



the Jane Goodall Institute of Canada

BIODIVERSITY

CURRICULUM GUIDE

The Jane Goodall Institute of Canada

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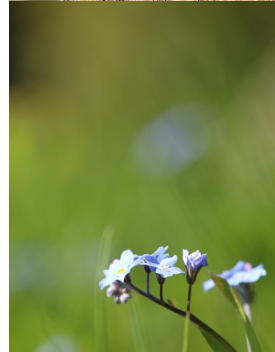
Jane Goodall's
roots&shoots



Toyota Motor
Manufacturing
Canada Inc.

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Carl Olsen Photography

SPIPIYUS

Foreword: Candace Campo, xets'emíts'a (To Always Be There) & Richard Till, smanít stumísh (Mountain Man)

I was born and grew up in a small town of Ch'atelich (Sechelt in settler language). This ocean-side community is situated on the peninsula of the Sunshine Coast of B.C., 45 km north of Vancouver. Our Shíshálh people have lived here for over 10,000 years and have stewarded over a million hectares of lands and waters.

Before contact with Europeans, our population of approximately 24,000 people was organized within four clans, several subclans and approximately 30 main villages with many additional seasonal fishing, hunting and harvesting camps. Each clan had approximately 6000+ plus members who were considered your direct family; all who lived, harvested, hunted, gathered and practiced forms of aquaculture and agriculture sustainably. It was a really good life our Elders share.

Our oral history and archaeologists both say our peoples were here during the ice age, or as we like to refer to the distant past: time immemorial. With the eventual and steady ice melt, the forests emerged and our material culture developed. As our populations expanded and with the abundance of food and resources, conditions allowed and supported social organization and specialization.

My grandmother's clan were specialists in fishing, and they were known as the people of the fish trap. Like my grandmother, I too am a fisher person and catch salmon to feed my family. We don't call plants, animals, rivers or mountains "resources". These beings are our relatives and we, skalmixw (humans) are the appreciative and grateful recipients of the gifts from the land.

Among our many relatives is a feathered seabird that is special to my heart—Sipiyyus (Sechelt name for the Marbled Murrelet). To give Sipiyyus his or her name is important to us. We are related both through the sea and the mountains. The wellbeing of this seabird friend is a sign of good health in our lands and waters. Settler people call our relative Sipiyyus the Marbled Murrelet.

This story we share with you about our relative Sipiyyus is the accumulated knowledge taught by our Elders and more specifically my Elder and relative the late Gilbert Joe, Skawki?iem, our Shíshálh peoples' Storyteller. Gilbert dedicated the later part of his life to saving the ancient forest where Sipiyyus lives on the west side of ?althtulích.



The story of the Marbled Murrelet as told by Candace Campo and Richard Till will be featured throughout the guide.

What is Biodiversity?

("Bio" = living things; "Diversity" = variety)

What comes to mind when you think of Biodiversity? Is it the plants and animals in your backyard, from the ones you can see to the ones that you can't? Is it the different shapes, sizes and colours of the trees around you? Do you think about how some animals have stripes, while others have spots? Or how some have feathers, fur or scales? Biodiversity is all around us, and it forms the foundation for everything we know about nature today.



Wildlife photo(s): Carl Olsen Photography



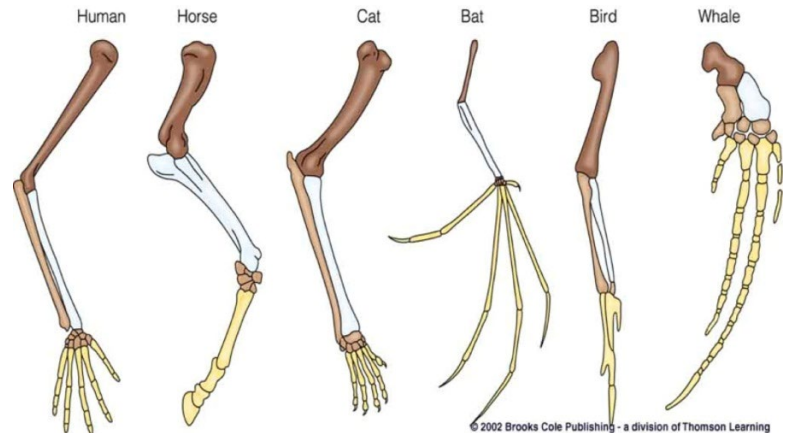
For scientists, "Biodiversity" is a term used to describe the variety of living things found in different ecosystems all over the world, including all species of plants, animals, bacteria and fungi. Biodiversity can be expressed in genes, species and functional traits, and also encompasses relationships between all species and their connection to ecological processes, in which they play a critical role.

Whether it be the deep oceans, rainforests, the middle of the desert or in your own backyard—species that are found in these places are highly specialized masters of survival in these environments.

Typically, the more unique a species is, the more specialized it is to its own ecosystem. When you consider all of the weird and wonderful places we have all over planet Earth, it's no wonder that scientists have only discovered less than 2 million of the 8–15 million species estimated to live on Earth!

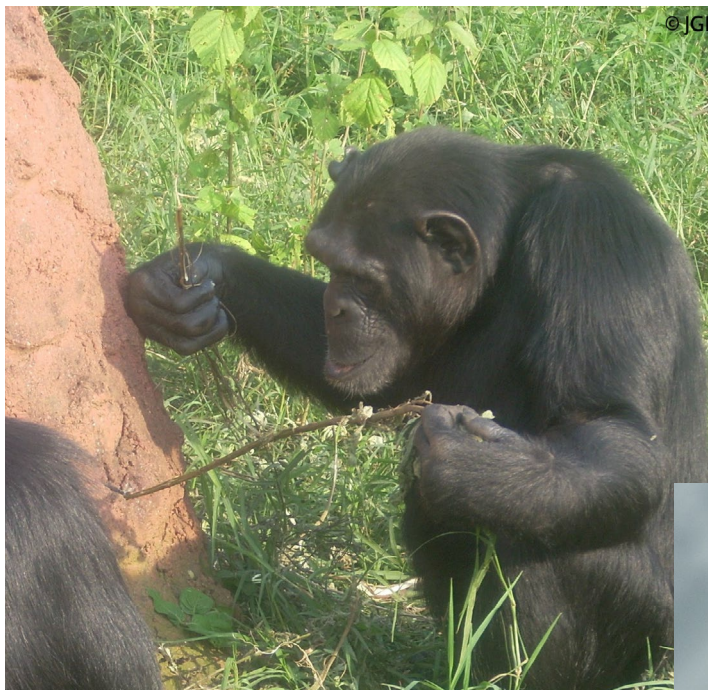
Evolution: How Biodiversity Came to Be

Evolution is the well-supported theory that all living things took millions of years to evolve and diversify from a common ancestor into all of the biodiversity we see today. Over many generations, species were under immense pressure to adapt to their changing environments in order to survive and reproduce (what is known as "Natural Selection"). The more a species was able to evolve, the better its chance of survival against changes to its environment (e.g. disease, drought or major extinction events).



Can you spot similarities between the human and animal limbs above? Why might we see the differences we do?

(Hint: each of the colours represent the same bone in all of the skeletons)



Every feature of every creature is specialized and exists for a very specific reason! What are some features of plants and animals that you can think of that might have evolved to serve a very specific purpose?

In sub-Saharan Africa, consider the opposable thumbs on great apes, such as chimpanzees, which are thought to have evolved to grip tools and branches for accessing food and climbing. Dr. Jane Goodall was among the first documented scientists to discover that chimpanzees could grip and use tools with their hands!

In northern Canada, Arctic Foxes have evolved a coat colour that changes with the seasons. Scientists suspect having a white coat in the winter and a brown coat in the summer allows them to blend in with their surroundings across different seasons, have better camouflage and be better predators. This ability to adapt with the seasons is also common in other arctic mammals such as hares and weasels.



Illustration: Brooks Cole Publishing
Photo of Chim: Michael Neugebauer
Bryan Walker, unsplash.com (bottom right)

Canada's Biodiversity

Canada hosts a number of unique environments, climates and topographies across its 15 million km² of land. This includes the tundra in the northern territories, the coastal marine and temperate rainforest ecosystems found in British Columbia, the continental prairies and the boreal forest, which stretches from Yukon to Newfoundland covering 55% of Canada's land mass. Canada also makes up 24% of all wetlands, 20% of all freshwater reserves and 8% of all forests worldwide.

Canada is home to over 140,000 species of plants, animals, insects and other microorganisms—many of which haven't been identified yet. There are an estimated 198 species of mammals, 456 species of birds, nearly 100 species of reptiles and amphibians, over 1000 species of fish and over 14,000 insect species that have been identified to date!

Did you know?

There are more species of Canadian earthworms than there are of all Canadian mammals!



SPIPIYUS



The Marbled Murrelet is a member of the auk family of seabirds numbering about 357,000 in the world. A small, football shaped alcid, darkly feathered above with a white underside displays marbled brown plumage that helps provide camouflage at nesting sites during breeding season.

The Marbled Murrelet lives mostly at sea from the Aluetian islands of Alaska, down through BC, Washington, Oregon and Northern California but also ranges 80 kilometers inland for nesting. The bird nests up to 1300 metres above sea level and forages offshore as far as 200 kms. When seeking food it dives down to depths of 50 metres below the surface of the sea. This profound range of subalpine to subsea habitat means the bird has developed a highly adaptable physiology and range.

Wildlife photos: Carl Olsen Photography



© Illustration copyright: JGI Canada

Biodiversity Example: *The Great Lakes*

The Great Lakes system that sits on the border of Canada and the USA, is made up of 5 large lakes (Ontario, Erie, Michigan, Huron, Superior), 1 small lake, 4 connecting channels and the St. Lawrence Seaway. It is the largest surface freshwater system in the world—holding nearly 20% of Earth’s freshwater! With over 16,000 km of shoreline and covering a surface area over half a million square kilometers, there is endless wildlife and vegetation of all shapes and sizes that call the great lakes home.

The Great Lakes are also home to approximately 40 million people that live and depend upon the region for commercial and sport fishing, agriculture, manufacturing, shipping, tourism and recreation. Even though the Great Lakes are vast and resilient, the ecosystems and biodiversity within are sensitive and their resources are finite. Human behaviour has had several significant impacts on the Great Lakes region for decades due to the expansion and development of urban areas, and it is imperative we preserve its natural systems for generations to come.

Biodiversity is a concept that connects us all—the plants and animals around the world depend on each other and a healthy habitat for survival. This includes us! Without the insects, plants, animals, bacteria, fungi, and everything in between, we would be unable to survive.

With the Roots and Shoots program, you can take action as a citizen scientist and choose a project that can directly or indirectly protect biodiversity in your community.



Why Should We Care About Biodiversity?

Biodiversity all over the world provides the foundation for life as we know it. It has incredible ecological, economical, cultural and spiritual significance and we would be unable to survive without it. Our land, oceans, soil and everything in between rely on biodiversity.

Animals rely on plants and other animals as sources of food and nourish the soil when they decompose. Some animals (such as bees, butterflies, birds and bats) pollinate our plants, which supplies us with the food we need to survive.

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ECOLOGICAL IMPORTANCE OF MARBLED MURRELETS

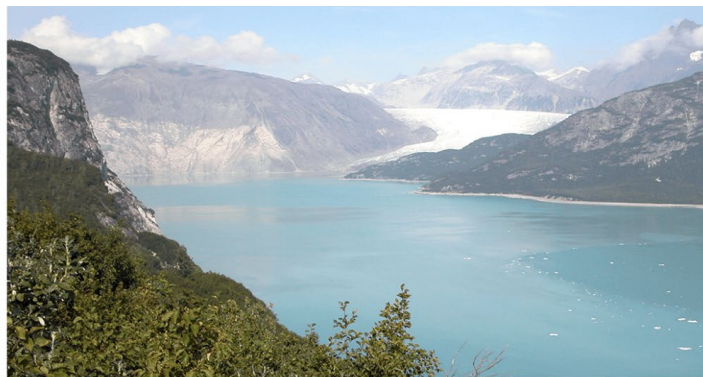
Along with wolves and bears, Marbled Murrelets have been transferring sea-derived nitrogen rich fertilizers to the forests for thousands of years. The importance of this nutrient distribution is known, but not yet fully appreciated.

Carl Olsen Photography

While natural fluctuations over millions of years at a time are normal, scientists have noticed global changes to our Earth that match the speed of human development—a rate far faster than most of our biodiversity is able to handle. Plants and animals aren't able to **adapt** and **evolve** fast enough to keep up!

"Adaptation" indicates changes to species **within** a generation

"Evolution" indicates changes to species **across** generations



And because all of Earth's plants, animals and microorganisms alike depend so greatly on each other, the loss of one species can have significant impacts on many others. This includes us! We've already lost approximately 60% of our global biodiversity and it is our job to protect the biodiversity that still exists today.

Photo: Alaska's Muir Glacier, taken 63 years apart (1941 vs. 2004). Species that formerly relied on sea ice must literally sink or swim!

Photo Source: NASA Climate Kids, 2021

Endangered Species

Endangered species are animal and plant species that have so few individuals left alive that they are at risk of disappearing forever. Many of these species include some of the most beloved animals we know today—elephants, polar bears, blue whales, chimps—are all endangered!

When all living species are wiped from a particular **region**, the species has been **extirpated** from that region.

When all living individuals of a species have been wiped from **Earth**, the species is considered to be **extinct**.

Did you know?

One in every four mammal species, one in eight bird species, one in three amphibian species and one in five plant species are endangered across the world! Some major causes of extirpation or extinction include poaching, deforestation, habitat loss, invasive species, natural causes and weather disasters driven by climate change.

Endangered Species in Canada

Many species in Canada are at risk of extinction at the hands of deforestation and habitat loss. Since the early 1900's, twenty-three Canadian species have been extirpated (exist in other areas but are no longer found in Canada), and an additional thirteen have become extinct all together. Currently over 550 species in Canada are considered to be at risk!

In order to conserve species at risk several actions are needed, including habitat conservation, natural resource management and more efforts to ensure invasive species are not being introduced to new habitats!



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CONSERVATION OF THE MARBLED MURRELET

The Marbled Murrelet was listed as a threatened species in 1992 in the US and in 2012 in Canada. The greatest and most obvious threat to the bird is loss of moss layered nesting habitat in old growth trees. Other concerns are reduced food sources (such as herring) due to overfishing and the implications of climate change as it affects sea life. The birds become caught in fishing nets and are killed by predators due to the lack of suitably camouflaged or remote nesting sites.

The forestry industry is required to account for and recognize habitat for the protection of Marbled Murrelet nesting sites, making the bird a flagship species for environmental organizations. Locating nest sites has previously depended on the use of tree climbers and radar, aircraft and observation posts, however the use of Drones and LIDAR is an effective and cost efficient method of habitat mapping. Whether the information is effectively implemented remains to be clearly understood, as large old-growth trees are still being harvested at a rapid rate, especially on the west coast of Vancouver Island.

Human Impacts on Biodiversity

In our estimated 2 million years on Earth, humans have evolved and achieved some remarkable advancements. The opportunity to develop and expand settlements, started by the Industrial Revolution 240 years ago, created exponential growth of all kinds with impacts that weren't widely recognized until later in the 20th century. While many cultures, including Indigenous peoples in Canada, have recognized the importance of biodiversity for millenia, most westernized societies have only recently begun to realize just how important biodiversity is, and how much we depend on it for our own survival.

What are some of the ways that humans have had an impact on biodiversity?



Invasive Species
Quagga & Zebra Mussels

Invasive species are non-native and cause detrimental impacts to ecosystems. They are usually spread through human transportation and often outcompete native species for resources with no natural predators or diseases to regulate their population.



Pesticides & Insecticides
Pollinators

Pesticides and Insecticides are often used in commercial agriculture to control crop pests, however they have the ability to impact local bee colonies **and other pollinators** if not applied properly.



Urban Development
Turtle

Urban expansion and development causes the displacement of localized plant and animal species and habitat fragmentation.



Overfishing/Overhunting
Commercial Fishing Boat

Overfishing and over hunting of wildlife deplete population numbers and create instability within the ecosystem. The lower the population numbers are, the more difficult it is for species to recover.



Lake Stocking
Lake Trout (Stocked Species)

Lake stocking involves the introduction of fish species into water bodies, most often for sporting purposes. Fish stocked into lakes in high quantities provide little opportunity for Indigenous fish species to compete or adapt.



Pollution
Commercial Plants

Pollutants such as sulphur and nitrogen emissions lower air quality and have the ability to acidify water, negatively impacting plant and animal species that depend on these resources for survival.



Commercial Logging
Red Fox

Deforestation for commercial logging or agricultural purposes destroys large habitats relied upon by thousands of species contained within, leaving them without food, shelter and other resources.



Photo Source: Artiom Vallat, unsplash.com

Actions Students Can Take

- When visiting conservation areas or forests, make sure to stay on the trails and wipe off your shoes when leaving to prevent carrying out seeds and insects. Do the same if you are out with your pet (wipe off their paws) or riding your bike (brush off the tires).
- Ensure that when out exploring natural places, you leave nature as you found it. This includes replacing overturned rocks and logs that are home to little critters.
- If you are in Ontario and see an invasive species, report it on the Early Detection & Distribution Mapping System website www.eddmaps.org/ontario/. Biologists are able to track and monitor where invasive species are occurring in Ontario so they can stop their spread.
- Plant native and local flowers in your front or backyard to attract pollinators. Some helpful plants are sunflowers, milkweed, blueberry and raspberry bushes and goldenrod. These will support pollinators through the spring, summer and fall.
- Pick up litter and other harmful debris when you're out exploring nature. Often these items are mistaken for food and can be harmful to wildlife if eaten and can be damaging to local vegetation.
- When wearing a disposable mask, be sure to cut the ear tabs off before throwing it away so it doesn't get tangled on plants or wildlife.
- When driving down rural roads (even with your parents!), be sure to go slow and keep your eyes out for small critters on their migration routes. Amphibians and reptiles such as frogs, toads and turtles often cross busy roads that fragment their habitat.
- Don't be afraid to take action in your community! Use your citizen voice to do research and become educated on local issues, use your consumer voice to support more environmentally-friendly businesses and use your political voice to demand change from local governments.
- Get out in nature! One of the best ways to care about nature is to understand what's in your own community. If you come across any neat species, while you shouldn't touch it, there are some fun apps that can help you identify exactly what you're looking at! (e.g. *iNaturalist* and *Seek* from National Geographic)

Classroom Activities

1. Are you Naturally Selected? (Grade 3 - 9)

Materials

- Several dried large beans (e.g. kidney)
- An assortment of forks, spoons and dull knives
- Cups (1 per student)

Instructions

- Place dried beans on designated floor area
- Each student is given a cup and one of the utensils (either spoon, fork or knife)
- Each student will “compete” for food by trying to get as many kidney beans in their cup as possible

Rules

- The cup cannot touch the ground (i.e. cannot be used as a scoop), only their utensil can be used to pick up the “food”

Key Learnings

- You should notice that on average, spoons pick up the most beans, followed by forks and then knives
- Game shows how natural selection gives a survival advantage to species with the best ability to gather food and resources
- Competition for food is a major driver of evolution, as those outcompeted for food were forced to evolve over many generations or go extinct



2. How are we Connected? (Grade 4 - 10)

Materials

- Large ball of yarn
- Identification cards for an assortment of plants and animals (ideally a good mix of herbivores, omnivores and carnivores living in a somewhat similar habitat)
- One identification card should be the sun

Instructions

- Each student is provided an identification card to wear on their shirt and all students are seated in a closed circle facing one another
- Student with “the sun” ID card starts with the ball of yarn, and takes hold of the end
- The “sun” (Student 1) tosses the ball of yarn to Student 2 and indicates how the sun influences the ID card of Student 2
- Student 2 grabs hold of the yarn and tosses the ball to Student 3, indicating how their species interacts with Student 3 (e.g. the sun supports the tree through photosynthesis, the tree provides food for the deer, the wolf preys on the deer for food, etc.)
- The yarn is tossed across the circle until all students are holding a piece of the yarn and a big web of yarn is revealed throughout

Rules

- Students are encouraged to help each other, as some connections are more indirect than others (e.g. the bear eats the salmon, the salmon carcass decomposes and provides nutrients to the tree, etc.)

Key Learnings

- Exercise shows how all organisms are connected and rely on each other to survive (even humans!)
- If one person were to drop their yarn (i.e. that species went extinct/extirpated), the whole web would quickly begin to unravel (other organisms would be unable to survive)

Classroom Activities

3. Future Darwins: Evolutionary Brainstorm Exercise (Grades 5-10)

Instructions

- Have the class break into smaller groups of 2-3 people
- Assign each group a plant/animal species and provide the type of ecosystem the species inhabits (the more complicated the species, the more difficult the exercise)
- Each group works together to identify certain traits of their assigned species and why those traits might have evolved to suit their way of life

Examples

(Camels, Desert)

- Humps store fat as an energy source when food is scarce in the desert
- Long legs to run long distances

(Squid, Deep Ocean)

- Large, camera style eye to see with low to no light
- Long tentacles to capture prey for feeding

(Wild Bergamot flower, Temperate Deciduous)

- Plants that flower seasonally to cope with freezing temperatures in winter months
- Purple petals that attract pollinators to help with fertilization

Key Learnings

- The goal of this exercise is more about critical thinking and exploring why animals have become so fine-tuned to suit their environment (no need to be right!)
- Ecosystem variation across the world means that the species that live in these ecosystems must be diverse as well, which is why we see so much biodiversity!

4. Community BioBlitz: What Lives in Your Backyard? (Grades 9-12)

Instructions & Materials

- Have the class break into small groups and visit a local natural area where they will try to identify as many plant and animals species (including insects!) as possible
- If permitted, students can download the National Geographic apps, Seek™ or iNaturalist™, which will help them identify what they see and record it in a national database
- For more of a challenge, have them use a local dichotomous key based on their region which will improve their species identification skills

Key Learnings

- The goal of this exercise is to demonstrate to students how biodiversity surrounds us all—even if we didn't notice it at first or can't readily see it!



Contributors

Candace Campo (Talaysay Tours)

Candace, ancestral name xets'emits'a, a member of the Shishalh community, started her company, Talaysay Tours with her husband Larry, in 2002. Trained as an anthropologist and school teacher, Candace enjoys sharing outdoor education, traditional Indigenous knowledge, history and Indigenous culture throughout Vancouver and the lower mainland. Candace is a volunteer with the Jane Goodall Institute of Canada's Roots & Shoots program and a communications representative for Greenpeace (GP). In her work, Candace aspires to reach students and the community to understand the interconnection of people, animals and the land. "We are the land and the land is us". Her life dream is to work with her youth and community members to support their reconnection to the land that their ancestors have stewarded and lived on sustainably for thousands of years. Candace with her husband Larry own and operate Talaysay Tours and Aboriginal Eco Tours. Candace and Larry live on the Sunshine Coast and in the Squamish Nation community in West Vancouver and are the proud parents of two adult children Elias and Talaysay.



Richard C. Till – smanit stumish (Mountain Man)

Richard has taught land-based learning, search and rescue and youth counselling and training for 30 years. He has worked within Indigenous communities for over 40 years and is an adopted member of the Shishalh people. Shishalh people, in ceremony, have bestowed him with the ancestral name Smanit Stumish, Mountain Man, for his countless years of commitment to many generations of the youth in land-based education and cultural rediscovery. To bring the highest value to his work with the youth, Richard has spent ages of time with Elders learning traditional ways of life and cultural teachings. Richard, a welder by trade, is also a boat builder and artist, sculpting three-dimensional art with welding materials. His primary artistic endeavor at present is a historical fiction novel about a young British soldier who befriends a Canadian Indigenous soldier during WW1. The story spans three generations formed by this original relationship between two friends from different cultures. Richard has worked with Candace for 25 years providing land-based education to schools and communities and today these services span 40 schools and organizations nation-wide, including the Jane Goodall Institute, post-secondary institutions, and both the Shishalh and Skwxwú7mesh communities. Richard has been a volunteer and manager with Search and Rescue in British Columbia for over 20 years.



Carl Olsen (Photography)

After retiring as a stationary engineer on British Columbia's Sunshine Coast, Carl Olsen combined his interest in photography with a life-long love for animals by taking up wildlife photography, which he now considers to be his true calling. He maintains a gallery that can be viewed at <https://carlolsenphotography.ca>.



Photo by Nadine Olsen

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