



Engaging the Environment through Photography

Learner-friendly tools to help build a better understanding of
Environmental Science

The population at large has an important role to play in influencing changes that will contribute to the preservation of our natural environment. A large portion of humanity is estranged from nature. We need to cultivate a sense of awe, respect and appreciation for the other life forms that share our crowded and imperilled planet forging an emotional bond between nature and us. Acquired knowledge of a subject has a heavy influence on subsequent attitudes and behaviours.

Photography anchors the learning experiences that The Roberta Bondar Foundation provides. It can be a gateway to understanding, inquisitiveness and life-long learning. Photography speaks the universal language of images, which is understood by people of every culture. It is a powerful medium for transmitting ideas, bringing the reality of unfamiliar perception closer to our emotional core. Through the fusion of photographic art and science, learning becomes a creative and stimulating means to broadening our understanding of the environment, and our inter-relationship with the elements of nature and other life forms that exist on planet Earth. We become better attuned with the intricate ecosystems that adapt to changing environments.

The following pages are samples of learning tools that are under development by the Foundation – infusing art in science and science in art.



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Acacus Rock Art (panorama 54" x 18")

Tadrart Acacus of Libya & UNESCO World Heritage Site

These paintings and carvings are found within a mountain range in the Saharan desert in southwestern Libya. They date from 12,000 BC to 100 AD and reflect natural changes in the area.

You can see from the outlines and drawings that this area was once part of a large grassland or savannah that supported large mammals, more, and quite different life than is presently found here — in early, recorded graphics of climate change complete with local species extinctions.

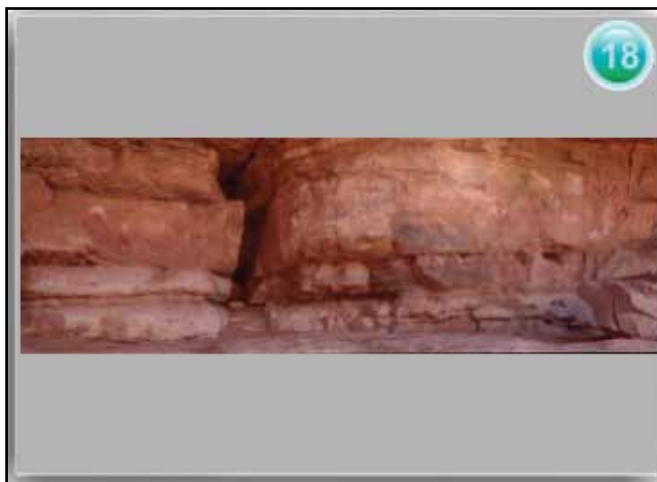
The rock art begins with outlines of giraffes, elephants, ostriches, then moves forward in time to depictions of bovine herds, followed in time by horses, and, finally, camels.

ECOZONE: Palearctic (one of the eight largest scale biogeographic divisions of the lands of Earth)
Sahara Desert

- rivers carved canyons through sedimentary rock
- flora adapted to arid conditions with more evaporation than precipitation:
 - shrubs with long taproots
 - succulents -- leaf, root, fruit
 - short-lived plants (2 to 3 week life cycles) with specially encased seeds
 - perennial plants that remain dormant until rains fall

YOUR TURN! What species and landscape features would you expect to find here?

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How can you explain rocks and mountains and lava in this location?

What could you draw that reflects the animals you see in your environment?

Can you show each drawing on a timeline that illustrates historically when they arrived in your locale?

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See the giraffe drawing? How might the ancient artist have reached this wall height?



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BIOMES within Tadrart Acacus World Heritage Site

Desert

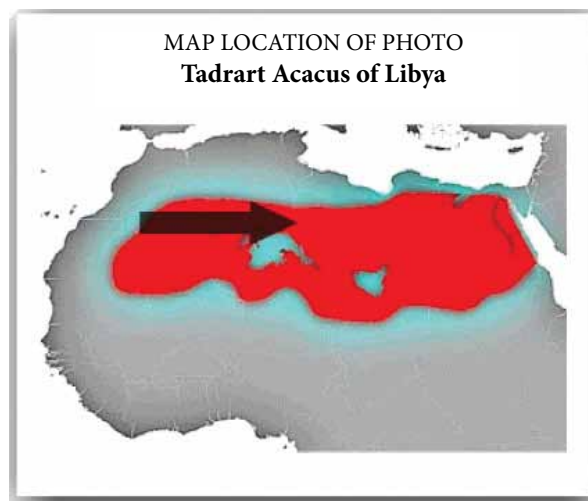
- Caves provide protection from temperature extremes.
- Oases support plants and rock formations that trap water.

YOUR TURN! What specialized life forms would you expect to find in each biome?

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TECHNICAL CHALLENGES IN TAKING THIS PHOTO:

We reached this site after a bumpy 1½ hour ride over lava rock in a 4x4 vehicle off the road from Awaynat. There is a rock roof over part of this site that shades the images, having kept them from fading over centuries. I took the image under a large black umbrella on blistering hot sand.



Ready to try the Challenge?

Take a photograph using both shadow and direct light with different white balances!

The white balance setting on a digital camera allows the operator to make the images look colder or warmer.

Shadows on a sunny day are illuminated by blue light from the sky making images “colder” than photos taken in direct sunlight. Blue is from the short wave length end of the visible spectrum. Yellow “warmer” looking light has a much longer wavelength.



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Boreal Fall (panorama 54" x 18")

Prince Albert National Park of Canada

Saskatchewan has these very beautiful Big Sky views. I try to take simple colors and the primary colours of blue sky and yellow tones are pleasing to the eye. Several sets of lines lead into this photo.

In autumn, all conifers retain their needles except the tamarack. One of the features that makes this image for me is the yellow of the tamarack. In this photograph you can see the three tree types starting with the exceptional tamarack in front of the black spruce in front of the leafless deciduous trees in the background.

Around this lake is a mat of grass that I wanted in the foreground to pick up the yellow and provide another line into the photo.

ECOZONE: Nearctic (one of the eight largest scale biogeographic divisions of the lands of Earth)
Boreal Plains (Terrestrial Ecozones of Canada classification system)

- warm, short summers & cold winters
- Rocky Mountains block much moisture to these plains
- glacier-flattened land with dunes & meltwater in small lakes
- thick soils beneath conifers in the north and deciduous trees in the south
- supports large herbivores

YOUR TURN! What species of plant and animal would you expect to find here?

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Boreal Forest covers 25% of Canada's landmass and is Earth's largest contiguous Boreal Forest.

This park lies in a transition between large biomes of forest and grassland.

It contains the only fully protected nesting grounds of the white pelican in Canada.



Can you find the three tree types by their colour? Cloud diffuses the sunlight and softens shadows.



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BIOMES within Prince Albert National Park

- **Forests** help stabilize climate and temperature.
- **Lakes & rivers** influence diverse aquatic habitats.
- **Grasslands** growth is historically controlled by fire, drought, and grazing.
- **Wetlands** of bogs or muskeg filter sediments and pollutants.
- **Ice-across** biomes refresh the water table.

YOUR TURN! What specialized life forms would you expect to find in each biome?

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TECHNICAL CHALLENGES IN TAKING THIS PHOTO:

This mat of grasses grows in a bog along the edge of the lake. The moment I put my tripod down, it started to sink slowly into the bog... as did the park person with me. Me, too! I had to readjust and reset the tripod to slow the sinking to take the shot.

MAP LOCATION OF PHOTO
Prince Albert National Park of Canada



Ready to try the Challenge?

Use the wide angle setting on your camera or a wide-angle lens to pull together an interesting sky with simple lines of plant life or ecosystem.

Ask yourself why you are attracted to this image and then try to recompose to make the photograph better represent what you really had in mind.



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Lake Huron Shore (32" x 40")

Bruce Peninsula National Park of Canada

In the clear water, you can see dolomite boulders that have broken off from the limestone rock of the escarpment cliffs along the shoreline of the park that is known for its heavily wooded hiking trails.

Old glaciers scraped soils from most shoreline outcrops. Constant ice, rain, and water contain mild acids that create little pits that, in turn, hold water and provide tiny habitats for pioneering plants.

In summer, radiation from the sun's extreme heat, coupled with drying winds, creates a desert-like biome on the exposed rock. Species that live on this rock have adapted to drought conditions.

The deep greens of the water match the mosses. The bright lichens sprinkle the outcrop with a confetti of colour.

ECOZONE: Nearctic (one of the eight largest scale biogeographic divisions of the lands of Earth)
Mixedwood Plains (Terrestrial Ecozones of Canada classification system)

- warm winters, cool summers
- carbon rich bedrock
- mix of coniferous & deciduous trees
- some cedars are many hundreds of years old

YOUR TURN! What species of plant and animal would you expect to find here?

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400 million years ago, the Bruce Peninsula was part of a shallow tropical sea... complete with corals!

Today, you can find caves and grottos in places where water has eroded the sedimentary layers.

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Can you find the blocks of dolomite that have fallen into the bay? Lake wave action undercuts many cliffs here.

How many different kinds of lichen can you identify on the rocks? Lichens are very smart and very cool combos of fungi and algae! Each kind has a different colour but they all do many important jobs in their environments. Can you name some of the jobs they do?



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BIOMES within Bruce Peninsula

- Forests help stabilize climate and temperature.
- Lakes & rivers influence diverse aquatic habitats.
- Wetlands help control flooding.
- Ice-across biomes refresh the water table.

YOUR TURN! What specialized life forms would you expect to find in each biome?

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TECHNICAL CHALLENGES IN TAKING THIS PHOTO:

The hardest part was trying not to damage the tiny plants and lichens growing on the rock and in the groundcover. It requires sharp eyes to see the biodiversity. It takes even smarter *feet* to miss stomping it flat!

MAP LOCATION OF PHOTO
Bruce Peninsula National Park of Canada



Ready to try the Challenge?

Guard against damaging any life on the surface on which the tripod stands.

In windy or low light conditions it is often difficult to hold a camera still enough to capture an image that is not blurred. A sturdy tripod will help diminish “camera shake”.



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Monarch Gathering (16" sq)

Taken in autumn during Monarch migration that will eventually end thousands of kilometers later in Mexico. Morning is cold and the butterflies here are still hanging onto the trees before they migrate across the lake. As the sun warms them up, the butterflies can pump fluid into their wings enabling them to fly. Why such a migratory range for so fragile an insect? Milkweed is the only plant that Monarch caterpillars eat. Talk about picky eaters. Milkweed has cleverly adapted and extended its growing range north. Monarchs follow and, in their larval stage, they can eat their favourite food farther away from home base. The farther they spread, the longer the migration home. Today, this covers such a distance for Ontario Monarchs that the generation that leaves Point Pelee is not the generation that returns! In fact it takes *many* generations to complete the cycle from northern summer to southern winter and back north again.

ECOZONE: Nearctic (one of the eight largest scale biogeographic divisions of the lands of Earth)
Mixedwood Plains (Terrestrial Ecozones of Canada classification system)

- northern tip of the Carolinian forest that spreads from the Carolinas in the USA
- habitat for most species of Canadian reptiles and amphibians
- site used a few days each autumn by migrating monarch butterflies that stage their crossing of the lake from this southernmost tip closest to the opposite shore.

YOUR TURN! What species of plant and animal would you expect to find here?

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How did *milkweed* get its name?

Very cool fact (unless you're a bird)
— Monarch larvae store milkweed *cardenolides* in their bodies that sicken birds... so birds learn to avoid the bright orange Monarch adults and the bright orange-striped larvae.

How many scales on a Monarch wing? Order Lepidoptera (scale wing) Male or Female? How can you tell?



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Monarch Wing Spread (16" sq)

BIOMES within Point Pelee National Park

- **Forests** house complex ecological processes from below ground to canopy top
- **Lakes & rivers** include seasonal variations in precipitation and evaporation
- **Wetlands** are saturated with freshwater all or most of the time.

YOUR TURN! What specialized life forms would you expect to find in each biome?

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TECHNICAL CHALLENGES IN TAKING THIS PHOTO:

Butterflies are difficult to photograph with their wings outstretched. At rest, butterfly wings are usually vertical whereas moth wings are horizontal. With patience following this Monarch as it moved along the branch, I was able to capture the moment when the wings opened.

MAP LOCATION OF PHOTO
Point Pelee National Park of Canada



Ready to try the Challenge?

In the spring and summer, locate and photograph the progressively hard-to-find milkweed plants, especially their seedpods as they open.

If you find the colourful caterpillars of the Monarch, try to photograph them and identify how many feet they have.

If you are very fortunate you may find a caterpillar or larva has transformed into a chrysalis or pupa, soon to be an adult in 7 to 15 days, temperature-dependent.



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Red Cliff (panorama 54" x 18")

Prince Edward Island National Park of Canada

Here you can see some of the forms and boulders normally underwater since the tide is out. Coastal wave action undercuts and erodes the soft sedimentary soil and rock coloured by red iron oxide.

The green forest on the right on the top of the clay cliffs is endangered by wind and water erosion. Because the cliffs are fairly soft and continuously eroded, the trees eventually fall into the water. The bright green of these resolute trees and Irish moss growing on the rocks below pulls the eye away from the predominant red.

ECOZONE: Nearctic (one of the eight largest scale biogeographic divisions of the lands of Earth)
Atlantic Maritime (Terrestrial Ecozones of Canada classification system)

- the ocean influence produces warmer winters and cooler summers than inland
- more storms here than elsewhere in Canada
- numerous aquatic mammal species, forest, sea, and shore life

YOUR TURN! What species of plant and animal would you expect to find here?

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Irish moss has a holdfast, root structure that anchors like glue on smooth rocks.

Once connected to the mainland, this island remained through ocean levels rising from the last glacier melt, slow rebound from its weight, and tectonic uplift.

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Part of the red algae family, Irish moss ranges in colour from greenish yellow through red to dark purple.



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BIOMES within Prince Edward Island National Park

- **Forests** on the coast face strong winds and salt spray from the ocean.
- **Coastal** biomes include sand dunes, sandbars, beaches, and spits.
- **Wetlands** support specialized and diverse vegetation adapted to wet environments.
- **Marine** biomes cover over 70% of Earth's surface and are in constant motion.

YOUR TURN! What specialized life forms would you expect to find in each biome?

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TECHNICAL CHALLENGES IN TAKING THIS PHOTO:

The soft red clay base was neither a suitable stable platform for my tripod nor a clean surface on which to rest equipment or backpack. Crouching, I used a wide-angle lens on my tripod-mounted camera to compose an interesting foreground against the sweeping curve of the coast.

MAP LOCATION OF PHOTO
Prince Edward Island National Park of Canada



Ready to try the Challenge?

Pick a subject such as a tree, flower or rock. Photograph it from a standing position.

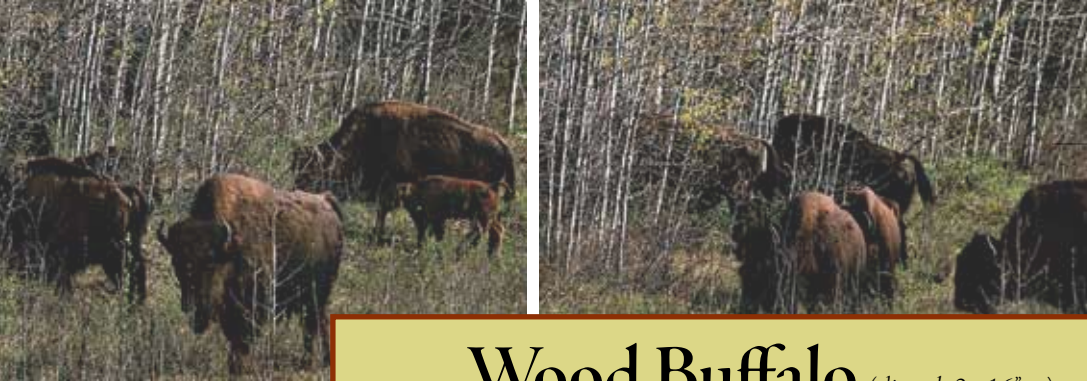
Change your posture. Bend down halfway, recompose and re-shoot. Try kneeling and looking across or up at your subject and take another image.

Try different lenses as well as positions.

Always look where you are putting both your and the tripod's feet and avoid crushing other living things. Many plants can rebound from an occasional tread but others cannot.



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Wood Buffalo (diptych 2 x 16" sq)

Wood Buffalo National Park of Canada & UNESCO World Heritage Site

Yes, there are buffalo that actually live in the woods! The reason for the diptych is to show how the buffalo just disappear before your eyes. These wood buffalo with their calves were feeding on grasses along the road and disappearing as I watched them.

In the first image, you see one disappearing. In the next image, several disappear at a time. These horned bison are massive herbivores, weighing in at approx 900 kg (2000 lb) so their disappearance into a bunch of relatively thinner trees is pretty impressive. This group of bison was moving naturally from the open area along the roadside to the camouflage of the trees.

ECOZONE: Nearctic (one of the eight largest scale biogeographic divisions of the lands of Earth)
Boreal Plains (Terrestrial Ecozones of Canada classification system)

- short, cool summers & long, cold winters
- snow & freshwater ice lasts half a year or more
- widespread permafrost
- little rainfall
- many plant species especially adapted to fire
- supports one of Earth's largest free-roaming, self-regulating bison herds

YOUR TURN! What species of plant and animal would you expect to find here?

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Lichen Tidbit #3: Lichen often serves as brunch for Wood Buffalo.

This largest land mammal in North America is threatened by hunting and severe winter weather or spring ice break-up.

Called buffalo in many parts of North America, they are also known as bison, distinguishing them from the water buffalo of Asia and South America.

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Now you see them... now you don't!

This incredible disappearing act is a good example of how the word "buffaloed" can mean "puzzled" or "amazed" because we were simply buffaloed by how they vanished right before our eyes.



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BIOMES within Wood Buffalo National Park

- **Forests** help stabilize climate & temperature.
- **Lakes & rivers** influence diverse aquatic habitats.
- **Wetlands** of muskeg support large herbivore populations with wet sedges.
- **Ice-across** biomes refresh the park's thousands of small lakes and ponds.

YOUR TURN! What specialized life forms would you expect to find in each biome?

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TECHNICAL CHALLENGES IN TAKING THIS PHOTO:

This picture was taken in autumn with a handheld camera at a distance from a very slow moving car. Bison are extremely protective of their calves and despite their large size, will outrun a human being. Respect wildlife within its habitat. Make photographing any wildlife as non-invasive as possible.

MAP LOCATION OF PHOTO
Wood Buffalo National Park of Canada



Ready to try the Challenge?

Take a series of images on your next trip as a car passenger.

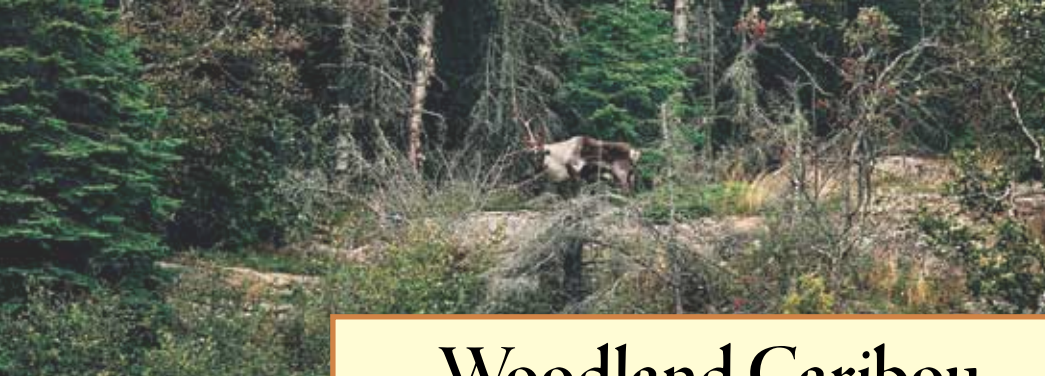
Pick out a tree or some structure in the distance that you would like to photograph.

Use the window ledge to steady your camera while you take a series of images as you pass by.

This is very helpful training for your next safari.



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Woodland Caribou (35" sq)

Pukaskwa National Park of Canada

This Woodland Caribou was an unknown male that had not been seen before this moment. Only one other male had been documented in the park before this new sighting. He is well camouflaged in this typical habitat of the boreal forest of the boreal shield ecozone. Eating small herbaceous plants and ruminating or re-chewing his food, he turned to look at us. We were offshore, bobbing up and down in a small boat as we sought shelter from large waves on Lake Superior. We were not close enough to startle him so he kept on grazing across the three billion-year-old granite. Both sexes grow antlers which are larger in the males. The Woodland Caribou is larger and darker than its tundra dwelling migratory counterpart, the Barren-Ground Caribou

ECOZONE: Nearctic (one of the eight largest scale biogeographic divisions of the lands of Earth)

Boreal Shield (Terrestrial Ecozones of Canada classification system)

- largest of Canada's ecozones
- wide ranges of winter temperatures and precipitation
- similar approximate summer temperature
- glaciers have left series of depressions that form & fill thousands of lakes & wetlands
- commonly exposed rock is Precambrian granite

YOUR TURN! What species of plant and animal would you expect to find here?

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Habitat loss contributes to the decline in Woodland Caribou and In Ontario is protected under the *Endangered Species Act, 2007*.

What other ruminants do you know?

Did you know that the caribou is often called a *reindeer*?

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This male may be 226 kg (500 lb) and about 1.5 m (5 ft) tall with an extra 1 m (3 ft) rack but he's dwarfed by the size of the towering rocks and birch and spruce trees.

A herbivore, he reaches this size on a diet of plants, mosses and lichen!



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BIOMES within Pukaskwa National Park

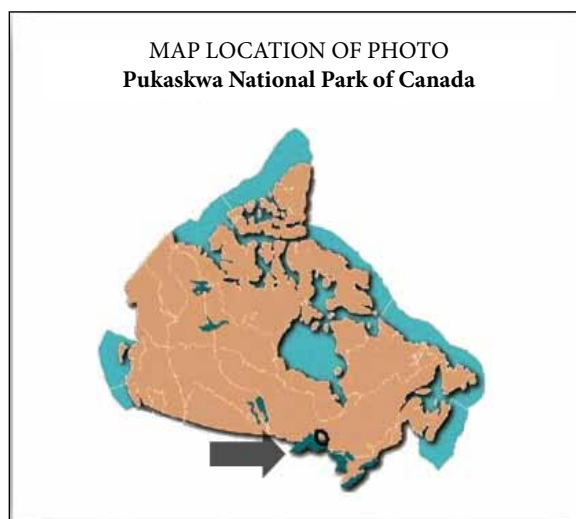
- **Forests** help stabilize climate & temperature.
- **Lakes & rivers** influence diverse aquatic habitats.
- **Wetlands** cover 20% of the Boreal Shield.
- **Ice-across** biomes refresh the water table.

YOUR TURN! What specialized life forms would you expect to find in each biome?

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TECHNICAL CHALLENGES IN TAKING THIS PHOTO:

As the boat bounced up and down, the caribou kept eating. I set up my tripod and camera. I added a big telephoto lens that not only brought the caribou closer but also magnified the boat's motion. This photograph was taken at a very fast shutter speed at the crest of a wave in the hesitation before the boat dropped in the trough.



Ready to try the Challenge?

What shutter speed do you need to photograph an object that is moving or when you are moving to reduce blur?

Binoculars or telephoto lenses/setting on a camera bring an object closer to the eye. This also enhances our movement that can be diminished by:

- taking a deep breath then holding it while looking through binoculars
- using a tripod or image stabilizing features of binoculars or camera.



Dr. Roberta Bondar as Photographer

A true renaissance woman, Dr. Roberta Bondar is an acclaimed photographer of the natural wonders of our planet.

In 1992 Dr. Bondar flew as an international astronaut onboard the space shuttle Discovery. As part of NASA's Earth Observation Team, her in-flight role included photographing planet Earth using many different camera types.

Dr. Bondar was an honors student in Professional Nature Photography at the Brooks Institute of Photography, Santa Barbara, CA. She has been photographing since the age of seven, when she used her Brownie Hawkeye camera to shoot in black and white, capturing her first space models and landscapes. In her careers as scientist and physician, she developed new techniques for color and black and white photography using both fluorescence and electron microscopy. She developed and printed her own photographs for the preparation of her PhD thesis. A neurologist, Dr. Bondar sub-specialized in neuro-ophthalmology – how we see and view the world around us.

Influenced by the wide horizons that she viewed out of the spacecraft window, she uses medium and large format cameras to capture the Earth from the ground as a planet in evolution. In 1997 the Curator of Photography at the National Gallery of Canada included Dr. Bondar's images in their exhibition *Beauty of Another Order ~ Photography in Science*.

For three years, Dr. Bondar photographed all of Canada's National Parks producing the book *Passionate Vision ~ Discovering Canada's National Parks* and a 4300 square foot exhibition of her large photographs that has been displayed at venues such as the Canadian Museum of Nature and The Royal Ontario Museum. The smaller travelling version continues to be hosted by communities across Canada.

Dr. Bondar is the author of *Touching the Earth* (also translated into German), her story of her spaceflight and her view of the Earth from space, and two other best-selling photo-essay books, also the core of her major exhibitions: *Canada ~ Landscape of Dreams* and *The Arid Edge of Earth*.

The Toronto Parks and Trees Foundation commissioned Roberta to write and photograph for their 2009 calendar for which she chose the theme of the Toronto tree canopy. The large panoramas have been exhibited in galleries across Canada.

Dr. Bondar's large fine art photographic prints are exhibited by The Loch Gallery, Toronto, Calgary and Winnipeg, The Art Gallery of Algoma, Sault Ste. Marie, and Hoopers Gallery, London, UK. Her works can be found in private, corporate and institutional collections in Canada, the USA and England.

On establishing The Roberta Bondar Foundation, Dr. Bondar donated a significant collection of images to the Foundation for its use.