

We need to do many things to maintain biodiversity. An important part of those efforts involves protecting representative ecosystems so we can guarantee habitat and minimize interference for as many species as possible.

Canada's system of national parks and marine conservation areas offer excellent protection for many biotic and abiotic ecosystem components.

Parks Canada  
<http://parkscanada.pch.gc.ca/>

Provincial parks, conservation areas, wildlife management areas and other specially managed landscapes all provide different levels of protection and use.

One example is Ontario's Living Legacy program established in 1999. Living Legacy is the most comprehensive, long-term program of natural heritage protection in Ontario's history, involving the establishment of 378 new parks and protected areas. One of the primary objectives in establishing these new protected areas is to measure, monitor and protect biodiversity.

Ontario's Living Legacy  
[www.ontarioslivinglegacy.com/](http://www.ontarioslivinglegacy.com/)

Private stewardship activities also supplement the public networks of protected areas. Ducks Unlimited, the North American

Waterfowl Management Plan, and other initiatives provide care for thousands of hectares of wetlands and other special ecosystems.

Ducks Unlimited  
[www.ducks.ca/](http://www.ducks.ca/)

North American Waterfowl Management Plan  
[www.nawmp.ca/](http://www.nawmp.ca/)

We need to protect large representative parts of ecosystems ensuring habitat supply for a wide range of species, which will help us maintain and preserve biodiversity. We must also consider the importance of protecting smaller areas that are critical in maintaining habitat for species at risk.

## 7) Climate Change

Most people are aware of terms such as global warming, the greenhouse effect and ozone depletion. These are just a sample of things that may influence climate. The rate of global climate change over the long term has many implications for natural ecosystems and biodiversity.

The Earth's natural climate is always changing, however, activities such as burning fossil fuels are speeding up this change. As we continue to adopt increasingly sophisticated and mechanized lifestyles, we put more and more heat-trapping greenhouse gases into the atmosphere.

Climate change is an overall change in weather patterns, including temperature, precipitation and wind. The rate and intensity of climate change is not the same throughout the world. As a northern nation, Canada will experience a greater degree of warming than countries closer to the equator. According to experts, temperatures in Canada could increase an average of 5 to 10 C over the next 100 years.

Climate Change Site  
[www.climatechange.gc.ca](http://www.climatechange.gc.ca)

Climate change could lead to more forest fires, more severe insect infestations, loss of habitat, and changes in the distribution of species including types of trees.

For more information on climate change see our 2001 Climate Change Teaching Kit *A Breath of Fresh Air*.

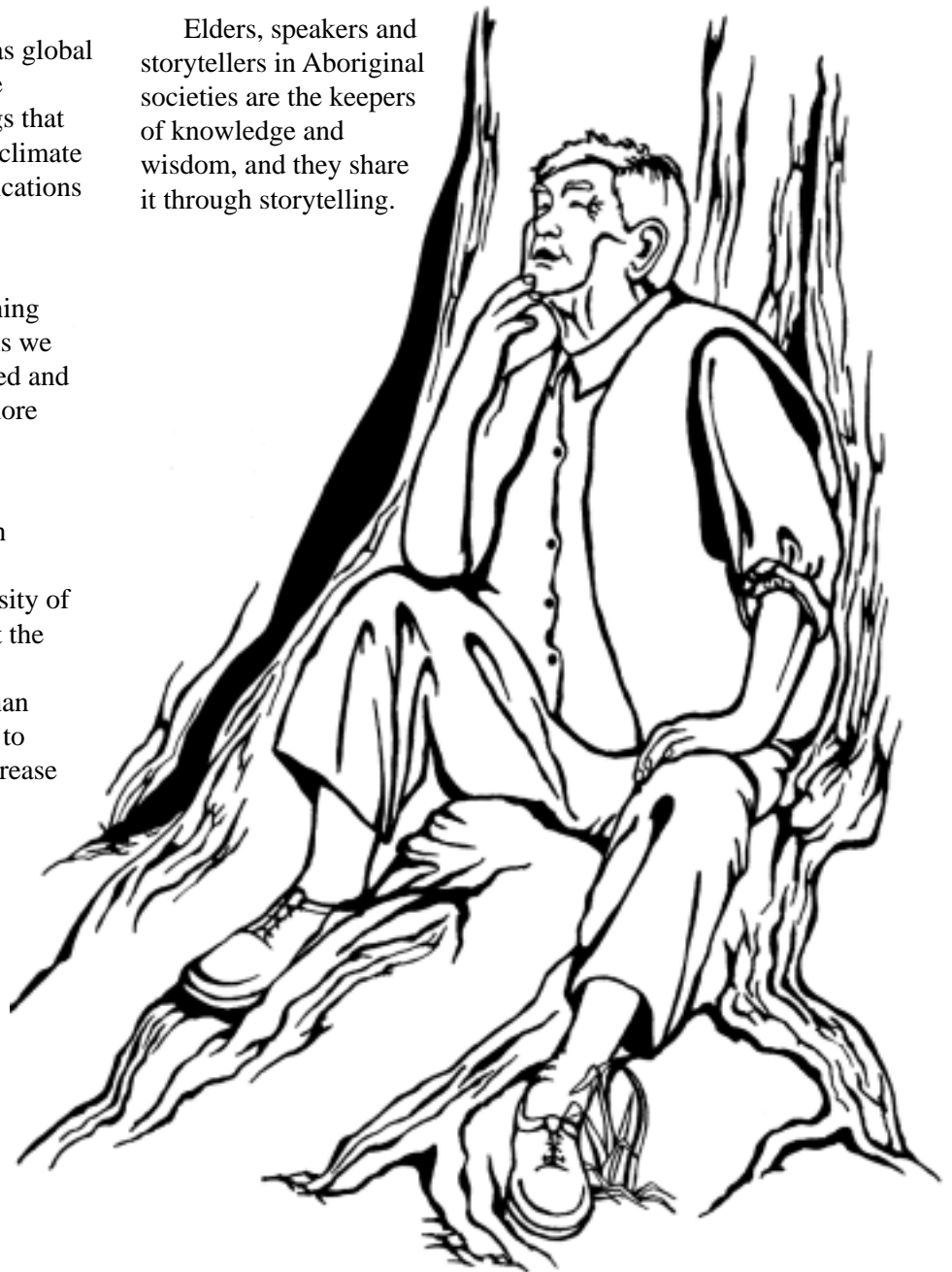
CFA Teaching Kits  
[www.canadianforestry.com/html/education/cfa\\_kits](http://www.canadianforestry.com/html/education/cfa_kits)

## 8) Traditional and Indigenous Knowledge

Patricia Longley Cochran, executive director of the Alaska Native Science Commission, once wrote an article entitled *When an Elder Dies, a Library Burns*. The article's title is an eloquent way to acknowledge the oral tradition of First Nations learning.

Elders, speakers and storytellers in Aboriginal societies are the keepers of knowledge and wisdom, and they share it through storytelling.

*When an Elder Dies, a Library Burns.*



Traditional knowledge about the environment is known as traditional ecological knowledge. It can be described as a collective body of knowledge, beliefs and observations, handed down generation to generation by oral, cultural transmission. It is based upon hundreds and even thousands of years of knowledge that is transmitted by way of legends and stories. It revolves around the relationship of living species with one another and with the environment.

Traditional native cultures survived through their close symbiotic relationship with the Earth, achieving their needs through simple but effective practices and technologies. There is no reason why we cannot learn many of these practices and apply them to our own relationship with the natural world.

In fact, native appreciation for the web of life, the inter-relatedness of all things, can help as we care for the forest environment and its biodiversity. This approach is broader than the science of ecology because of its spiritual component. It teaches respect for and sharing with other animals, plants and beings.

Traditional Knowledge  
[www.carc.org/pubs/v20no1/science.htm](http://www.carc.org/pubs/v20no1/science.htm)

## **What You and Your Students Can Do to Help Biodiversity**

There are many ways that Canadians can make a difference in conserving biodiversity in Canada.

The best place to start is right at home. It doesn't matter where you live. You can use the lessons in this kit to show your students the wonders of biodiversity if you are located in urban Halifax, next to the grasslands of Saskatchewan, in the heart of the boreal forest that stretches from Newfoundland and Labrador to the Yukon, or anywhere else in Canada.

Naturescape BC is a partnership program, which targets biodiversity conservation in backyards

The Evergreen Foundation and the Tree Canada Foundation both have programs designed to naturalize a schoolyard or urban area. These hands-on experiences help young people understand biodiversity basics and provide a strong motivation for larger-scale initiatives.

Other activities involve collecting scientific data for biodiversity conservation. The Nova Scotia Museum of Natural History's Frog Watch involves the public in monitoring amphibian populations during the spring and summer.

The Breeding Bird Survey, an initiative of Environment Canada, is designed to detect and measure changes in breeding bird populations.

Naturescape BC  
<http://wlapwww.gov.bc.ca/hctf/naturescape/about.htm>

Breeding Bird Survey  
[www.cws-scf.ec.gc.ca/nwrc-cnrf/migb/01\\_1\\_2\\_e.cfm](http://www.cws-scf.ec.gc.ca/nwrc-cnrf/migb/01_1_2_e.cfm)

Nova Scotia Frogwatch  
[www.naturewatch.ca/english/frogwatch/ns/intro.html](http://www.naturewatch.ca/english/frogwatch/ns/intro.html)

Greening School Grounds  
[www.greengrounds.org](http://www.greengrounds.org)

Tree Canada Federation  
[www.treecanada.ca](http://www.treecanada.ca)

Evergreen Foundation  
[www.evergreen.ca](http://www.evergreen.ca)

Go For Green  
[www.goforgreen.ca/asrts](http://www.goforgreen.ca/asrts)

Destination Conservation  
[www.dcplanet.org](http://www.dcplanet.org)

## **Pre-Lesson Activities**

We have prepared two fun, pre-lesson activities to help your students begin their exploration of biodiversity:

- A Biodiversity Scramble (Grades 4 to 6)
- A Biodiversity Crossword (Grades 6 and 7)