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Forest Beaty Box (005)

Customized lesson plan and specimen information

Welcome to the Forest Beaty Box (005)!

This outreach kit is intended to provide you and your students with the opportunity to connect with the Beaty Biodiversity Museum's (BBM) unique biological collections. The Beaty Box contains touchable specimens and other resources to stimulate inquiry and discussion within the classroom, enhancing the student learning experience.

Theme

The theme for this Beaty Box is **the Pacific coastal temperate rainforest**, with a focus on **ecological connections**. Under this theme, students can learn more about:

- making observations about forest-dwelling organisms
- connections between living and non-living things
- the role of salmon in the temperate rainforest

By the end of the lesson, your group should feel more comfortable with the temperate forest ecosystem and the organisms living within it.

How can I integrate the Beaty Box into my curriculum?

- We encourage you to adapt the Beaty Box lesson plan to best fit your classroom and curriculum.
- Before beginning your lesson, please take the time to familiarize yourself with the contents of the Beaty Box.
    - Both sections of this manual contain useful background information on the contents of this Beaty Box. Reading over these resources in advance will help prepare you for students' questions.
- Use the online resources referenced throughout the manual to help complement your lessons.
    - For additional worksheets and activities, please visit the BBM website to view our Educator Resources.
    - Show some videos of the Beaty Box organisms during the activity to help bring the specimens to life.
- If possible, consider taking your group to the BBM before or after using the Beaty Box to enhance their biodiversity experience.

Curriculum Links to the Interactions Lesson Plan

An ecosystem is defined not just by the sum of its parts, but also by the interactions between the living and non-living things within it. Recognizing the diversity of connections that exist and considering where connections *could* exist is a way of generating hypotheses, which is an important first step for inquiry and research. In this section, we have included a suggested interactions lesson plan for you and your group. Please feel free to modify these activities to best suit your needs. Find the full lesson plan on page 76.

Some of the "big ideas" and core concepts that you can explore with this Beaty Box are:

Science Curriculum (K-9)

- *Kindergarten*: Plants and animals have observable features; daily and seasonal changes affect all living things
- *Grade 1*: Living things have features and behaviours that help them survive in their environment; observable patterns and cycles occur in the landscape
- *Grade 2*: Living things have life cycles adapted to their environment; materials can be changed through physical and chemical processes; water is essential to all living things, and it cycles through the environment
- *Grade 3*: Living things are diverse, can be grouped, and interact in their ecosystems
- *Grade 4*: All living things sense and respond to their environment; matter has mass, takes up space, and can change phase; energy can be transformed; the motions of Earth and the moon cause observable patterns that affect living systems
- *Grade 5*: Multicellular organisms have organ systems that enable them to survive and interact within their environment; Earth materials can be used as natural resources
- *Grade 6*: Multicellular organisms rely on internal systems to survive, reproduce, and interact with their environment
- *Grade 7*: Evolution by natural selection provides an explanation for the diversity and survival of living things
- *Grade 8*: Life processes are performed at the cellular level
- *Grade 9*: Cells are derived from cells; the biosphere, geosphere, hydrosphere, and atmosphere are interconnected, as matter cycles and energy flows through them

Science Curriculum (10-12 Drafts 2017)

- *Grade 10*: Genes are the foundation for the diversity of living things; energy is conserved and its transformation can affect living things and the environment
- *Chemistry 11*: Matter and energy are conserved in chemical reactions; chemical reactions and their applications have significant implications for the environment
- *Earth Sciences 11*: Earth materials are changed as they cycle through the geosphere and are used as resources, with environmental implication; the distribution of water has a major influence on weather and climate
- *Environmental Science 11*: Local environments contain diverse ecosystems with many roles and relationships; interconnected systems sustain healthy ecosystems; ecosystem stability is an important result of sustainability; humans can play a role in conservation of ecosystems
- *Life Sciences 11*: All living things have common characteristics; living things evolve over time; organisms are grouped on the basis of identifiable similarities
- *Physics 11*: Energy is found in different forms, is conserved, and has the ability to do work
- *Science for Citizens 11*: Science helps explain how natural changes and human choices affect global systems
- *Anatomy and Physiology 12*: The body strives to maintain homeostasis; all living things are made of cells, which contain DNA and cell structures that allow cells to survive and reproduce
- *Environmental Science 12*: Sustainable land use and food production will meet the needs of a growing population; living sustainably supports the well-being of self, community, and Earth
- *Geology 12*: Geologic time is preserved in Earth's rock record as fossils and reflects profound changes in the history of life on Earth

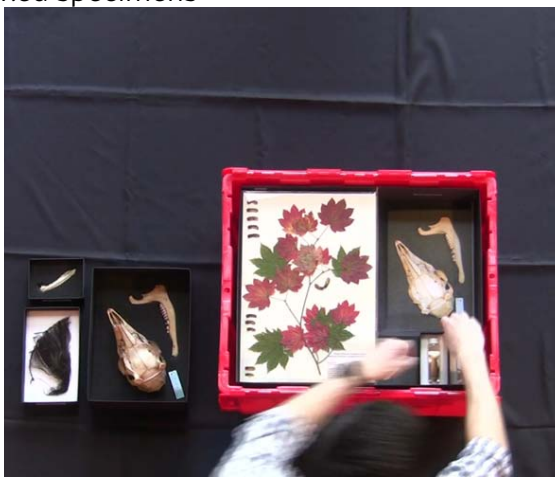
Photos: Unpacking Your Beaty Box

When unpacking your Beaty Box, plan to have lots of table space available. Please follow the instructions below to ensure the safety of specimens. To help you see how this works, please watch the Forest Beaty Box video: https://youtu.be/Wyln7gG1jxA

Tray 1

1. This tray is heavy. Remove the specimens before lifting out the whole tray. Doing so in the following order will help the specimens last longer.

2. Lift out the deer skull, then the smaller boxed specimens

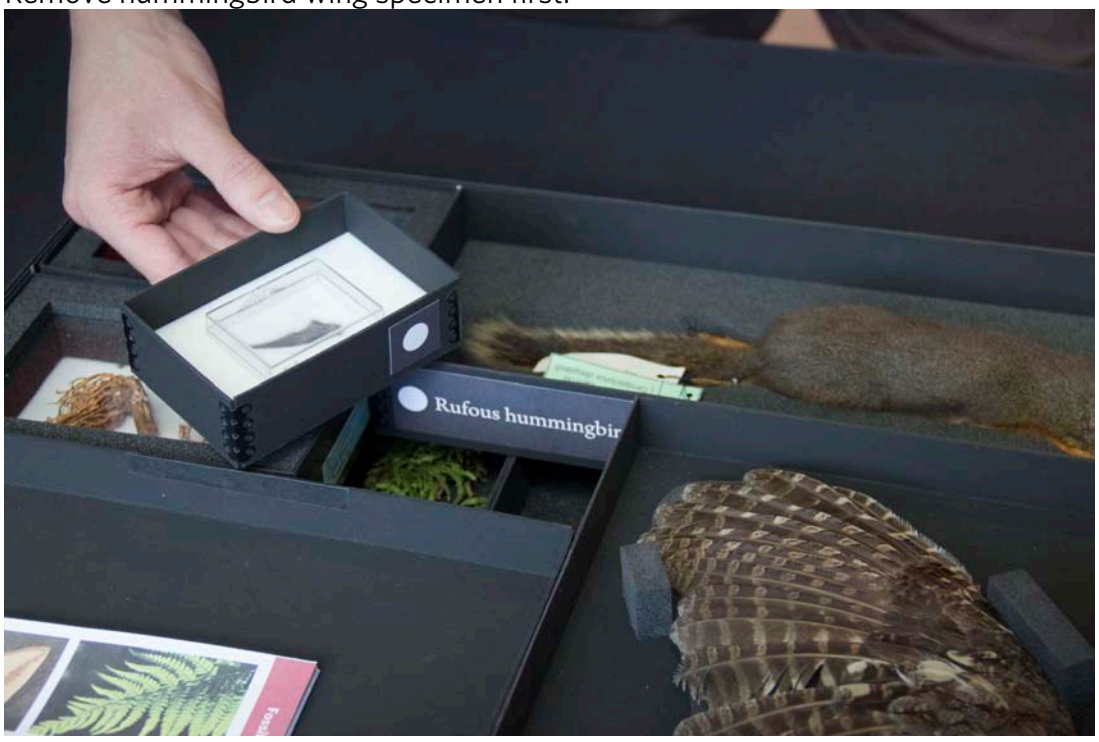
3. Slide the stack of herbarium sheets to the center and lift out of the box.

4. Lift out the empty tray, set it aside.

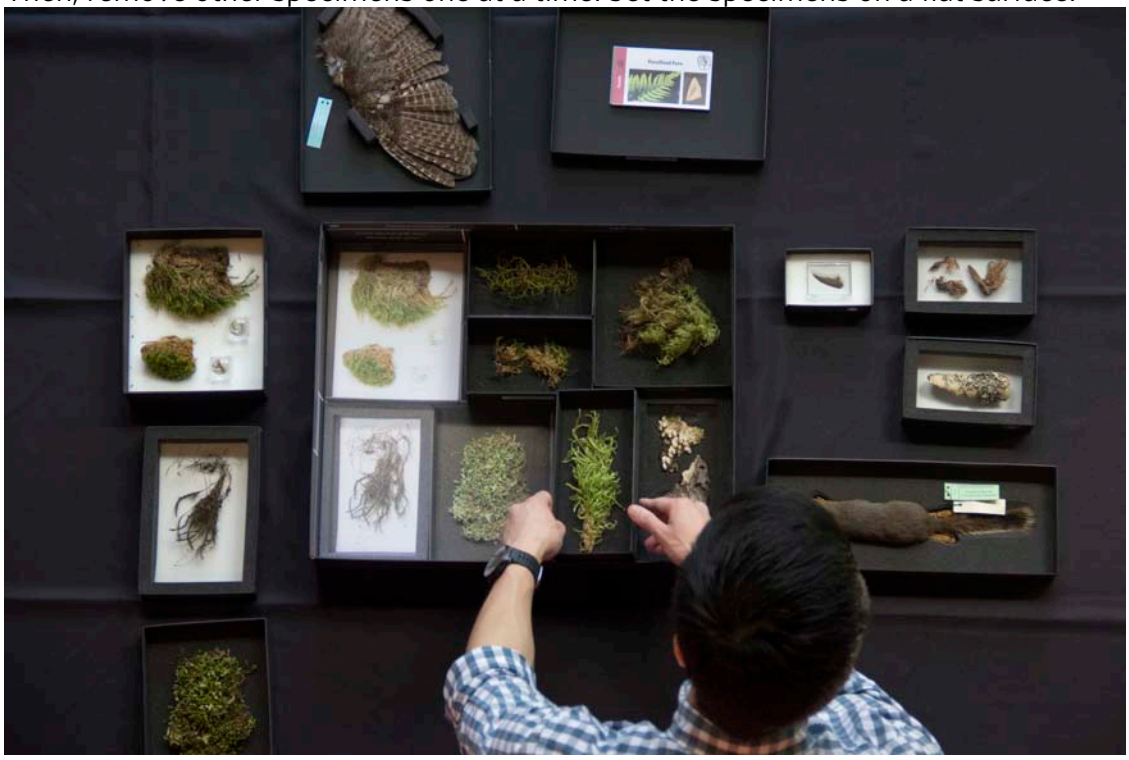
Tray 2

1. Lift entire tray out of Beaty Box, including the specimens. Use both hands and lift by the edge of the tray. Set it on the table.

2. Remove hummingbird wing specimen first.



3. Then, remove other specimens one at a time. Set the specimens on a flat surface.



4. Set the empty tray aside.

Tray 3

This holding tray is glued to the bottom of the Beaty Box and not to be removed. Instead:

1. Remove the bear fur.

2. Next, holding by the center struts, lift out the tray containing cones and woodlice, and the tray with mussels and the leaf fossil.


3. The remaining heavier specimens can then be removed. Support their weight by the base of the boxes.

4. All of your specimens should be out on one or two tables. Remember to keep the specimens in their trays, and use both hands to move them.

Unique Handling Instructions for Forest Beaty Box

Magnifying Cases:

Woodlice: These magnifying cases may be gently lifted out of the black boxes for viewing. At all times, ensure that they are not opened, flipped, or shaken.
Dicranum mosses: These magnifying cases should remain in their black boxes at all times.

Western Screech-Owl wing:

The wing is the only other specimen that may be removed from its black box. Please see the following instructions for handling the wing.

1. Remove the western screech-owl box from the Beaty Box. Lay it on a clean, flat surface.

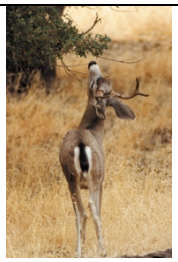
2. Holding by the bony part of the wing, remove it carefully from the black box.

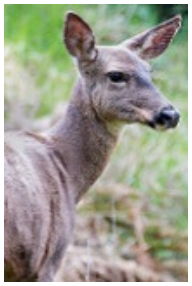
3. Handle the wing. You may choose to stroke feathers in the direction of growth, or even 'flap' the wing to hear how quiet it is. At all times, be gentle and support the wing by the bony part. If the wing is to be moved away from its box, keep it close to a table surface when possible, to reduce the risk of drops.

4. Place wing gently back into black box.

What's in the Beaty Box?

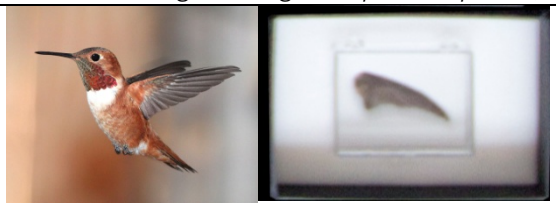
Below, you will find background information for each specimen included in the Forest Beaty Box, as well as links to external resources. The majority of this information can be found on the flash cards included with this Beaty Box.

Tetrapods	**Specimen**	Black-tailed deer skull, male (*Odocoileus hemionus*) T(m)20-59
	Image	  Photo: Flickr user California Department of Fish and Wildlife, used under a creative commons license
	Habitat	*Native*; Pacific coast (California to Alaska); coniferous rainforests or wooded suburban environments
	Diet	*Herbivore*; browse, berries, nuts, fungi, grasses, lichen, woody growth
	Predators	Wolves, cougars, bears, coyotes, domestic dogs, humans
	Description	Every year, male black-tailed deer grow a new pair of antlers, then shed them in the winter. Can you see where the antlers used to be on this specimen? From an antler alone, scientists can figure out the age and health of the deer that it belonged to.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Ecological Connections	Shed antlers do not last long on the forest floor. They are gnawed away at by animals such as squirrels, bears, coyotes, and wolves, since they are a good source of calcium and other nutrients.
	Resources	**Black-tailed Deer Facts** | Pets on Momme http://animals.mom.me/blacktailed-deer-6477.html **Living with Wildlife: Deer** | Washington Department of Fish & Wildlife http://wdfw.wa.gov/living/deer.html **We're not the only ones looking for shed antlers** | Naturally North Idaho http://www.naturallynorthidaho.com/2013/05/were-not-only-ones-looking-for-shed.htm

Tetrapods	**Specimen**	Black-tailed deer skull, female (*Odocoileus hemionus*) T(m)20-56
	Image	  Photo: Flickr user Mitchell haindfield, used under a creative commons license
	Habitat	*Native*; Pacific coast (California to Alaska); coniferous rainforests or wooded suburban environments
	Diet	*Herbivore*; browse, berries, nuts, fungi, grasses, lichen, woody growth
	Predators	Wolves, cougars, bears, coyotes, domestic dogs, humans
	Description	Black-tailed deer have reddish-brown coats in the summer and brown-gray coats in the winter, to blend in better with their environments. Their name comes from their tails, which are dark brown or black on top.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Ecological Connections	Deer eat plants, but they cannot digest plant material on their own. They rely on bacteria living in their four-chambered stomachs that break down the tough fibers in plants. This is a mutualistic symbiosis: the bacteria get a home and the deer gets to eat foods it wouldn't be able to otherwise.
	Resources	**Black-tailed Deer Facts** | Pets on Momme http://animals.mom.me/blacktailed-deer-6477.html **Living with Wildlife: Deer** | Washington Department of Fish & Wildlife http://wdfw.wa.gov/living/deer.html **We're not the only ones looking for shed antlers** | Naturally North Idaho http://www.naturallynorthidaho.com/2013/05/were-not-only-ones-looking-for-shed.htm

Tetrapods	**Specimen**	American black bear fur (*Ursus americanus*) T(m)40-81
	Image	  Photo: Flickr user Jitze Couperus, used under a creative commons license
	Habitat	*Native*; widespread in North America; various habitats including forests rich in shrub/tree-based food sources, meadows, fields
	Diet	*Omnivore*; grasses, tubers, seeds, grains, nuts, fruit, insects, salmon, occasional mammals
	Predators	Humans, wolves, mountain lions
	Description	Despite their name, black bears are not always black: they can be brown, bluish-gray, or even white! Black bears have short claws for climbing trees. In the winter when food is hard to find, they hibernate. During hibernation, they do not eat, drink, pee, or poo.
	Safety & Handling	Touch gently with one or two fingers in the direction of fur growth. Do not remove from black box. Hold by the sides and base of the box.
	Ecological Connections	Black bears eat plants, insects, and fish. In doing so, they disperse seeds and other nutrient sources in the forest.
	Resources	**American Black Bear** | Animal Diversity Web http://animaldiversity.org/accounts/Ursus_americanus/ **Black Bears in British Columbia** | BC Ministry of Environment http://www.env.gov.bc.ca/wld/documents/blackbear.pdf

Tetrapods	**Specimen**	Douglas' squirrel (*Tamiasciurus douglasii*) T(m)20-78
	Image	  Photo: Flickr user Jon Nelson, used under a creative commons license
	Habitat	*Native*; Pacific coast (BC to California); old-growth coniferous forests
	Diet	*Omnivore*; conifer/maple seeds, fungi, eggs, young mammals and birds, invertebrates, flowers, fruits, nuts
	Predators	Owls, hawks, weasels, bobcats, domestic cats
	Description	This small squirrel can be recognized by its pale orange belly. It is very territorial: if you ever hear a "chickaree" sound while out in the woods, odds are that a Douglas' squirrel is warning you to stay out of its territory!
	Safety & Handling	Touch gently with one or two fingers in the direction of fur growth. Do not remove from black box. Hold by the sides and base of the box.
	Ecological Connections	These squirrels nest in holes in trees, which are usually made by woodpeckers. They line their nests with moss, lichen, and cedar bark, and are known to sometimes hang mushrooms off the edges of their nests to dry for their food stores.
	Resources	**Douglas Squirrel** | Green Timbers Heritage Society http://www.greentimbers.ca/vegetation-wildlife/wildlife/mammals/douglas-squirrel/ **Douglas Squirrel** | E-Fauna BC http://linnet.geog.ubc.ca/efauna/Atlas/Atlas.aspx?sciname=Tamiasciurus%20douglasii

Tetrapods	**Specimen**	Rufous hummingbird wing (*Selasphorus rufus*) T(b)30-308
	Image	 Photo: Flickr user ALAN SCHMIERER, used under a creative commons license
	Habitat	*Native*; breed in Pacific coast (BC to Oregon), overwinter in Mexico; various habitats including forests, swamps, meadows
	Diet	*Omnivore*; flower nectar, small insects
	Predators	Mostly domestic cats and rodents (squirrels, rats). Also jays, crows, hawks, falcons, praying mantis
	Description	Rufous hummingbirds have short wings that can beat up to 60 times a second, and have narrow beaks and long tongues to pull nectar from flowers. Although they are very small, weighing only three grams (that's less than the weight of a nickel!), they are aggressive and known to chase intruders as large as chipmunks and hawks away from feeders, flower patches, or nests.
	Safety & Handling	Do not open plastic box or remove it from the black box. Hold by the sides and base of the box.
	Ecological Connections	Rufous hummingbirds nest in trees such as the western redcedar and Douglas-fir. They make their nests using spiderwebs to hold soft plant material together, and camouflage them with bark, moss, and lichen.
	Resources	**Rufous Hummingbird** | All About Birds https://www.allaboutbirds.org/guide/Rufous_Hummingbird/ **Hummingbird Predators** | The Hummingbird Society http://www.hummingbirdsociety.org/index-inside.php?Hummingbirds-101-Predators-14 **How Birds Make Colourful Feathers** | Bird Academy https://academy.allaboutbirds.org/how-birds-make-colorful-feathers/

Tetrapods	**Specimen**	Western screech-owl wing (*Megascops kennicottii*) T(b)30-287
	Image	  Photo: Flickr user Jon Nelson, used under a creative commons license
	Habitat	*Native;* Pacific coast (Mexico to Alaska); various habitats including semi-open woodlands and treed suburban areas
	Diet	*Carnivore;* rodents, bats, birds, fish, amphibians, invertebrates
	Predators	Owls, hawks, raccoons
	Description	Western screech-owls can either be gray or brown. In BC, they are mostly gray with dark streaks on their breasts. They are good hunters, with large yellow eyes that help them to see at night, and broad wings with very soft feathers that help them fly silently.
	Safety & Handling	Touch gently with one or two fingers in the direction of feather growth. Wing may be removed from box: see Forest Beaty Box manual, page 35.
	Ecological Connections	These owls are cavity nesters; they usually nest in holes in large trees such as those made by woodpeckers. Owls cough up pellets that are like miniature ecosystems since they often contain moth larvae, fungi, and insects!
	Resources	**Western Screech-Owl** | All About Birds https://www.allaboutbirds.org/guide/Western_Screech-Owl/ **Owl pellets provide clues to owl's diet** | Naturally North Idaho http://www.naturallynorthidaho.com/2015/11/owl-pellets-provide-clues-to-owls-diet.htm

Tetrapods	**Specimen**	Ensatina (*Ensatina eschscholtzii*) T(a)10-08
	Image	  Photo: Flickr user Brian Gratwicke, used under a creative commons license
	Habitat	*Native*; Pacific coast (Mexico to California); moist, shaded coniferous and deciduous forests
	Diet	*Carnivore*; sow bugs, worms, ants, beetles, millipedes, scorpions, snails
	Predators	Birds, snakes, raccoons
	Description	Ensatina are salamanders with some very cool adaptations to guard against predators. They can cover their tails with poisonous foam when they are scared. They can also drop their tails entirely to distract predators, but this is only done in life-threatening situations because the tail takes about two years to grow back.
	Safety & Handling	Do not open vial or remove it from the black box (it is attached to the box for safe viewing). Pick up by the sides and base of the box.
	Ecological Connections	Fallen trees on the forest floor make moist environments for Ensatina to live underneath. This is very important since Ensatina do not have lungs and breathe through their skin, which requires keeping their skin moist at all times.
	Resources	**Oregon Ensatina Intergrades** | CaliforniaHerps.com http://www.californiaherps.com/salamanders/pages/e.e.klauberi.html **Ensatina** | Washington NatureMapping Program http://naturemappingfoundation.org/natmap/facts/ensatina_712.html

Marine Invertebrates	**Specimen**	Foolish mussel (*Mytilus trossulus*) MI(m)60-94
	Image	  Photo: Flickr user Katrin-Lena, used under a creative commons license
	Habitat	*Native*; Pacific coast (California to Arctic Ocean); marine intertidal zone, usually in protected bays
	Diet	*Omnivore, filter feeder*; phytoplankton, bivalve larvae, bits of algae
	Predators	Birds (gulls, crows, oystercatchers), sea stars, anemones, crabs
	Description	Foolish mussels are often found along the seashore in large clusters attached to rocks, docks, and other hard surfaces. They produce byssal threads: thin but very strong and stretchy fibers used to anchor themselves down and avoid being washed away by the waves.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Ecological Connections	Predatory birds try to break open mussels by dropping them on sharp rocks. They may bring them as far inland as the temperate rainforest.
	Resources	**Mussels** | Traditional Animal Foods of Indigenous Peoples of Northern North America http://traditionalanimalfoods.org/marine-invertebrates/bivalves/page.aspx?id=6505

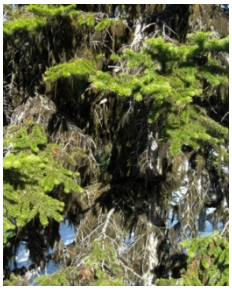
Marine Invertebrates	**Specimen**	Butter clam (*Saxidomus gigantea*) MI(m)60-241
	Image	  Photo: Wikimedia Commons user clpo13, used under a creative commons license
	Habitat	*Native*; Pacific coast (Alaska to California); buried in sandy, gravelly substrate, in sheltered intertidal areas
	Diet	*Omnivore, filter feeder*; phytoplankton, bivalve larvae, bits of algae
	Predators	Sea stars, crabs, sea otters, gulls, crows, humans
	Description	This clam can grow up to 15 centimetres across and can live a very long time: over 20 years! On the outside of its white or gray shell are rings that are added when the clam grows. Unlike growth rings in a tree, clams can add multiple rings every year. A really wide band tells you of a period of time when the clam had a good food supply: how many of these can you see?
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Ecological Connections	Predatory birds try to break open small clams by dropping them on sharp rocks. They may bring them as far inland as the temperate rainforest.
	Resources	**Butter clam** | Encyclopedia of Life http://eol.org/pages/491722/details

Marine Invertebrates	**Specimen**	Nuttall's cockle (*Clinocardium nuttallii*) MI(m)60-242
	Image	  Photo: Flickr user J Maughn, used under a creative commons license
	Habitat	*Native*; Pacific coast (California to Alaska); in sheltered intertidal areas
	Diet	*Omnivore, filter feeder*; phytoplankton, bivalve larvae, bits of algae
	Predators	Gulls, sea stars, crabs
	Description	The Nuttall's cockle is a widespread clam species. It is usually not buried too deep below the surface because of its short siphon (the part of its body it uses to take in water for feeding and breathing).
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Ecological Connections	Predatory birds try to break open cockles by dropping them on sharp rocks. They may bring them as far inland as the temperate rainforest.
	Resources	**Nuttall's cockle** | Biodiversity of the Central Coast http://www.centralcoastbiodiversity.org/nuttalls-cockle-bull-clinocardium-nuttallii.html

Entomology	**Specimen**	Woodlice I(o)00-126
	Image	  Photo: Flickr user John, used under a creative commons license
	Habitat	*Native*; globally widespread; moist, dark places (e.g. beneath rotting logs and piles of leaves)
	Diet	*Omnivore, decomposer;* decaying plant and animal matter, fungi
	Predators	Spiders, small mammals, birds, amphibians, centipedes, beetles
	Description	If you thought these were insects, then look again: woodlice have many more than six legs and are in fact crustaceans (related to lobsters, shrimps, and crabs). Among crustaceans, some isopods such as woodlice are unique because they have adapted to life on land.
	Safety & Handling	Magnifying cases may be individually removed from box; however, do not open, flip, or shake them when viewing.
	Ecological Connections	Woodlice are decomposers, and have an important role in recycling nutrients from rotting plant material and making it available to other organisms. Because their exoskeletons are mostly made of calcium carbonate, woodlice are a good source of calcium for their predators.
	Resources	**Woodlouse** | A-Z Animals https://a-z-animals.com/animals/woodlouse/ **Get Rid of Woodlice or Don't Bother?** | Dengarden https://dengarden.com/pest-control/How-to-get-rid-of-woodlice-roly-pollies ***Porcellio scaber*** | Animal Diversity Web http://animaldiversity.org/accounts/Porcellio_scaber/

Fossils	**Specimen**	Fossilized wood FO 50-41
	Image	  Photo: Flickr user richardghawley, used under a creative commons license
	Description	Wood is made of tough fibrous materials such as lignin and cellulose. It provides structure to many plants and helps with the transport of water and nutrients. It is the main reason why trees are able to grow so tall!
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Ecological Connections	Although wood evolved around 400 million years ago, it took another 110 million years before fungi evolved the ability to decompose wood. In that time, large quantities of wood sank to the bottoms of swamps and formed much of the coal we use today.
	Resources	**N.B. fossils show origins of wood** | CBC News http://www.cbc.ca/news/canada/new-brunswick/n-b-fossils-show-origins-of-wood-1.1052870 **White Rot Fungi Slowed Coal Formation** | Scientific American https://www.scientificamerican.com/article/mushroom-evolution-breaks-down-lignin-slows-coal-formation/

Fossils	**Specimen**	Fossilized leaf FO 50-42
	Image	  Photo: Flickr user dw_ross, used under a creative commons license
	Description	This is a small fossil of what was most likely a leaf from an ancient flowering plant. While we do not know when or where this particular specimen was found, the fossil record suggests that flowering plants began to appear on Earth around 125 million years ago. Flowering plants became very successful very quickly, largely because of their symbiotic relationships with insect pollinators.
	Safety & Handling	Touch gently; do not remove from black box. Hold by the sides and base of the box.

Herbarium	**Specimen**	Horsehair lichen (*Bryoria pseudofuscescens*) H(I)00-47
	Image	  Photo: Flickr user Jason Hollinger, used under a creative commons license
	Habitat	*Native*; western Canada and Alaska; epiphyte on conifers in open forests
	Description	What's in a name? "*Fuscescens*" is Latin meaning "becoming dark" – a good description for this lichen, which is usually grey-brown to black in colour. The horsehair lichen's common name refers to its many slender, twisted branches that look like coarse horsehair.
	Safety & Handling	Very delicate; touch gently and do not pick up (specimen is sewn down). Hold by the sides and base of the box.
	Ecological Connections	This lichen is important to animals such as elk and mule deer because it is common and can be eaten in the winter when food is scarce. Also, because this lichen is dark-coloured, it absorbs more energy from the sun and is less likely to freeze; during cold periods when most water is frozen, this lichen is a good source of drinking water for animals.
	Resources	**Lichen Use by Wildlife in North America** | Lichens of North America Information http://www.lichen.com/fauna.html

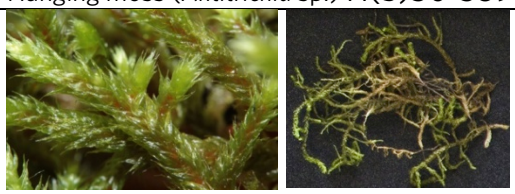
Herbarium	**Specimen**	Seaside tube lichen, on bark (*Hypogymnia oceanica*) H(l)00-49
	Image	  Photo: © Tim Wheeler, used with permission
	Habitat	*Native*; Pacific coast (Alaska to Oregon); epiphyte on conifers in open areas of old growth forests
	Description	A smallish leaf-like lichen that ranges from white to green-gray in colour and has long, puffy lobes. It is a fairly rare lichen; in fact, the first time it was ever described was right here in British Columbia, in 1988!
	Safety & Handling	Do not open, flip, or shake display case. Hold by the sides and base of the box.
	Ecological Connections	The seaside tube lichen reproduces using tiny powdery balls of spores, and one way they can spread is through animal transport. The spore balls attach to small invertebrates like ants and mites, or to larger vertebrates including furry animals and birds.
	Resources	***Hypogymnia oceanica*** | U.S. Bureau of Land Management https://www.blm.gov/or/plans/surveyandmanage/MR/Lichens/HYOC20.pdf

Herbarium	**Specimen**	Red-belted conk (*Fomitopsis pinicola*) H(fu)50-28
	Image	  Photo: Flickr user Jon Nelson, used under a creative commons license
	Habitat	*Native*; widely distributed in northern hemisphere; often on dead trees in coniferous forests
	Description	This shelf-like fungus is brown and shiny on top, and has a red belt around its outer edge.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Ecological Connections	The red-belted conk is usually found on the sides of dead or dying trees (especially Douglas-fir), where it works to recycle dead woody material back into the forest soil. Fungi reproduce using spores instead of seeds like most plants. Spores of the red-belted conk can be brought to new trees by insects.
	Resources	**Mushroom of the Week - 'Conked Out'** | Oregon WildBlog http://www.oregonwild.org/about/blog/mushroom-week-conked-out ***Fomitopsis pinicola*** | MushroomExpert.com http://www.mushroomexpert.com/fomitopsis_pinicola.html

Herbarium	**Specimen**	Coral fungi (*Ramaria* sp.) H(fu)50-25
	Image	  Photo: Flickr user USFWSmidwest, used under a creative commons license
	Habitat	*Native*; found globally; often on decaying logs in forests
	Description	"Coral fungus" is a group of fungi that are coral-like in appearance. They come in many different colours (white, yellow, pink, purple) and have many fleshy upright branches. For these fungi, the branches are important because they raise up the spore-producing structures; this makes it more likely that wind will carry the spores far away.
	Safety & Handling	Do not open, flip, or shake display case. Hold by the sides and base of the box.
	Ecological Connections	This genus includes many mycorrhizal species. Mycorrhizal fungi form mats to cover the roots of trees, allowing the fungus to exchange nutrients with tree roots. This relationship is an example of mutualistic symbiosis, where the trees and fungi help each other to survive.
	Resources	**Coral and Tooth Fungi** | St. Lawrence Lowlands Blog https://stlawrencelowlands.wordpress.com/2013/11/18/coral-and-tooth-fungi/

Herbarium	**Specimen**	Purplepore bracket (*Trichaptum abietinum*) H(fu)50-25
	Image	  Photo: Flickr user Dick Culbert, used under a creative commons license
	Habitat	*Native*; widely distributed in North America; found on dead or dying conifers
	Predators	Beetles, thrips; fungi grow on fruiting body
	Description	A small, purple fungus that can be found in great numbers on decomposing wood, where it forms shelf-like layers.
	Safety & Handling	Very delicate; touch gently and do not pick up (specimen is sewn down). Hold by the sides and base of the box.
	Ecological Connections	This fungus is able to decompose some of the toughest fibers in wood. This makes this species one of the most powerful decomposers in the temperate forest ecosystem, quickly breaking down wood into softer organic material that is more easily used by other organisms.
	Resources	***Trichaptum abietinum*** | MushroomExpert.com http://www.mushroomexpert.com/trichaptum_abietinum.html

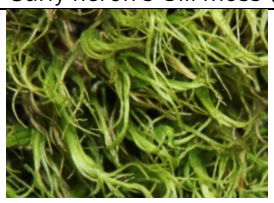
Herbarium	**Specimen**	Step moss (*Hylocomium splendens*) H(b)50-388
	Image	 Photo: Flickr user Paul McCoubrie, used under a creative commons license
	Habitat	*Native*; widespread in most continents; moist, shaded parts of old growth coniferous forests (e.g. decaying wood, calcium-rich soils)
	Description	The scientific name for this species means "shining moss of the forest", an apt description for this glossy, dark-green moss. Its common name describes how each year's new growth appears to "step out" of the previous year's. While most mosses can only reach several centimetres in height, the step moss has modified root hairs that allow water and nutrients to be transported over longer distances.
	Safety & Handling	Very delicate; touch gently and do not pick up (specimen is sewn down). Hold by the sides and base of the box.
	Ecological Connections	This moss usually grows in thick mats on the forest floor, which helps to hold the top layers of nutrient-rich soil together and keep it available for other plants to use. These mats also provide moist habitats and hiding places for invertebrates such as spiders, insects, and worms.
	Resources	**Step Moss** | Biodiversity of the Central Coast http://www.centralcoastbiodiversity.org/step-moss-bull-hylocomium-splendens.html

Herbarium	**Specimen**	Hanging moss (*Antitrichia* sp.) H(b)50-389
	Image	 Photo: Wikimedia Commons user HermannSchachner, used under a creative commons license
	Habitat	*Native;* Pacific coast (BC to California) and other parts of northern hemisphere; on boulders or an epiphyte on tree trunks/branches
	Description	The scientific name for this genus, *Antitrichia*, is Latin for "without filaments". True to its name, this specimen looks coarse and like it's having a bad hair day, compared to the other, more threadlike mosses. What other differences can you spot?
	Safety & Handling	Very delicate; touch gently and do not pick up (specimen is sewn down). Hold by the sides and base of the box.
	Ecological Connections	This moss is an epiphyte, which means it grows on top of tree trunks or branches but is able to get its own nutrients from the sun and water (commensalism). The moss provides moist habitats and hiding places for invertebrates such as spiders and insects.
	Resources	**Hanging wing-moss, hanging moss** | Biodiversity of the Central Coast http://www.centralcoastbiodiversity.org/hanging-wing-moss-bull-antitrichia-curtipendula.html ***Antitrichia curtipendula*** | E-flora BC http://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Antitrichia%20curtipendula

Herbarium	**Specimen**	Cat-tail moss (*Isothecium stoloniferum*) H(b)50-391
	Image	 Photo: Flickr user Cheryl DeWolfe, used under a creative commons license
	Habitat	*Native*; Pacific coast (Alaska to Oregon); on boulders or an epiphyte on tree trunks and branches, shrubs
	Description	This is probably the most common moss in coastal rainforests. In fact, it is so common in some places that you would find it hard to find a single tree branch that did not have this moss growing on it!
	Safety & Handling	Very delicate; touch gently and do not pick up (specimen is sewn down). Hold by the sides and base of the box.
	Ecological Connections	This moss is an epiphyte, which means it grows on top of tree trunks or branches but is able to get its own nutrients from the sun and water (commensalism). The moss provides moist habitats and hiding places for invertebrates such as spiders and insects.
	Resources	Pojar, J. and Andy MacKinnon. *Plants of Coastal British Columbia*. Lone Pine Publishing, 2004.

Herbarium	**Specimen**	Douglas' neckera (*Neckera douglasii*) H(b)50-394
	Image	  Photo: Flickr user Kirill Ignatyev, used under a creative commons license
	Habitat	*Native*; Pacific coast (California to Alaska); humid coastal rainforest, hangs from tree trunks and branches
	Description	A common moss found on tree trunks, wet boulders, or hanging from tree branches. It is lighter in colour than most mosses, usually ranging from a glossy olive-green to light green. Notice how flat and scale-like this moss is.
	Safety & Handling	Very delicate; touch gently and do not pick up (specimen is sewn down). Hold by the sides and base of the box.
	Ecological Connections	This moss is an epiphyte, which means it grows on top of tree trunks or branches but is able to get its own nutrients from the sun and water (commensalism). The moss provides moist habitats and hiding places for invertebrates such as spiders and insects.
	Resources	Pojar, J. and Andy MacKinnon. *Plants of Coastal British Columbia*. Lone Pine Publishing, 2004.

Herbarium	**Specimen**	Lesser featherwort (*Plagiochila porelloides*) H(b)50-392
	Image	  Photo: Flickr user Kirill Ignatyev, used under a creative commons license
	Habitat	*Native*; worldwide in boreal and Arctic habitats
	Description	If you thought this was a moss, you wouldn't be the first to have made that mistake. Leafy liverworts like the lesser featherwort are often mistaken for mosses because they are small, green, and form mats. One way you can tell them apart when they're alive (this won't work on our dried specimen) is to rub it gently between your fingers: if your fingers come away oily and a bit smelly, chances are you've got a liverwort on your hands!
	Safety & Handling	Very delicate; touch gently and do not pick up (specimen is sewn down). Hold by the sides and base of the box.
	Ecological Connections	This liverwort usually grows in mats on the forest floor, which helps to hold the top layers of nutrient-rich soil together and keep it available for other plants to use. These mats also provide moist habitats and hiding places for invertebrates such as spiders, insects, and worms.
	Resources	**Liverwort** | Encyclopedia Britannica https://www.britannica.com/plant/liverwort

Herbarium	**Specimen**	Curly heron's-bill moss (*Dicranum fuscescens)* H(b)50-396
	Image	  Photo: Wikimedia Commons user HermannSchachner, used under a creative commons license
	Habitat	*Native*; Pacific coast (California to Alaska) and other boreal forests worldwide; old-growth forests on conifer trunks, rotting logs, humus
	Description	This species is one of 20 members of the *Dicranum* genus that are native to BC. In comparison to the broom forkmoss, the curly heron's-bill moss is smaller and fuzzier. When dry, it curls similarly to human hair: it twists in more than one direction, and sometimes spirals.
	Safety & Handling	Very delicate; touch gently and do not pick up specimen or its magnifying case. Hold by the sides and base of the box.
	Ecological Connections	*Dicranum* species grow in tufts, cushions or mats that are good at holding the top layers of nutrient-rich soil together and making it available to other plants. These mats also provide moist habitats and hiding places for invertebrates such as spiders, insects, and worms.
	Resources	***Dicranum fuscescens*** | E-flora BC http://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Dicranum%20fuscescens **Dusky fork moss** | Biodiversity of the Central Coast http://www.centralcoastbiodiversity.org/dusky-fork-moss-bull-dicranum-fuscescens.html

Herbarium	**Specimen**	Broom forkmoss (*Dicranum scoparium*) H(b)50-395
	Image	  Photo: Flickr user Wolfram Sondermann, used under a creative commons license
	Habitat	*Native*; common and widespread globally; rotten logs, forest floor, or an epiphyte on tree trunks
	Description	This species is one of 20 members of the *Dicranum* genus that are native to BC. Compared to the curly heron's-bill moss, the broom forkmoss is larger and has a more windblown appearance. Can you see how the moss is swept to one side, like in a broom?
	Safety & Handling	Very delicate; touch gently and do not pick up specimen or its magnifying case. Hold by the sides and base of the box.
	Ecological Connections	*Dicranum* species grow in tufts, cushions or mats that are good at holding the top layers of nutrient-rich soil together and making it available to other plants. These mats also provide moist habitats and hiding places for invertebrates such as spiders, insects, and worms.
	Resources	***Dicranum scoparium*** | Royal Botanic Garden Edinburgh http://rbg-web2.rbge.org.uk/bbs/Activities/mosses/Dicranum%20scoparium.pdf

Herbarium	**Specimen**	Alpine haircap moss (*Polytrichum alpinum*) H(b)50-390
	Image	  Photo: Wikimedia Commons user HermannSchachner, used under a creative commons license
	Habitat	*Native*; primarily Pacific coast (California to Alaska); soil, rotting wood, roots of overturned trees in mountainous regions
	Description	Lives in harsh, exposed environments where not many nutrients are available. Male plants have 'splash cups' containing their reproductive structures: when raindrops hit them, the sperm bounces out and disperses, hopefully finding its way to a female moss!
	Safety & Handling	Do not open, flip, or shake display case. Hold by the sides and base of the box.
	Ecological Connections	This moss usually grows in loose mats, which helps to hold the top layers of nutrient-rich soil together and keep it available for other plants to use. These mats also provide moist habitats and hiding places for invertebrates such as spiders, insects, and worms.
	Resources	***Polytrichastrum alpinum***| Royal Botanic Garden Edinburgh http://rbg-web2.rbge.org.uk/bbs/Activities/mosses/Polytrichastrum%20alpinum.pdf

Herbarium	**Specimen**	Western redcedar (*Thuja plicata*) H(v)50-395
	Image	  Photo: Wikimedia Commons user abdallahh, used under a creative commons license
	Habitat	*Native*; Pacific coast (California to Alaska); shade-tolerant, most common in moist, nutrient-poor forests
	Predators	Leaves, seedings: deer, birds, insects
	Description	The western redcedar is the provincial tree of British Columbia. It is a conifer with scale-like leaves and bark that tears off in strips. When low-lying branches break off or make contact with the ground, they sometimes start to grow roots and can become new, independent trees.
	Safety & Handling	Do not remove from plastic cover.
	Ecological Connections	Many animals (including bears, raccoons and birds) use cavities in the western redcedar as dens or nests.
	Resources	Pojar, J. and Andy MacKinnon. *Plants of Coastal British Columbia*. Lone Pine Publishing, 2004.

Herbarium	**Specimen**	Western redcedar cones (*Thuja plicata*) H(v)50-249b
	Image	  Photo: Wikimedia Commons user abdallahh, used under a creative commons license
	Habitat	*Native*; Pacific coast (California to Alaska); shade-tolerant, most common in moist, nutrient-poor forests
	Predators	Leaves, seedings: deer, birds, insects.
	Description	The western redcedar is the provincial tree of British Columbia. It is a conifer with scale-like leaves and bark that tears off in strips. When low-lying branches break off or make contact with the ground, they sometimes start to grow roots and can become new, independent trees.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Ecological Connections	Many animals (including bears, raccoons and birds) use cavities in the western redcedar as dens or nests.
	Resources	Pojar, J. and Andy MacKinnon. *Plants of Coastal British Columbia*. Lone Pine Publishing, 2004.

Herbarium	**Specimen**	Douglas-fir cones (*Pseudotsuga menziesii*) H(v)50-393
	Image	  Photo: Wikimedia Commons user Victor R. Ruiz, used under a creative commons license
	Habitat	*Native*; Pacific coast (BC to Washington); coniferous forests, an early settler after forest fires
	Predators	Sap: bears. Seeds: squirrels, birds.
	Description	This is a large coniferous tree. Sometimes, Douglas-fir trees live over 1,000 years, partially because they have very thick bark, which helps them survive forest fires and reduces damage from diseases and insects. The seed cones of this tree are very distinctive: they have protective bracts (woody scales) that stick out and look like the tails and hind feet of mice hiding in the cones.
	Safety & Handling	Handle the cones gently, as the bracts are delicate. Do not remove from black box. Hold by the sides and base of the box.
	Ecological Connections	The Douglas-fir provides food for many organisms. Bears often scrape the bark of young trees away in order to eat the sap beneath, while rodents (including squirrels) and birds will eat the seeds.
	Resources	Pojar, J. and Andy MacKinnon. *Plants of Coastal British Columbia*. Lone Pine Publishing, 2004.

Herbarium	**Specimen**	Douglas-fir (*Pseudotsuga menziesii*) H(v)50-395
	Image	  Photo: Wikimedia Commons user Victor R. Ruiz, used under a creative commons license
	Habitat	*Native*; Pacific coast (BC to Washington); coniferous forests, an early settler after forest fires
	Predators	Sap: bears. Seeds: squirrels, birds.
	Description	This is a large coniferous tree. Sometimes, Douglas-fir trees live over 1,000 years, partially because they have very thick bark, which helps them survive forest fires and reduces damage from diseases and insects. The seed cones of this tree are very distinctive: they have protective bracts (woody scales) that stick out and look like the tails and hind feet of mice hiding in the cones.
	Safety & Handling	Do not remove from plastic cover.
	Ecological Connections	The Douglas-fir provides food for many organisms. Bears often scrape the bark of young trees away in order to eat the sap beneath, while rodents (including squirrels) and birds will eat the seeds.
	Resources	Pojar, J. and Andy MacKinnon. *Plants of Coastal British Columbia*. Lone Pine Publishing, 2004.

Herbarium	**Specimen**	Western hemlock cones (*Tsuga heterophylla*) H(v)50-257b
	Image	 Photo: Flickr user Born1975, used under a creative commons license
	Habitat	*Native*; Pacific coast (BC to Alaska); in coniferous forests, often in the shade of mature trees, sometimes growing on decaying wood
	Predators	Seedlings: rabbits, hares. Leaves: deer, elk.
	Description	The western hemlock is a large conifer, able to grow up to 60 metres tall. Its seed cones are small by comparison, at less than two centimetres long. Little cones and seeds can be an advantage for dispersal: because they are so light, the winged seeds of the western hemlock can be carried by the wind for over a kilometre!
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Ecological Connections	Western hemlock seedlings are eaten by rabbits and hares, while its leaves provide food for deer and elk. Cavities in this tree can also be used as nests for birds.
	Resources	**Western hemlock** | Food as Medicine http://www.foodasmedicine.ca/2011/western-hemlock/ **Western hemlock** | Mountain Loop Conservancy http://www.mtloopconservancy.org/Mt.Loop/MLCFactSheetWesternHemlock.pdf

Herbarium	**Specimen**	Western hemlock (*Tsuga heterophylla*) H(v)50-388
	Image	 Photo: Flickr user Born1975, used under a creative commons license
	Habitat	*Native*; Pacific coast (BC to Alaska); in coniferous forests, often in the shade of mature trees, sometimes growing on decaying wood
	Predators	Seedlings: rabbits, hares. Leaves: deer, elk.
	Description	The western hemlock is a large conifer, able to grow up to 60 metres tall. Its seed cones are small by comparison, at less than two centimetres long. Little cones and seeds can be an advantage for dispersal: because they are so light, the winged seeds of the western hemlock can be carried by the wind for over a kilometre!
	Safety & Handling	Do not remove from plastic cover.
	Ecological Connections	Western hemlock seedlings are eaten by rabbits and hares, while its leaves provide food for deer and elk. Cavities in this tree can also be used as nests for birds.
	Resources	**Western hemlock** | Food as Medicine http://www.foodasmedicine.ca/2011/western-hemlock/ **Western hemlock** | Mountain Loop Conservancy http://www.mtloopconservancy.org/Mt.Loop/MLCFactSheetWesternHemlock.pdf

Herbarium	**Specimen**	Red alder (*Alnus rubra*) H(v)50-390
	Image	 Photo: Flickr user Luke McGuff, used under a creative commons license
	Habitat	*Native*; Pacific coast (California to Alaska); moist woods, streambanks, floodplains; an early colonizer after disturbances, shade-intolerant
	Predators	Leaves: deer, elk. Seeds: songbirds, rodents, deer.
	Description	The red alder is a deciduous tree that grows up to 25 metres tall. Its thin, smooth bark is often encrusted with white patches of lichen, like in our specimen.
	Safety & Handling	Do not remove from plastic cover.
	Ecological Connections	Red alder trees have symbiotic relationships with bacteria living in their roots. The bacteria fix nitrogen, helping the alders grow. In return, the bacteria are given food and a safe home. When red alder leaves decompose, they release nutrients into the soil and help nearby plants.
	Resources	***Alnus rubra*** | U.S. Forest Service https://www.fs.fed.us/database/feis/plants/tree/alnrub/all.html

Herbarium	**Specimen**	Salal (*Gaultheria shallon*) H(v)50-394
	Image	 Photo: Flickr user Malcolm Manners, used under a creative commons license
	Habitat	*Native*; Pacific coast (California to Alaska); coniferous forests; early colonizer after fires
	Predators	Leaves: deer, elk. Berries: birds, mammals. Flowers: birds.
	Description	Salal is a common shrub that grows to one metre tall and has hairy stems and leathery, evergreen leaves. It produces white or pink bell-shaped flowers, as well as edible dark purple "berries". Can you spot the berries in our specimen? *Hint: they look like dried blueberries*
	Safety & Handling	Do not remove from plastic cover.
	Ecological Connections	Salal leaves are evergreen, making them an important food source for deer and elk, particularly in the wintertime when many low-lying plant species are covered with snow. Salal berries are another important food source, and are eaten by animals such as the Douglas' squirrel and black bear. Hummingbirds are known to visit salal flowers in the spring.
	Resources	***Gaultheria shallon* (Salal)** | The Wild Garden http://www.nwplants.com/business/catalog/gau_sha.html

Herbarium	**Specimen**	Western swordfern (*Polystichum munitum*) H(v)50-396
	Image	  Photo: Wikimedia Commons user brewbooks, used under a creative commons license
	Habitat	*Native*; western North America (California to Alaska); moist, shaded forest understory
	Predators	Fronds: American black bear, deer, elk
	Description	This is one of the largest local ferns, sometimes growing up to one and a half metres tall: that's as tall as a human! The swordfern has leaflets that attach by small stalks. Some people think that this looks like the handle of a sword, which is where the common name comes from.
	Safety & Handling	Do not remove from plastic cover.
	Ecological Connections	Swordfern often form mycorrhizal relationships with fungi, where the fungi form mats to cover the fern's roots, allowing the fungus to exchange nutrients with the fern. This relationship is an example of mutualistic symbiosis, where the ferns and fungi help each other to survive.
	Resources	**Sword fern** | Biodiversity of the Central Coast http://www.centralcoastbiodiversity.org/sword-fern-bull-polystichum-munitum.html

Herbarium	**Specimen**	Deer fern (*Blechnum spicant*) H(b)50-392
	Image	  Photo: Flickr user J Brew, used under a creative commons license
	Habitat	*Native*; Pacific coast (Alaska to California); moist/wet forests, streambanks
	Predators	Fronds: deer, elk
	Description	The deer fern is an evergreen plant with two different types of fronds (fern "leaves"). The fronds used for photosynthesis droop over the ground, while the spore-producing fronds stand straight up from the middle of the fern. The spore-producing fronds have much thinner leaflets. Can you tell which of the fronds on this specimen are photosynthetic and which are spore-producing?
	Safety & Handling	Do not remove from plastic cover.
	Ecological Connections	Deer fern often form mycorrhizal relationships with fungi, where the fungi form mats to cover the fern's roots, allowing the fungus to exchange nutrients with the fern. This relationship is an example of mutualistic symbiosis, where the ferns and fungi help each other to survive.
	Resources	***Blechnum spicant*** | E-flora BC http://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Blechnum+spicant ***Blechnum spicant* (Deer Fern or Hard Fern)** | The Wild Garden http://www.nwplants.com/business/catalog/ble_spi.html

Herbarium	**Specimen**	Vine maple (*Acer circinatum*) H(v)50-391
	Image	  Photo: Flickr user Debbie Ballentine, used under a creative commons license
	Habitat	*Native*; Pacific coast (California to BC); moist places, streamsides, canopy openings, forest edges; early colonizer after disturbances
	Predators	Leaves, flowers: birds, small mammals, insects. Leaves, bark: deer, elk.
	Description	Depending on the habitat it grows in, the vine maple can look like anything from a vine (hence its name) to a shrub or seven-metre tall tree. It has small white flowers and winged fruits, and its lobed leaves turn gold or bright red in the fall.
	Safety & Handling	Do not remove from plastic cover.
	Ecological Connections	In the warmer months, the vine maple's leaves and flowers are eaten by birds, mammals, and insects, or used by birds as nesting material. In the colder months, its leaves and bark are eaten by deer and elk.
	Resources	***Acer circinatum* (Vine Maple)** | The Wild Garden http://www.nwplants.com/business/catalog/ace_cir.html

Herbarium	**Specimen**	Bigleaf maple (*Acer macrophyllum*) H(v)50-393
	Image	  Photo: Flickr user Forest Service, used under a creative commons license
	Habitat	*Native*; Pacific coast (California to BC); often in disturbed sites
	Predators	Twigs, leaves: deer, elk
	Description	The bigleaf maple is the largest native maple tree in Canada. It grows up to 35 metres tall, and its massive five-lobed leaves measure up to 30 centimetres across! It can produce up to a million golden-brown winged seeds every year, which descend like helicopters to help with dispersal.
	Safety & Handling	Do not remove from plastic cover.
	Ecological Connections	The bigleaf maple is often covered by such large quantities of mosses, lichens, and ferns that its branches often break under the weight of all these epiphytes (plants that grow on top of other plants but are not parasitic). The layers of epiphytes can be so thick that they form a 'soil' of sorts from which new plants can take root and grow!
	Resources	***Acer macrophyllum***| The Wild Garden http://www.nwplants.com/business/catalog/ace_mac.html ***Acer macrophyllum*** | E-flora BC http://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Acer%20macrophyllum

Fish	**Specimen**	Salmon jaw F(b)20-56b
	Image	  Photo: Flickr user Bureau of Land Management Oregon and Washington, used under a creative commons license
	Habitat	*Native*; North Pacific Ocean and its tributaries, including along the Pacific coast (California to Alaska)
	Diet	Adult: small fish, amphipods, krill. Juvenile: zooplankton, insects and other invertebrates.
	Predators	Bears, eagles, hawks, orcas, sea lions, seals, fishes
	Description	This is a jaw from an adult salmon. Salmon are born in fresh water then live for years in the ocean, where they feed and grow larger. They then migrate back to their birth streams to spawn, but all die after spawning.
	Safety & Handling	Do not remove from black box. Hold by the sides of the box.
	Ecological Connections	When salmon decompose after spawning, they provide nutrients for insects and other animals living in freshwater ecosystems. Other times, forest animals catch and eat salmon and bring their bodies into the forest where they can decompose and provide nutrients for plants in the forest.
	Resources	**Salmon** | Vancouver Aquarium http://www.vanaqua.org/learn/aquafacts/fish/salmon **Coho salmon** | Fish Choice http://www.fishchoice.com/buying-guide/coho-salmon

Fish	**Specimen**	Coho salmon fry (*Oncorhynchus kisutch*) F(b)10-36c
	Image	  Photo: Brian Klinkenberg, used with permission
	Habitat	*Native;* North Pacific Ocean and its tributaries, including along the Pacific coast (California to Alaska)
	Diet	Adult: small fish, amphipods, krill. Juvenile: zooplankton, insects and other invertebrates.
	Predators	Bears, eagles, hawks, orcas, sea lions, seals, fishes
	Description	This is a salmon fry specimen. At this stage in their life cycle, salmon live in the freshwater streams and lakes where they were born. They spend much of their time hiding from predators behind boulders and logs.
	Safety & Handling	Do not open vial. Hold by the sides of the box (the vial is attached to black box for safe viewing).
	Ecological Connections	When adult salmon migrate back to their birth streams and lakes, they become an important food source for many animals. Their decomposing bodies introduce nutrients into streams, rivers and surrounding forests.
	Resources	**Salmon** | Vancouver Aquarium http://www.vanaqua.org/learn/aquafacts/fish/salmon **Coho salmon** | Fish Choice http://www.fishchoice.com/buying-guide/coho-salmon

Background Information

What is a temperate rainforest?

The temperate rainforest is a small biome that covers only 1% of Earth's surface. To be considered a temperate rainforest, it needs to be close to oceans and mountains and get more than 200 centimetres of precipitation every year. The Pacific coastal temperate rainforest is the largest example of this biome in the world. It stretches for 4,000 kilometres along the northwestern coast of North America. Temperate rainforests can also be found in parts of Chile, northern Europe, Australia, and New Zealand.

The temperate rainforest climate affects organisms living within it. The cool temperature slows down decomposition, and this causes lots of organic material to collect on the forest floor. The large amount of precipitation creates a moist environment where organisms such as ferns, mosses, and slugs can live. Frequent rainfall also means that fires are not very common in the temperate rainforest. Fewer fires means that trees here can get very old – sometimes over 1,000 years!

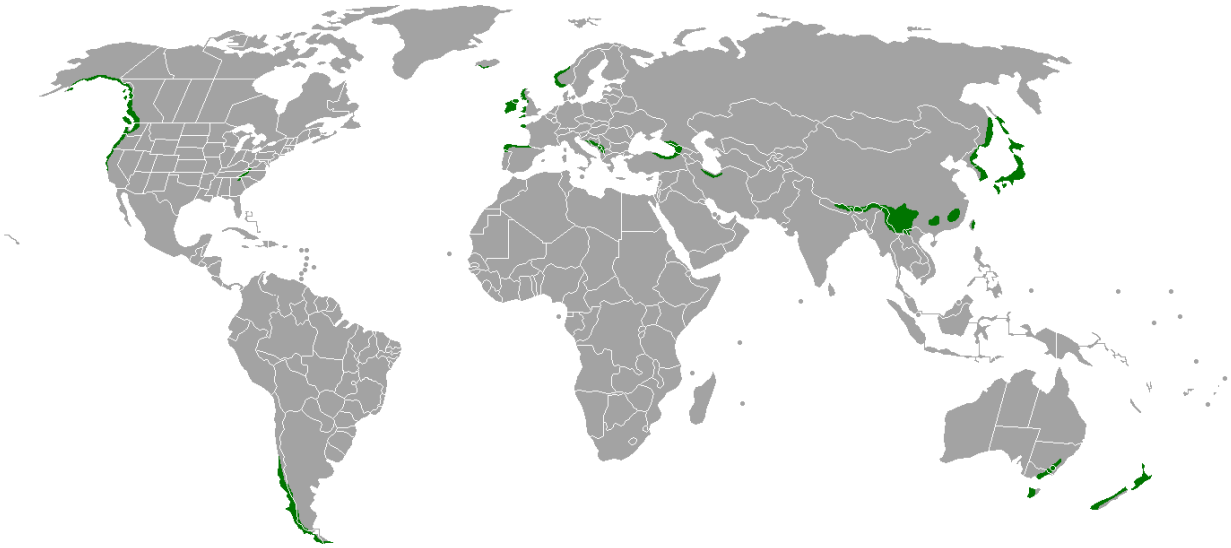


Figure 1: Global distribution of temperate rainforests. Photo: Wikimedia Commons user KarlUdo, used under a creative commons license

Resources:

Pacific Coastal Temperate Rainforest of North America | Alaska Coastal Rainforest Center
http://acrc.alaska.edu/_docs/data_publications/factsheets/pacificcoastal.pdf

Temperate Rain Forest | Beautiful Pacific Northwest
http://www.beautifulpacificnorthwest.com/temperate-rain-forest.html

Ecological Interactions

Figure 2: A female **Rufous Hummingbird feeding chick in a nest shingled with lichen.** Image: Flickr user Brendan Lally, used under a creative commons license.

Organisms are constantly interacting with the living and non-living things in their environments. Interactions can be broadly classified as intraspecific ("within species") or interspecific ("between species"), depending on whether the participants are of the same or different species, respectively. In Figure 2, the hummingbird demonstrates both intraspecific (feeding her chick) and interspecific (using lichen to decorate her nest) interactions. In the following sections, we will focus on interspecific interactions, which are broader in scale and will give us a more complete understanding of how ecosystems work.

Food

Every living thing needs energy to survive. Producers get energy straight from their environments. For example, plants and algae photosynthesize, converting sunlight and water into food. Consumers need to get energy by eating other living organisms: herbivores eat plants, carnivores eat animals, and omnivores eat both. But living things cannot live forever. When they die, their bodies are broken down by decomposers such as insects, fungi, and bacteria. This returns nutrients to the environment so that they can then be used by other living things.

Habitat

Many living things rely on other species to create ideal habitat for them. In the temperate rainforest, trees and shrubs provide shade, helping to keep the forest moist and cool for plants and animals like mosses, woodlice, and salamanders that need moist places to live. Many plants are epiphytes (Figure 3); instead of growing in soil, they grow on tree trunks and tree branches, helping them get more sunlight. Another example is when birds and small mammals use holes in trees as nests.

Figure 3: Epiphytes like this moss are constantly interacting with the plants they grow on Photo: Flickr user MelisaTG, used under a creative commons license

Symbiotic Relationships

In general, when two different species live closely together and interact, we call this a symbiotic relationship. This includes some of the food and habitat relationships outlined above. Symbiotic relationships can have helpful (+), harmful (-), or no (0) effects on the organisms involved. Types of symbiotic relationships include mutualism (+/+), commensalism (+/0), and parasitism (+/-).

Figure 4: Bees interact with flowers in their habitats by pollinating them and getting food in return. Photo: Flickr user slgckgc, used under a creative commons license

Usually, symbiosis refers to close interactions like the one between algae and fungi in lichen, but lichen interact with other living things too (see Beaty Box flash cards or "Lichen: Two Living Things in One" video, page 91). For example, squirrels and birds use lichen to decorate their nests. Deer also eat lichen as food and to help with digestion. There are countless ways that organisms in ecosystems interact with each other, and all of them are important in some way or another.

This is the meaning of interconnectedness; in ecosystems, everything is connected. Organisms interact with the living and non-living parts of their environments, and depend on these interactions for survival, growth, and reproduction. When even a single part of an ecosystem is changed, many other parts of the ecosystem may change with it.

Resources:

Canada's Coastal Rainforest | Hinterland Who's Who
http://www.hww.ca/assets/pdfs/factsheets/canadas-coastal-rainforest.pdf

Ecological Interactions | Khan Academy
https://www.khanacademy.org/science/biology/ecology/community-ecosystem-ecology/a/ecological-interactions

Nutrient cycling

When was the last time you recycled a piece of paper or a juice box? Did you know that ecosystems recycle materials, too? Nutrients are chemicals like water, carbon, and nitrogen that all organisms need.

Nutrients cycle constantly through ecosystems. Because many organisms get nutrients by eating other organisms, nutrient cycles are closely tied to food webs. At the bottom of most food webs are producers like plants and algae. These take up solar energy and nutrients from their environments and convert it into food. As producers are eaten by herbivores, which are eaten by carnivores and so on, nutrients feed into the food chain. But in the end, everything is broken down by decomposers (e.g. fungi, insects, and microbes) and the nutrients are returned to the soil where they can be taken up again by plants.

Nitrogen cycle

If you have ever tried to follow a recipe before, you know how important every ingredient is. For example, if you are trying to bake cookies but run out of sugar, then it doesn't matter how much flour or butter you have – you won't be able to bake a single cookie. In other words, you are limited by the amount of sugar you have.

Something similar happens with organisms. For plants especially, nitrogen is a "limiting nutrient". Plants can only grow as long as there is nitrogen around, because nitrogen is needed to make proteins. This is why when farmers add nitrogen-based fertilizers to soil, this help their crops grow faster and larger.

You might be surprised to learn that nitrogen gas makes up 78% of the gases in Earth's atmosphere. With so much nitrogen around, how can it be a limiting nutrient? It turns out that plants cannot absorb nitrogen in this form (N_2); they can only absorb it as ammonium (NH_4^+) or nitrate (NO_3^-) ions. Unfortunately for plants, "nitrogen fixation" (converting nitrogen gas into useable forms) is a rare talent among living organisms: it can only be done by certain types of bacteria. Because of this, most plants can only get nitrogen when organisms die and decompose and the ammonium from their proteins enters the soil, where it can be taken up by plants' roots. Other plants get over their nitrogen limitation by forming symbiotic relationships with nitrogen-fixing bacteria: the plant is given useable nitrogen in return for giving the bacteria a safe home and food.

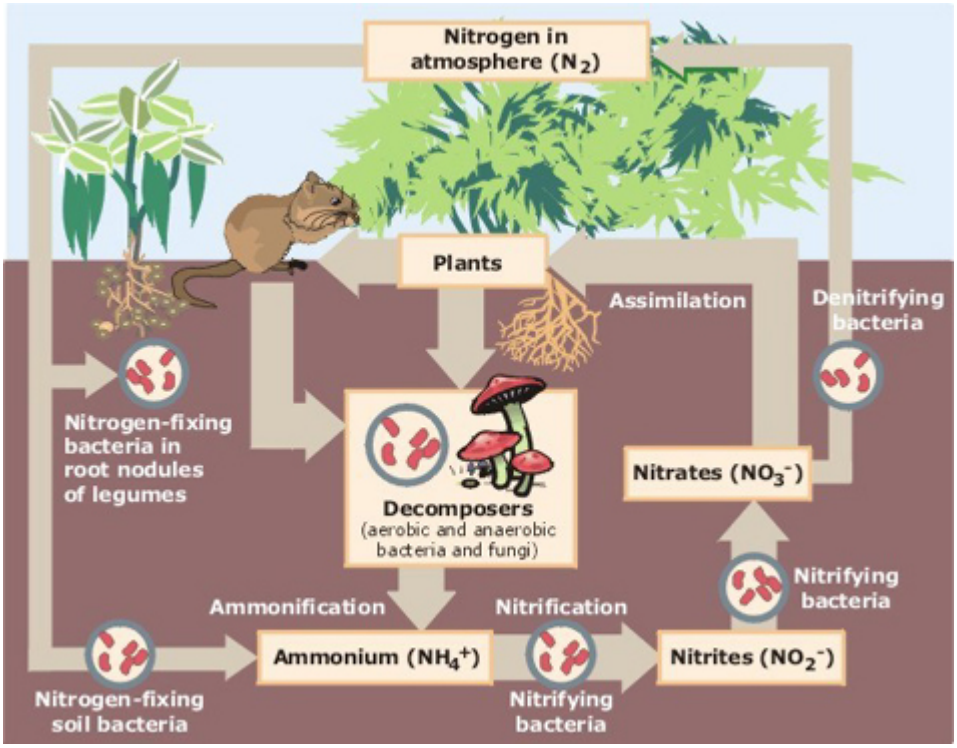


Figure 5: Nitrogen cycle. Wikimedia Commons, user "Environmental Protection Agency".

Resources

Nutrient Cycle | About, Inc.
https://www.thoughtco.com/all-about-the-nutrient-cycle-373411

The Nitrogen Cycle: Of Microbes and Men | Visionlearning, Inc.
http://www.visionlearning.com/en/library/Earth-Science/6/The-Nitrogen-Cycle/98

Salmon Cycle

Five salmon species (chinook, coho, sockeye, pink, chum) call British Columbia their home. Altogether, they are considered Pacific salmon, and are the official fishes of BC.

Salmon are anadromous, which means that they are born in fresh water, migrate to sea where they spend most of their lives, then return to fresh water to spawn.

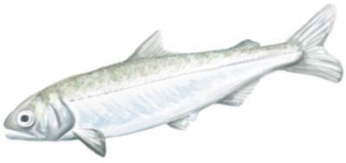
All Pacific salmon go through the same basic stages:

Egg Salmon embryos develop over the winter, getting nutrients from egg yolk.

Alevin Salmon hatch to become alevins. They can swim around at this stage, but they do not yet have to look for food because some yolk is left over and feeds them for a few more months.

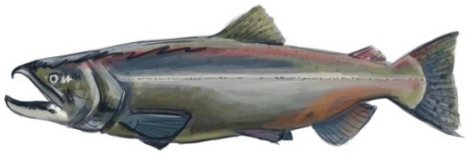
Fry When the yolk runs out, salmon fry must find their own food. They are very small (less than five centimetres long), so they have spots and dark stripes on their bodies to help with camouflage. They spend much of their time hiding from predators in the shadows behind logs and large rocks.

Smolt Salmon smolts are ready to head out to sea. They swim downstream to estuaries, which are the boundaries between fresh water and salt water. Before entering salt water, they undergo smoltification: their kidneys and gills change in a process that allows salmon to go from living in fresh water to living in sea water, something most animals could never do!



Adult Salmon spend several years in the ocean, where they feed and grow. When they begin to sexually mature, they make the long migration back to their birth streams. Once again, their bodies need to change, this time to allow them to go from salt water to fresh water. The remaining part of the migration is very exhausting. Salmon have to swim upstream the whole way, often fighting rapids and jumping over small waterfalls. Pacific salmon have been seen to jump up to four metres in height!

Spawner Salmon arriving at their birth streams change colour (some to red and green) to become more visible to mates. Males also develop hooked noses to fight for territories. Finally, the fish spawn: females lay thousands of unfertilized eggs, and males release milt that fertilizes the eggs. Soon after, the adult salmon die. In all, only around 0.05% (two in 4,000) of salmon survive to adulthood to spawn.



Illustrations by Derek Tan

The salmon-forest interaction

Salmon spend their first few months in fresh water next to temperate rainforests. Changes to the forests can affect salmon at this early stage, but salmon can also affect the forest. When salmon return to their birth streams and die, the nutrients they obtained from feeding in the sea are transferred to streams, rivers, lakes, and the forest.

Below is a summary of the effects that salmon and forests can have on each other:

Effect of salmon on forests

- Salmon are a food source for bears, mink, and other carnivores and decomposers.
- Decaying salmon introduce nitrogen into the soil that can be used directly by plants to grow. Trees grow up to three times faster because of this nitrogen (Helfield and Naiman 2001).
- Increased plant growth means that other animals – even the ones that don't eat salmon – have more food and better habitats to live in (Ben-David *et al*. 1998).

Effect of forests on salmon

- Trees keep streams shaded and cool.
- Leaves and other organic material falls into streams. This provides food for insects, which young salmon can eat.
- Tree roots hold the soil together on streambanks. They also filter water and keep it clean.
- Fallen logs in streams and rivers create safe areas for young salmon.

From this information you can see that there is a positive feedback loop: having salmon in rivers, streams, and lakes helps forests grow better and create better homes for future salmon. But damage to either salmon populations or forests can harm the whole salmon-forest interaction.

So far, we have discussed how salmon is related to the Pacific coastal temperate rainforest. But remember that salmon spend many years at sea, where they affect the animals they eat (e.g. krill, squid, herring) and those that eat them (e.g. killer whales, seals). In all, Pacific salmon are connected to at least 138 other species (Cedarholm *et al*. 2000). Because of the many species they affect, Pacific salmon are referred to as "keystone species".

Sadly, humans are overfishing and destroying salmon habitats in many places. As a result, nearly a third of salmon populations along the Pacific coast have become extinct, with many more now listed as endangered and threatened (Gustafson *et al*. 2006, Species at Risk Public Registry 2017). It is clear that the choices we make today are extremely important to the survival of Pacific salmon and the many species that depend on them.

Resources:

D. Suzuki_ Salmon and the forest | Steven Holzberg
youtube.com/watch?v=UOtkekP-sxk

Pacific Salmon and Wildlife | Cedarholm *et al*. 2000
http://wdfw.wa.gov/publications/00063/wdfw00063.pdf

Species at Risk Public Registry | Government of Canada
http://www.registrelep-sararegistry.gc.ca/sar/index/default_e.cfm

Ben-David, M., Hanley, T.A. and Schnell, D.M. 1998. Fertilization of terrestrial vegetation by spawning Pacific salmon: the role of flooding and predator activity. Oikos 83(1): 47-55.

Gustafson, R.G., Waples, R.S., Myers, J.M., Weitkamp, L.A., Bryant, G.J., Johnson, O.W. and Hard, J.J. 2006. Pacific salmon extinctions: quantifying lost and remaining diversity. Conservation Biology 21(4): 1009-1020.

Helfield, J.M. and Naiman, R.J. 2001. Effects of salmon-derived nitrogen on riparian forest growth and implications for stream productivity. Ecology 82(9):2403-2409.

Vocabulary list

Adaptation	Inherited trait or set of traits that increases an organism's chances of surviving and/or reproducing in an environment
Alevin	Newly hatched salmon that is free-swimming and feeds on leftover yolk
Anadromous	Describes fish that migrate from the sea to fresh water to spawn
Biome	Region characterized by its climate and the types of organisms living there
Browse	Leaves, twigs, and other above-ground vegetation
Byssal threads	Thin, strong, stretchy fibers that mussels produce to anchor themselves down
Camouflage	Occurs when an organism's behaviours and/or its appearance help it to blend in to its environment, often to avoid predation
Carnivore	Organism that eats animal material
Climate	Typical weather conditions in a region over a long period of time
Commensalism	Symbiotic relationship where one organism benefits and the other is unaffected (e.g. remoras hitching rides on sharks)
Conifer	Evergreen tree that produces cones and needles
Crustacean	Group of arthropods including crabs, lobsters, shrimp, woodlice, and barnacles
Deciduous	Tree or shrub that loses its leaves every year
Decomposer	Organism that specializes in breaking down organic material
Ecology	Branch of biology that studies the relationships of living organisms to each other and to their environments
Ecosystem	Biological community of interacting organisms and the environment they live in
Epiphyte	Plant that lives on top of a larger plant (e.g. a moss growing on a tree)
Evergreen	Plant that keeps its green leaves throughout the year
Exoskeleton	Hard external skeleton that provides support and protection for invertebrates such as arthropods
Filter feeder	Feeding strategy that involves straining small food particles out of the water; is used by many non-moving animals such as clams, barnacles, and sponges
Frond	The 'leaf' of a fern

Fry	Young salmon that spend much of their time hiding but have to find their own food
Herbivore	Organism that eats plant material
Interspecific interaction	Ecological interaction between two organisms of two different species
Intertidal zone	Area that is above water at low tide and immersed underwater at high tide
Intraspecific interaction	Ecological interaction between two organisms of the same species
Invertebrate	Animal without a backbone (e.g. arthropod, mollusk)
Isopod	Group of crustaceans including woodlice and their relatives
Keystone species	Species that has a disproportionately large effect on other living things in its ecosystem
Lichen	Mutualistic symbiotic relationship between algae and fungi
Limiting nutrient	Nutrient that is relatively hard to get and limits the growth of an organism
Liverwort	Plant related to mosses that does not have true roots and that reproduces using spores
Migrate	The movement of animals from one place to another, usually seasonally
Milt	Sperm-containing fluid sprayed by male fish, mollusks, and some other animals, onto eggs to fertilize them
Mutualism	Symbiotic relationship where both organisms benefit (e.g. bees and flowers, where bees get food and flowers are pollinated)
Mycorrhiza	Mutualistic symbiotic relationship between a fungus and a plant, where the plant gives food to the fungus and the fungus helps the plant get water and minerals that the plant cannot absorb on its own
Nitrogen fixation	Conversion of atmospheric nitrogen to forms that can be used by plants (ammonium, nitrate ions)
Nutrient cycle	Cycling of nutrients between environments and organisms
Nutrient	Chemical element or molecule that living things need to survive and grow
Old growth forest	Forest that has had many years to grow without being disturbed by human activity
Omnivore	Organism that eats both plant and animal material
Pacific salmon	A group of five salmon species that are the official fishes of BC
Parasitism	Symbiotic relationship where the parasite benefits but its host is harmed (e.g. mountain pine beetle is a parasite of pine trees)

Photosynthesis	Where an organism uses sunlight, carbon dioxide, and water to make oxygen and food in the form of sugar
Positive feedback	General concept in biology where an organism has a positive effect on something that feeds back to benefit the original organism or species (e.g. when salmon give nutrients to the forest and the forest helps young salmon survive)
Producer	Organism that can convert light or chemical energy into organic material
Siphon	The part of a clam's body that it uses to take in water for feeding and breathing
Smolt	Young salmon that are large enough to migrate to sea and undergo smoltification
Smoltification	The transition that salmon make between living in fresh water to living in sea water
Spawn	The process of a salmon laying eggs or releasing sperm into the water
Specimen	An animal or a part of an animal preserved for scientific or educational use
Spore	A very small unit, usually made of a single cell, that can give rise to a new individual; this mode of reproduction is used by many fungi, algae, and non-flowering plants
Symbiosis	A relationship between two or more species, often living in close association with each other
Temperate rainforest	Biome usually found near coastlines and mountain ranges that experiences plentiful precipitation and cool weather
Vertebrate	Animal with a backbone (e.g. fish, bird)

Interactions Lesson Plan

Plan for at least 90 minutes for this activity.

Learning Objectives

After this lesson, students should be able to:

- Identify and describe non-living characteristics and living organisms of the temperate rainforest
- Handle real museum specimens gently
- Make connections between local species in the Pacific coastal temperate rainforest
- Infer and propose connections between organisms in an ecosystem
- Discuss the role of salmon in the Pacific coastal temperate rainforest

Big Ideas & Concepts

Science Curriculum (K-9)

- *Kindergarten*: Plants and animals have observable features; daily and seasonal changes affect all living things
- *Grade 1*: Living things have features and behaviours that help them survive in their environment; observable patterns and cycles occur in the landscape
- *Grade 2*: Living things have life cycles adapted to their environment; materials can be changed through physical and chemical processes; water is essential to all living things, and it cycles through the environment
- *Grade 3*: Living things are diverse, can be grouped, and interact in their ecosystems
- *Grade 4*: All living things sense and respond to their environment; matter has mass, takes up space, and can change phase; energy can be transformed; the motions of Earth and the moon cause observable patterns that affect living systems
- *Grade 5*: Multicellular organisms have organ systems that enable them to survive and interact within their environment; Earth materials can be used as natural resources
- *Grade 6*: Multicellular organisms rely on internal systems to survive, reproduce, and interact with their environment
- *Grade 7*: Evolution by natural selection provides an explanation for the diversity and survival of living things
- *Grade 8*: Life processes are performed at the cellular level
- *Grade 9*: Cells are derived from cells; the biosphere, geosphere, hydrosphere, and atmosphere are interconnected, as matter cycles and energy flows through them

Science Curriculum (10-12 Drafts 2017)

- *Grade 10*: Genes are the foundation for the diversity of living things; energy is conserved and its transformation can affect living things and the environment
- *Chemistry 11*: Matter and energy are conserved in chemical reactions; chemical reactions and their applications have significant implications for the environment
- *Earth Sciences 11*: Earth materials are changed as they cycle through the geosphere and are used as resources, with environmental implication; the distribution of water has a major influence on weather and climate
- *Environmental Science 11*: Local environments contain diverse ecosystems with many roles and relationships; interconnected systems sustain healthy ecosystems; ecosystem stability is an important result of sustainability; humans can play a role in conservation of ecosystems
- *Life Sciences 11*: All living things have common characteristics; living things evolve over time; organisms are grouped on the basis of identifiable similarities
- *Physics 11*: Energy is found in different forms, is conserved, and has the ability to do work
- *Science for Citizens 11*: Science helps explain how natural changes and human choices affect global systems
- *Anatomy and Physiology 12*: The body strives to maintain homeostasis; all living things are made of cells, which contain DNA and cell structures that allow cells to survive and reproduce
- *Environmental Science 12*: Sustainable land use and food production will meet the needs of a growing population; living sustainably supports the well-being of self, community, and Earth
- *Geology 12*: Geologic time is preserved in Earth's rock record as fossils and reflects profound changes in the history of life on Earth

Materials & Supplies

The Beaty Box provides all specimens and flash cards required for the following lesson plan.

Additional suggested supplies include:

- Flipchart paper and markers
- Whiteboard and markers
- Ball of string or yarn
- Optional: name-tag holders, masking tape, or paper clips to help students label themselves as their organism
- Optional: image/video projector
- Optional: print-outs of temperate rainforest pictures (digital copies available on attached USB)
- Optional: stuffed animal or other object for students to practise specimen handling
- Optional: more balls of string (if split into groups)

Before the Lesson

For all activities, the safety of the specimens is paramount. Please familiarize yourself with handling procedures (pages 12-15 of the Beaty Box Manual; and pages 35 to 64 in this section), and be prepared to intervene if students are found either intentionally or accidentally mishandling specimens.

To keep specimens safe, we suggest laying them out with their flash cards on tables in an area separate from where you will be performing the Web of Life activity. If this is not possible, then please adapt the activity to better suit the needs of your students and your classroom.

While initially laying out the specimens, decide which ones you will use for the Pacific Salmon Forest activity. We suggest placing these specimens near each other for easy access. To preserve the element of surprise, ensure that the salmon specimens and their flash cards are out of sight. You could keep them in the box.

Introduction

1. **Introduce the temperate rainforest biome**
    - Define 'biomes', and introduce the temperate rainforest. Describe its climate and geographical range (see page 64).

2. **Show images of the temperate rainforest**
    - You may wish to use a projector or provide groups with print-outs of photos.
    - Some sample images are provided in the USB stick accompanying this Beaty Box, but feel free to use your own.
    - You may be able to borrow books from your library about this ecosystem or the organisms within it.

Figure 6: A typical scene in the temperate rainforest. Image: Flickr user Sam Beebe, used under a creative commons license.

3. **Discuss the ecological effects of temperate rainforest characteristics**
    - What kinds of organisms live in the temperate rainforest?
        - Prompts: What kinds of organisms can you see in these pictures?
          What insects and small animals are probably hiding?
          If you were walking on a trail in this kind of forest, what might you come across?
    - How does the cold, wet climate affect organisms in the temperate rainforest? (e.g. behaviour, appearance, habitat)
        - Prompts: What do you do when you're wet or cold?
          What are some of the challenges/benefits associated with being wet or cold?
          What adaptations might help organisms survive in these conditions?

4. **Review specimen handling procedures with your group**
    - There are many ways to cover specimen handling. Here is one option:
        - Hold up a specimen of your choice (e.g. Douglas' squirrel). Hold the specimen with both hands supporting the base and sides of the box and be careful not to tip it. You could walk around the class with the specimen as you speak.
        - Describe what a specimen is. Chances are that many students will never have seen or touched a specimen before. Explain why taking care of the specimens is important.
    - Demonstrate proper specimen handling. Encourage use of the 'pinky finger rule'. Have students practise using their pinkies to pet their own hands until they can just barely feel their own touch, and then transfer this technique over to a real specimen.
    - Discuss the differences in handling furry/feathery specimens, plants, shells, etc. Point out which specimens require extra care (mosses and lichens, vials, salmon jaw).
    - Ensure that students are fully aware that all specimens (except western screech-owl wing and woodlice magnifying cases; see page 35) should be left in their boxes at all times, and that extra handling details can be found on the flash cards.
        - When in doubt, be as gentle as you can!
    - Refer to pages 12-15 of the Beaty Box Manual for general details on specimen handling.

5. **Allow students to discover specimens on their own**
    - As they explore, get them thinking about the ecological significance of species in the temperate rainforest. For example:
        - What kinds of lives did these organisms lead?
          What food did they eat, and how did they get this food?
        - What kinds of interactions might occur between species in the forest ecosystem? (see pages 64 to 66)
        - How does this organism get to the temperate rainforest? At this stage in the activity, this is mostly applicable to the marine invertebrates, which must be brought into the rainforest by other animals, e.g. birds.
    - For younger students: split the class up into small groups. Designate one responsible member of each group as the 'leader' in charge of supervising correct specimen handling within that group.

Main Activity 1: A Web of Life

1. **Assign specimens**
    - Assign specimens to students. To avoid redundancy, consider grouping specimens (e.g. assigning several mosses to a single student), or leaving some out. If you are reducing specimens, make sure that you still have some plants, fungi, invertebrates, and vertebrates.
    - Have students hold their flash card or make specimen name tags for themselves. Allow time for students to acquaint themselves with their assigned specimen(s).

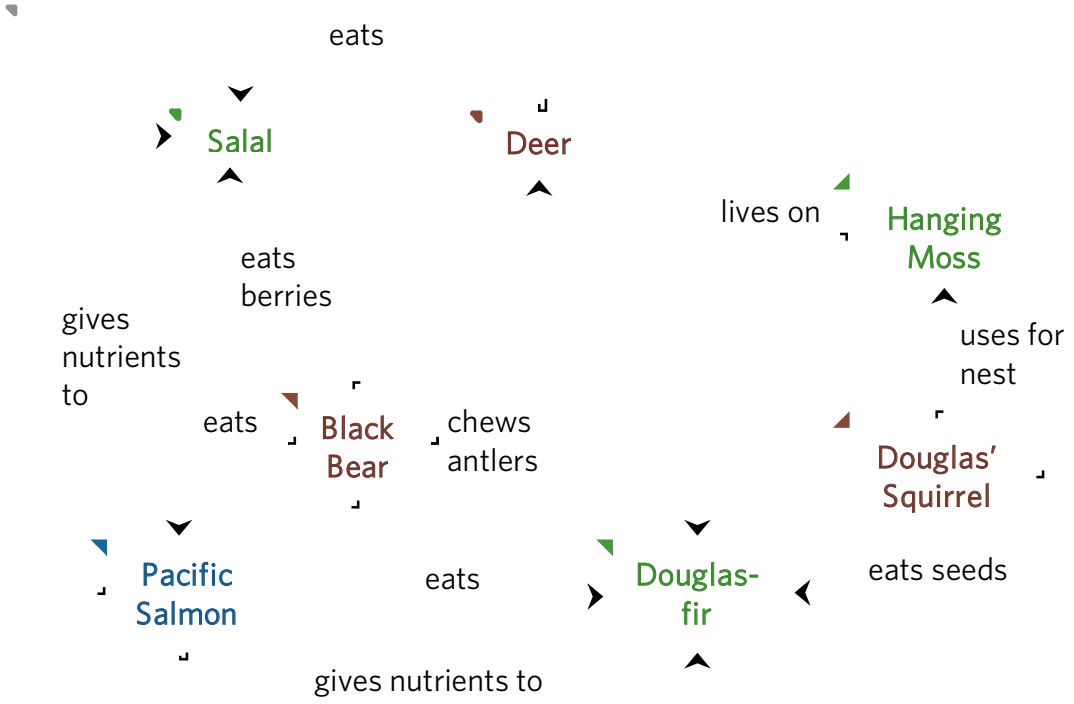
2. **Make connections!**
    - Once students have become familiar with their specimens, it is time to move to an open space away from the specimens for the next part of the activity!
    - Play catch with a ball of string, except have each student hold on to the string before throwing to another person who has not yet had a turn. When a student receives the ball, have them announce:
        - The name of the specimen
        - One cool fact about it
            - Encourage students to go beyond their flash cards (e.g. comment on the specimen's appearance, make a personal connection).
            - How it relates to the organism that came before it
            - Be creative! Allow roundabout connections (e.g. the Douglas' squirrel is connected to the rufous hummingbird through moss, which both use for their nests).
            - If an individual is struggling to find a connection, see if they can come up with a connection to a different temperate rainforest organism, or open up this discussion to the whole group.
        - Time-permitting, repeat the activity by assigning new specimens to students or challenging them to toss to new people in the circle.
        - For a large class, break up into smaller groups with diverse species in each group.

Main Activity 2: The Pacific Salmon Forest

1. **Prepare the activity**
    - Retrieve the following specimens and their corresponding flash cards. Lay them out where students can see.
        - Black bear fur
        - Black-tailed deer
        - Your favourite conifer species (not red alder)
        - One of: salal, deer fern, western swordfern
        - Other specimen(s) whose ecological connections you are comfortable describing
    - Keep the "coho salmon fry" and the "salmon jaw" specimens and their accompanying flash cards nearby but out of sight for now. You could keep them hidden in the box.
    - Have markers and flipchart paper ready.
    - Write the names of all species (except for salmon) on a whiteboard, leaving one space empty.

2. **Brainstorm connections between organisms**
    - Break up into groups of four or five. Give each group a sheet of flipchart paper and markers. Have groups replicate the whiteboard diagram on their paper, then draw and label ecological connections between the species. These connections can be real or hypothetical.
    - Discuss as a class, and add their ideas to the whiteboard.

3. **Discuss the role of salmon in the Pacific Coastal Temperate Rainforest**
    - Reveal and introduce the salmon specimens. Give background information on the salmon life cycle (see pages 69 to 72 of this manual).
    - Add "Pacific salmon" to your whiteboard chart.
    - Discuss how salmon affect the temperate rainforest. What new connections are formed? If you increase or decrease the amount of salmon in the ecosystem, what happens to other species? After this step, your web should look something like the one shown below.



    - Broaden the discussion. How do salmon affect other species in the ecosystem, and not just the ones listed on the whiteboard?
    - During this activity, we recommend showing the "How This Forest Runs on Salmon Sex and Death" or "Bears Catching Salmon – Harder Than It Looks" videos (see page 91 of this manual).

4. **Optional: Discuss nutrient cycling to reinforce the importance of salmon in the Pacific Coastal Temperate Rainforest**
    - What is a limiting nutrient?
    - Why is nitrogen important?
    - What is different about the nitrogen in salmon? How do scientists use these differences to figure out how important salmon are to the forest ecosystem?
    - See pages 67 to 72 for more information.

5. **Optional: Designing your own experiment**
    - See if you have access to peer-reviewed journals through your library or online sources.
        - Explore https://kids.frontiersin.org/articles for youth-reviewed primary literature.
    - Describe how experimenters tested the effect of salmon on the temperate rainforest (see appendix 2).
        - What was the experimenters' hypothesis?
        - What type of experiment did the experimenters run (observational, experimental)?
        - What variables did they measure?
        - What did they find?
    - Design an experiment to test one of the connections hypothesized by your group.
        - What type of experiment would you run (observational, experimental)?
        - What variables would you measure?
        - What external variables might affect your results? How might you account for these variables in your design?

Debrief

- Today, did you learn about any new and surprising ways that living and non-living things can affect each other?
- Discuss the concept of interconnectedness. What happens when one part of the ecosystem – whether living or non-living – changes? What changes are happening to the Pacific coastal temperate rainforest today? Some possibilities:
    - Human activity has reduced the number of salmon reaching some parts of the Pacific coastal temperate rainforest by 97% (Gresh *et al*. 2000). What other organisms might this affect? How?
    - Adding too much fertilizer to crops increases the amount of nitrogen available to organisms downstream. What organisms are affected the most? How might this be bad for ecosystems?
    - Cutting down trees in the temperate rainforest leads to soil erosion, and decreases the amount of shade, moisture, and old growth habitat. It also causes fewer logs floating in rivers to protect young salmon.
- What are some ways you reduce the impact of human activity on the temperate rainforest ecosystem?

Resources

Gresh, T., Lichatowich, J., and Schoonmaker, P. 2000. An estimation of historic and current levels of salmon production in the Northeast Pacific ecosystem: Evidence of a nutrient deficit in the freshwater systems of the Pacific Northwest. Fisheries 25(1):15-21.

Additional Resources

First Nations and Traditional Knowledge

The Pacific Northwest temperate rainforest covers a large geographic range that encompasses the traditional territories of many groups of people. British Columbia itself is home to 203 First Nations communities that have lived along the Pacific coast for thousands of years. During this time, these groups have learned much about biodiversity and its conservation from observing the natural world around them. Although these groups speak different languages and have distinct beliefs and customs, there are some general themes they share in the way they view and understand biodiversity. Common ideas include:

- Interrelatedness of all things, both living and non-living
- Recognition of the dependence of people on the environment
- Respectful & responsible use of natural resources (Brown and Brown 2009)

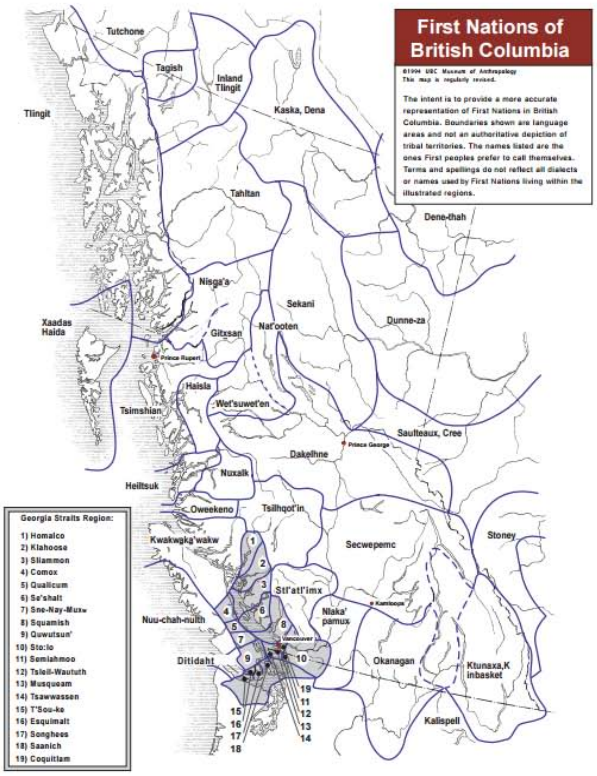


Figure 7: Map of BC First Nations territories. Image: produced by AANDC

There are several key species that are important natural resources for many people in the Pacific Northwest temperate rainforest area, serving their physical, social and spiritual needs. Below are some of the many traditional and current uses of several of the species included in this Beaty Box.

Pacific salmon

Pacific salmon have always been an important food source to coastal First Nations. The first salmon of the season is often marked by ceremony and celebration (see resource entitled “First-Salmon Ceremony”). Springtime harvest is a group effort, with some individuals catching the salmon, and others smoking and drying it for long-term storage. No edible fish parts are wasted: the eyes, head, eggs, and edible organs are all used. In fact, fish heads are considered a delicacy by the Gitxsan, who view them as a source of strength (FNHA).

Coastal First Nations people may have gotten up to 90% of their protein from marine sources such as salmon in the past (Chisholm *et al*. 1983). Today, coastal First Nations still rely heavily on salmon. For instance, surveys in several Sencoten communities found that an average person consumed 10 kilograms of salmon per year, and nearly half of respondents said that they fished and gathered seafood regularly (Mos *et al.* 2004).

Salal

Salal berries are another staple food source, valued for their juicy, sweet flavor. They can be eaten fresh or mixed in with other foods as a sweetener. Especially when served with seal or fish oil, the berries are nutritious and tasty (Pojar 2004). In the winter when fresh food was scarce, dried foods such as salal berries made up a large part of traditional coastal First Nations diets.

Western redcedar

The western redcedar has always been central to coastal First Nations communities, and it is currently considered by the Musqueam Nation to be the most useful of all plant species (Musqueam Band Council 1984). Traditionally, it was widely respected for its healing properties and spiritual significance, which is probably why it has been called the "Tree of Life" (Pojar 2004). Its wood was used to make houses, canoes, totem poles, and paddles, and its bark and branches could be woven into clothing, blankets, and baskets (Pojar 2004).

Resources
There is a great deal to learn about First Nations and traditional knowledge. Below are some resources to help you get started.

Books

Brown, F. and Brown, K.Y. Staying the Course, Staying Alive – Coastal First Nations Fundamental Truths: Biodiversity, Stewardship and Sustainability. Biodiversity BC, 2009.

Kuhnlein, H.V. and Nancy J. Turner. Traditional Plant Foods of Canadian Indigenous Peoples: Nutrition, Botany and Use. Gordon and Breach Publishers, 1991. Available online at <http://www.fao.org/wairdocs/other/ai215e/ai215e00.htm>.

Pojar, J. and Andy MacKinnon. Plants of Coastal British Columbia. Lone Pine Publishing, 2004.

Rival, L., ed. The Social Life of Trees: Anthropological Perspectives on Tree Symbolism. Berg Publishers, 1998.

Snively, G., & Williams, Wanosts'a7 L. (Eds.). (2016). Knowing Home: Braiding Indigenous Science with Western Science. Victoria, BC: University of Victoria is used under a CC-BY-NC-SA 4.0 International License, except where otherwise noted. Available online at <https://pressbooks.bccampus.ca/knowinghome/>

Stepp, J.R., Wyndham, F.S. and Zarger, R.K., eds. Ethnobiology and Biocultural Diversity. University of Georgia Press, 2002.

Turner, N.J. Food Plants of Coastal First Peoples. UBC Press, 1995.

Turner, N.J. Plant Technologies of First Peoples in British Columbia. Royal BC Museum, 1998.

Online

Aboriginal Education in British Columbia | BC Ministry of Education
http://www2.gov.bc.ca/gov/content/education-training/ways-to-learn/aboriginal-education

Bark Harvest | SFU Digitized Collections
http://bit.ly/2p498pk

Cedar | Indigenous Foundations
http://indigenousfoundations.adm.arts.ubc.ca/cedar/

First Nations Traditional Foods Fact Sheets | First Nations Health Authority (FNHA)
http://www.fnha.ca/wellnessContent/Wellness/Traditional_Food_Facts_Sheets.pdf

First-Salmon Ceremony | The Northwest Power and Conservation Council
https://www.nwcouncil.org/history/FirstSalmonCeremony

Legends and Symbology | First Nations Museum
https://shop.slcc.ca/legends-symbology/

Musqueam: A Living Culture | Musqueam Indian Band
http://www.musqueam.bc.ca/educational-materials

Musqueam Comprehensive Land Claim | Musqueam Band Council
http://www.musqueam.bc.ca/sites/default/files/miba_170_03_musqcompclaim_sm_0.pdf

Thuja plicata | The Gymnosperm Database
http://www.conifers.org/cu/Thuja_plicata.php

Uses of Cedar Bark | A Journey into Time Immemorial
http://www.sfu.museum/time/en/panoramas/beach/uses-of-cedar-bark/

Articles

Chisholm, B.S., Nelson, D.E. and Schwarcz, H.P. 1983. Marine and terrestrial protein in prehistoric diets on the British Columbia coast. Current Anthropology 24(3): 396-398.

Mos, L., Jack, J., Cullon, D., Montour, L., Alleyne, C., and Ross, P.S. 2004. The importance of marine foods to a near-urban First Nation community in coastal British Columbia, Canada: toward a risk-benefit assessment. Journal of Toxicology and Environmental Health, Part A 67: 791-808.

Beaty Museum Worksheets and Activities

A number of supplementary resources can be found on the BBM website and on other websites to help add to your Beaty Box experience. These museum-developed activities, which include worksheets and nature guides, are a great resource for bringing the museum experience into your classroom.

For use in the classroom without a museum visit:

The Five Senses Package: What's for Dinner? (Grades K-2) | Beaty Biodiversity Museum
http://beatymuseum.sites.olt.ubc.ca/files/2016/01/BBMFiveSensesPackage.pdf

Adaptation Creation (Grades 4-6) | Beaty Biodiversity Museum
http://beatymuseum.sites.olt.ubc.ca/files/2016/01/BBMAdaptationCreation.pdf

Build an Ecosystem (Grades 4-7) | Beaty Biodiversity Museum
http://beatymuseum.sites.olt.ubc.ca/files/2016/01/BBMBuildanEcosystem.pdf

Nature Table (all ages) | Beaty Biodiversity Museum
http://beatymuseum.sites.olt.ubc.ca/files/2016/01/BBMNatureTable.pdf

The Salmon Forest (Grades K-3) | Fraser River Discovery Center
https://frdc.mymti.ca/sites/default/files/MRMH-ResourceKit.pdf

For use in the classroom with a museum visit:

Forest Biodiversity (Grades 4-12) | Beaty Biodiversity Museum
http://beatymuseum.sites.olt.ubc.ca/files/2016/01/BBMForestBiodiversity.pdf

Eat or be Eaten (Grades K-7) | Beaty Biodiversity Museum
http://beatymuseum.sites.olt.ubc.ca/files/2016/01/BBMEatorbeEaten.pdf

Symbiotic Concentration Game (Grades K-7) | Beaty Biodiversity Museum
http://beatymuseum.sites.olt.ubc.ca/files/2016/01/BBMSymbioticConcentrationGame.pdf

Videos

Bears Catching Salmon: Harder Than It Looks (Episode 12) | National Geographic WILD
Note: some images show fish carcasses, blood
youtube.com/watch?v=1HPz5lCkbfw

Crittercam POV: Brown Bear Catches Salmon
video.nationalgeographic.com/video/crittercam/crittercam-brown-bear-eating

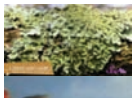
The Douglas' Squirrel...Vocalisation & Territorial Behaviour | Stephen Bolwell
youtube.com/watch?v=X4oAcXWbFD0

What Happens When You Put a Hummingbird in a Wind Tunnel? | Deep Look
youtube.com/watch?v=JyqY64ovjfY

Porcupine eating sword fern in the Oregon Coast Range | Braden Elliott
youtube.com/watch?v=WBtQZojOYvI

The Real Reason Leaves Change Color In the Fall | MinuteEarth
youtube.com/watch?v=JWva5AaDkXw

Life Cycle of Salmon (Discovery Channel) | NatureChannel7
youtube.com/watch?v=5DqjsWsY8-g



Lichen: Two Living Things In One | SciShow Kids
youtube.com/watch?v=4_cgm6kh0ns

Evolution in Action: Salamanders | PBS
pbs.org/wgbh/nova/evolution/evolution-action-salamanders.html

D. Suzuki_ Salmon and the forest | Steven Holzberg
youtube.com/watch?v=UOtkekP-sxk

How This Forest Runs on Salmon Sex and Death (Episode 11) | Nat Geo WILD youtube.com/watch?v=23tiek1rlV

Photos: Repacking Your Beaty Box

When repacking the Beaty Box, please ensure that all boxes and trays are placed in their appropriate locations. Use the specimen images at the bottoms of the trays, as well as the names on the sides, as a guide. You will notice that some specimen boxes have coloured dots on their sides. Please match these to the corresponding dots on the sides of the tray.

Please follow the instructions below to ensure the safety of specimens. To help you see how this works, please watch the Forest Beaty Box video: https://youtu.be/Wyln7gG1jxA

Tray 3

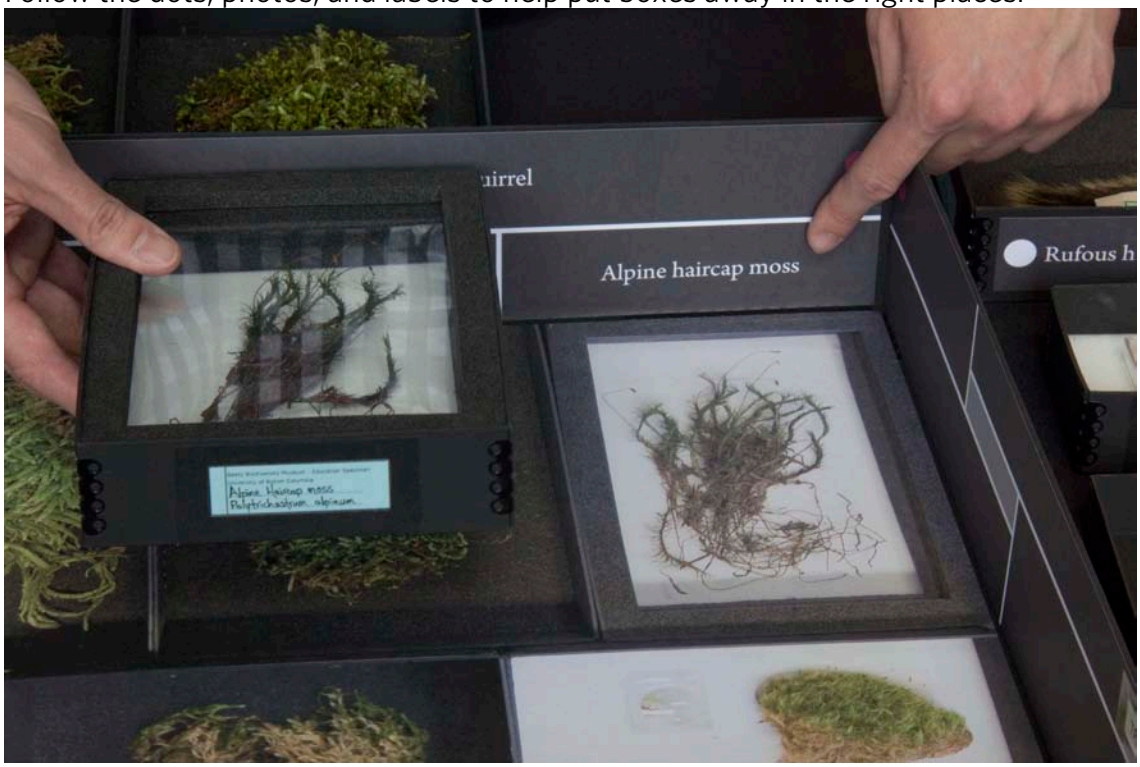
1. Replace the heaviest specimens (fossilized wood, red-belted conk, female deer skull) into the tray first, supporting their weight by the bottoms of the boxes.

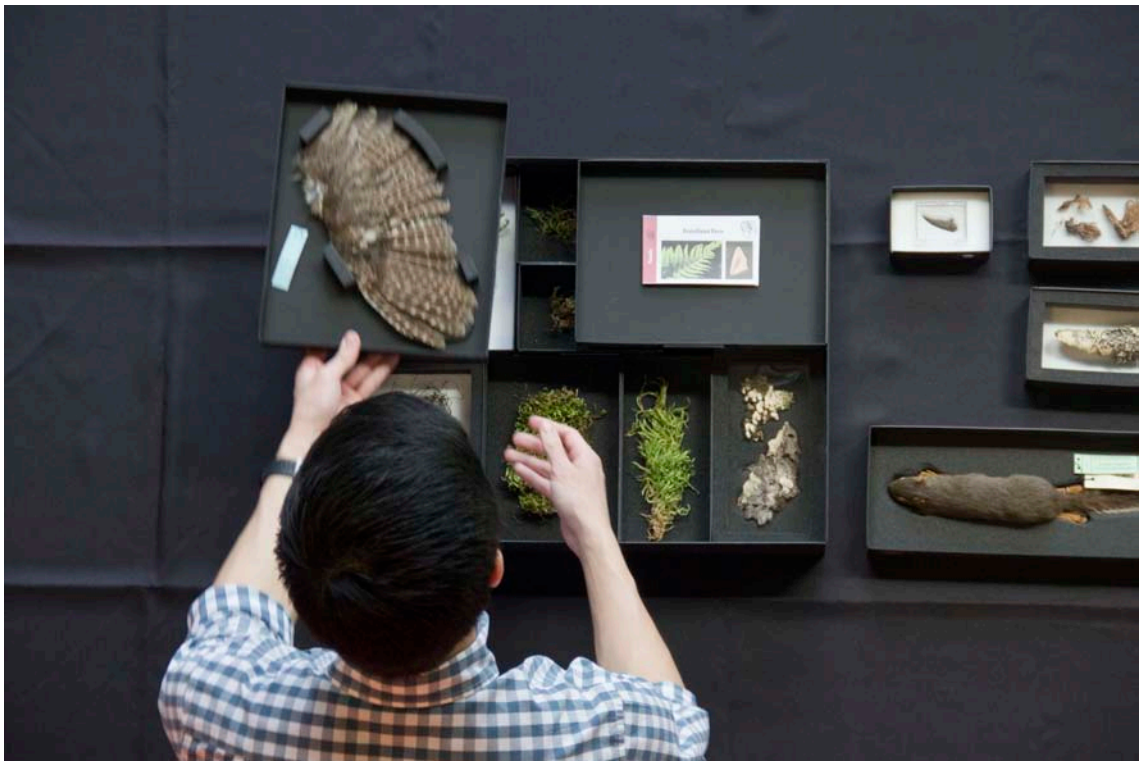
2. Replace the tray containing the mussels and leaf fossil, and then the tray containing cones and woodlice.

3. Replace the bear fur.

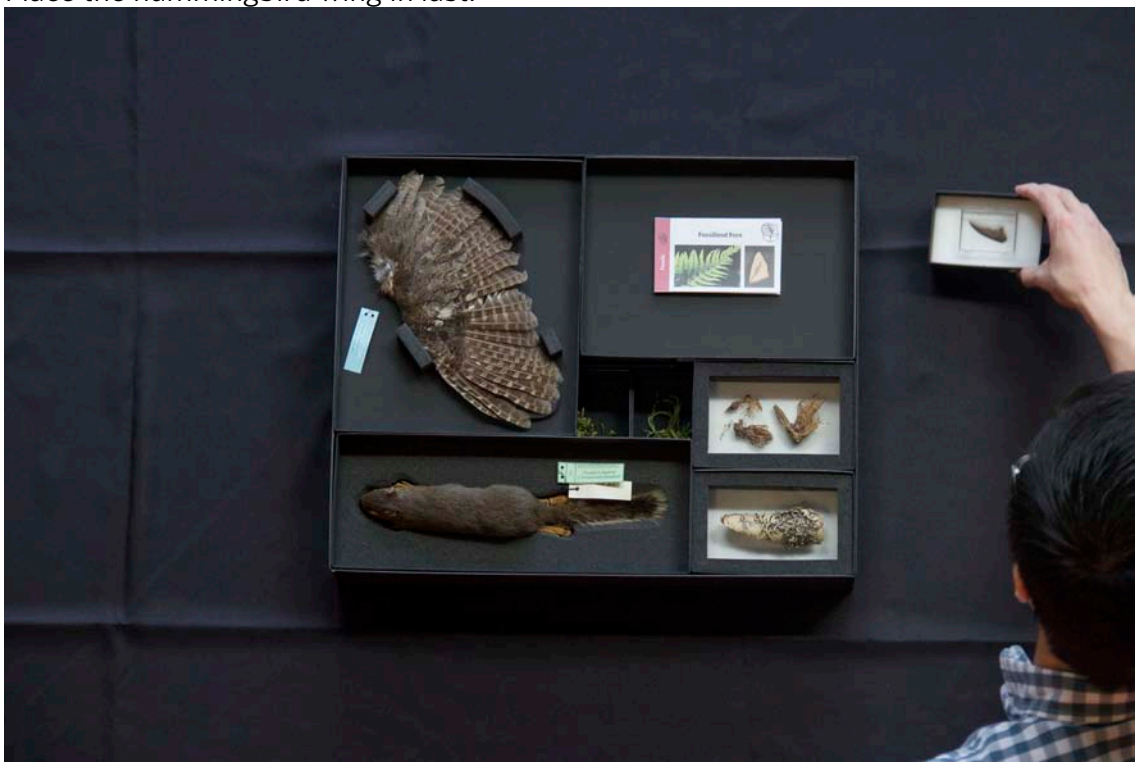
Tray 2

1. Replace all specimens, saving the hummingbird for last.
   Follow the dots, photos, and labels to help put boxes away in the right places.





2. Place the hummingbird wing in last.



3. Return the full tray to the Beaty Box.

Tray 1

1. Place the empty tray 1 into the box.

2. Return the herbarium sheets to the tray in two or three stacks.
   The order of these sheets does not matter.

3. Replace the smaller boxed specimens (salamander, salmon). If they do not seem to fit well, do not force it. Ensure that the herbarium sheets from step 1 are pushed all the way against the side of the box, and try again.

4. Replace the male deer skull last.

5. Place the manual on top of the plant specimens. Close up the box. Make sure that you do not have to force the lid closed.

Forest Beaty Box (005) Inventory

Please make sure all of the specimens are properly put away inside the Beaty Box. See the "Returning the Beaty Box Checklist" page in Beaty Box Basics for more information on sending the Beaty Box back to the museum.

Educator's Manual	Clear folder & USB Stick
Flash cards	40

Tray 1

Check	Item	Notes	Catalogue Number
	black-tailed deer, male	1 skull and jaw	T(m)20-59
	horsehair lichen	1 lichen, on foam	H(l)00-47
	salmon	1 jaw, in mount	F(b)20-56b
	coho salmon	1 fry, in vial	F(b)10-36c
	Ensatina	1 whole specimen, in vial	T(a)10-08
	vine maple	Herbarium sheet (1 branch, 12 seeds)	H(v)50-391
	western hemlock	Herbarium sheet (1 branch, 2 pcs bark, bag of needles)	H(v)50-388
	Douglas-fir	Herbarium sheet (1 branch, 1 pc bark)	H(v)50-389
	western redcedar	Herbarium sheet (1 branch, 2 pcs bark)	H(v)50-395
	salal	Herbarium sheet (1 branch)	H(v)50-394
	western swordfern	Herbarium sheet (2 fronds)	H(v)50-396
	deer fern	Herbarium sheet (3 fronds)	H(v)50-392
	red alder	Herbarium sheet (1 large branch, 4 smaller branches, 1 pc bark)	H(v)50-390
	bigleaf maple	Herbarium sheet (2 leaves, 9 seeds)	H(v)50-393

Inventory list continued on next page →

Tray 2

Check	Item	Notes	Catalogue Number
	flash cards (40)	40 flash cards, 1 title card	N/A
	western screech-owl	1 wing on foam	T(b)30-287
	rufous hummingbird	1 wing in plastic box on foam	T(b)30-308
	Douglas' squirrel	1 complete specimen, in mount	T(m)20-78
	seaside tube lichen	In display case	H(l)00-49
	coral fungi	In display case	H(fu)50-25
	step moss	1 moss, on foam	H(b)50-388
	hanging moss	1 moss, on foam	H(b)50-389
	cat-tail moss	1 moss, on foam	H(b)50-391
	curly herons' bill and broom fork moss	2 mosses, 2 magnifying boxes, in mount	H(b)50-396 H(b)50-395
	purplepore bracket	2 pieces, on foam	H(fu)50-25
	Douglas' neckera moss	1 moss, on foam	H(b)50-394
	lesser featherwort	1 moss, on foam	H(b)50-392
	alpine haircap moss	In display case	H(b)50-390

Tray 3

Check	Item	Notes	Catalogue Number
	American black bear	1 fur, on foam	T(m)40-81
	black-tailed deer, female	1 skull and jaw	T(m)20-56
	red-belted conk	2 pieces, in mount	H(fu)50-28
	western redcedar cones (9); western hemlock cones (5); woodlice in magnifying cases (4)	In mount	H(v)50-249b H(v)50-257b I(o)00-126
	Nuttall's cockle (1); butter clam (1); fossilized leaf (1); foolish mussel (3 valves)	In mount	MI(m)60-242 MI(m)60-241 FO 50-42 MI(m)60-94e
	fossilized wood	In mount	FO 50-41
	Douglas-fir	2 cones, 2 seeds, in mount	H(v)50-393

Appendix 1

Beaty Box Dimensions
Length: 33 cm (24")
Width: 50 cm (19.5")
Height: 61 cm (13")
Weight: 10.4 kg (23 lb)

Appendix 2

Studying the salmon-forest interaction

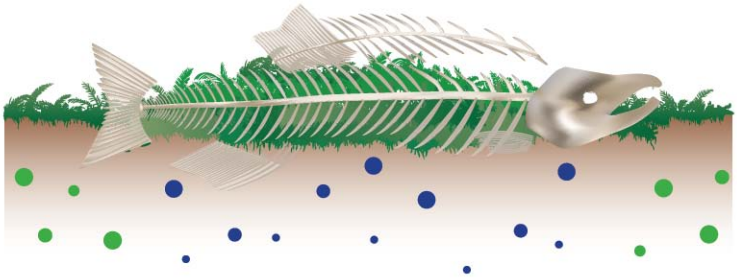


Figure 8: Salmon have more nitrogen-15 (blue dots) than the soil (nitrogen-14: green dots). When salmon bodies decompose, the nutrients move into the soil. Illustration by Derek Tan.

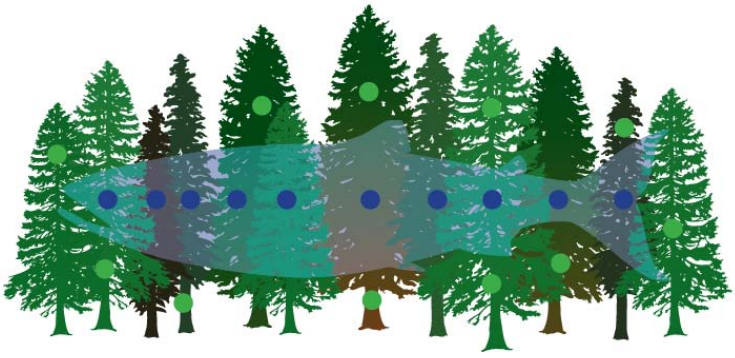


Figure 9: The nutrients from the ocean help the forest grow. Illustration by Derek Tan.

Atoms are made out of neutrons, protons, and electrons. The number of protons in an atom tells you which element it is (e.g. 7 protons is nitrogen), but atoms of the same element can have different numbers of neutrons. The most common form of nitrogen in nature is nitrogen-14, which has 7 neutrons. Nitrogen-15 is a different form that has 8 neutrons.

The amount of nitrogen-15 in an organism can tell you how high in the food chain it is. At each step in a food chain, consumers end up with more nitrogen-15 than what they eat (see resource entitled "The marine nitrogen cycle" for overview). Food chains are often longer in marine ecosystems than land-based ecosystems. As a result, animals that live in the ocean have more nitrogen-15 than those that live on land.

Salmon spend much of their lives in marine habitats. If they end up in the temperate rainforest and decompose, adding nitrogen to the soil, the plants that use this salmon-based nitrogen have higher nitrogen-15 than plants that do not use it. Scientists can measure how much nitrogen-15 is in plants and use this to figure out which ones rely the most on salmon as a nitrogen source. Using this method, scientists have found that plants with access to salmon-based nitrogen can grow up to three times faster than those without (Helfield and Naiman 2001). This increased growth from nitrogen enrichment is greatest close to streambanks and where fish-eating predators live (Ben-David *et al*.1998).

References:

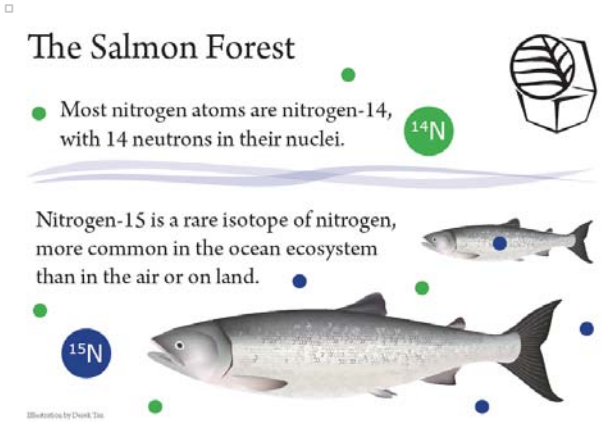
The marine nitrogen cycle | Words in mOcean
https://wordsinmocean.com/2012/02/21/the-marine-nitrogen-cycle/

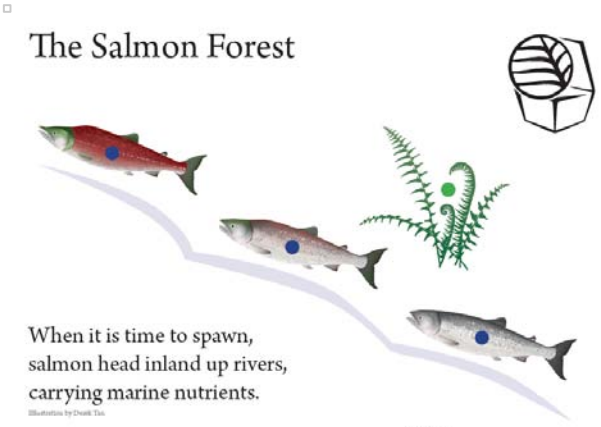
Ben-David, M., Hanley, T.A. and Schnell, D.M. 1998. Fertilization of terrestrial vegetation by spawning Pacific salmon: the role of flooding and predator activity. Oikos 83(1): 47-55.

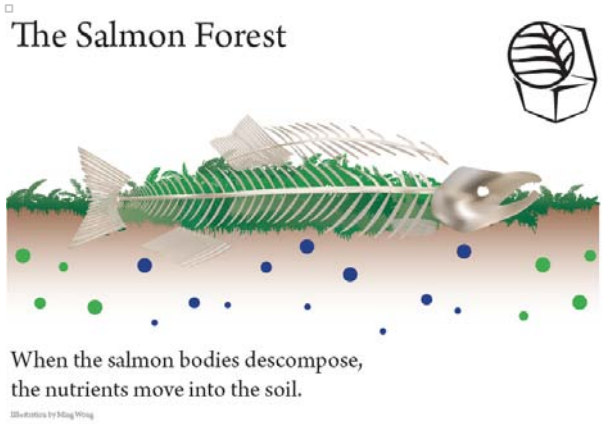
Helfield, J.M. and Naiman, R.J. 2001. Effects of salmon-derived nitrogen on riparian forest growth and implications for stream productivity. Ecology 82(9):2403-2409.

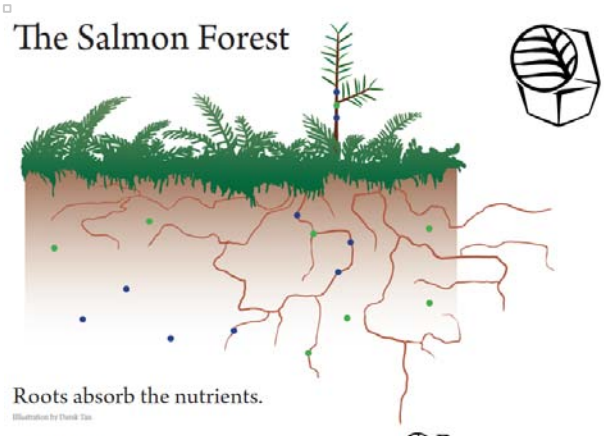
USB Contents

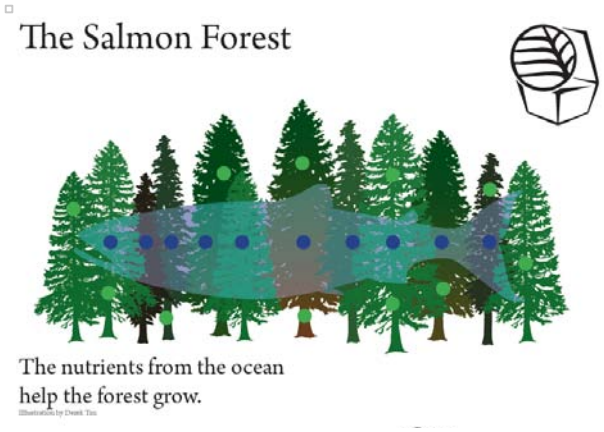
Included with the Beaty Box is a USB containing high-resolution copies of most of the images from this manual, suggested resources, in addition to some extra images, screenshots of which can be found below.











Salmon forest sequence illustrations by Derek Tan

Image: Flickr user Sam Beebe, used under a creative commons license

Image: Flickr user Ruth Hartnup, used under a creative commons license

Image: Flickr user pfly, used under a creative commons license

Image: Flickr user Bureau of Land Management Oregon and Washington, used under a creative commons license

Image: Flickr user Ruth Hartnup, used under a creative commons license

Image: Flickr user Sam Beebe, used under a creative commons license

Image: Flickr user Bryan Wilkins, used under a creative commons license

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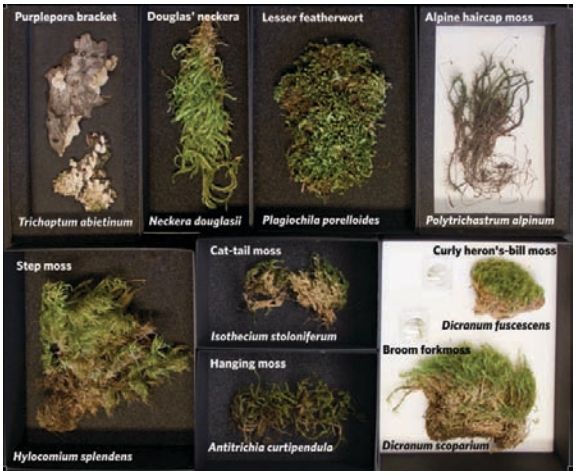

Image: Series of harder to identify species in the Forest Beaty Box, 1 of 2.

Image: Series of harder to identify species in the Forest Beaty Box, 2 of 2.