Table of Contents (Seashore Beaty Box #007)

Seashore Beaty Box 007

Adaptations lesson plan and specimen information

Welcome to the Seashore Beaty Box (007)!

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 to stimulate inquiry and discussion within the classroom, enhancing the student learning experience.

Theme

The theme for this Beaty Box is **British Columbia's seashore** with a focus on **adaptations**. Under this theme, students can learn more about:

- Interaction between organisms and their seashore environment
- The factors that lead to the banding patterns on the seashore
- Evolution and the diverse adaptations of organisms

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

How can I integrate the Beaty Box into my curriculum?

- We encourage you to adapt the contents of the Beaty Box and its lesson plan to best fit your curriculum.
- Before you begin 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.
- It is highly encouraged that you convey material about these organisms (such as their habitat, behaviours, characteristics) to your group before or during the adaptation activity.
- Use the online resources that are referenced throughout the manual to help compliment 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 add to their biodiversity experience.

Curriculum Links to the Adaptations Lesson Plan

The seashore is a fascinating habitat familiar to many students. Connecting a familiar environment to the concept of evolution allows us to apply scientific thought in everyday life. Through a close examination of specimens, the biodiversity of the seashore is highlighted, and evolution allows us to explain the distribution of organisms and the ways in which they are well-suited for their environment. In this section, we have included a suggested "Adaptations" lesson plan for you and your group. This lesson plan was designed with a classroom composed of individuals with varying abilities in mind. There are multiple levels within each lesson to suit the needs of a diverse group of learners. Please feel free to modify these activities to best suit your needs.

Some of the "big ideas" and core concepts included in this Beaty Box are:

Science Curriculum (K-9)

- *Kindergarten*: Plants and animals have observable features; daily and seasonal changes affect living things
- *Grade 1:* Living things have features and behaviors 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; 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; the motions of Earth and the moon cause observable patterns that affect living and non-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
- *Chemistry 11*: Organic chemistry and its applications have significant implications for human health, society, and the environment; chemical reactions and their applications have significant implications for the environment
- *Life sciences 11*: All living things have common characteristics; living things evolve over time; organisms are grouped on the basis of identifiable similarities
- *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
- *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

Source: BC Curriculum Drafts

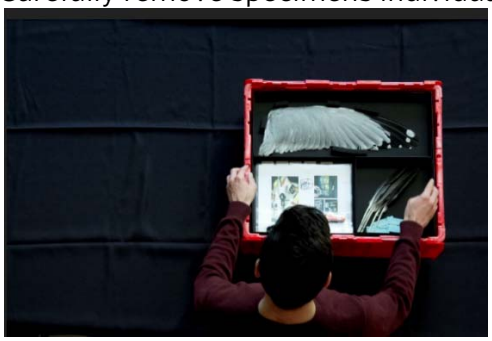
Photos: Unpacking Your Beaty Box

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: http://bit.ly/BeatyBoxPacking

Tray 1:

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.

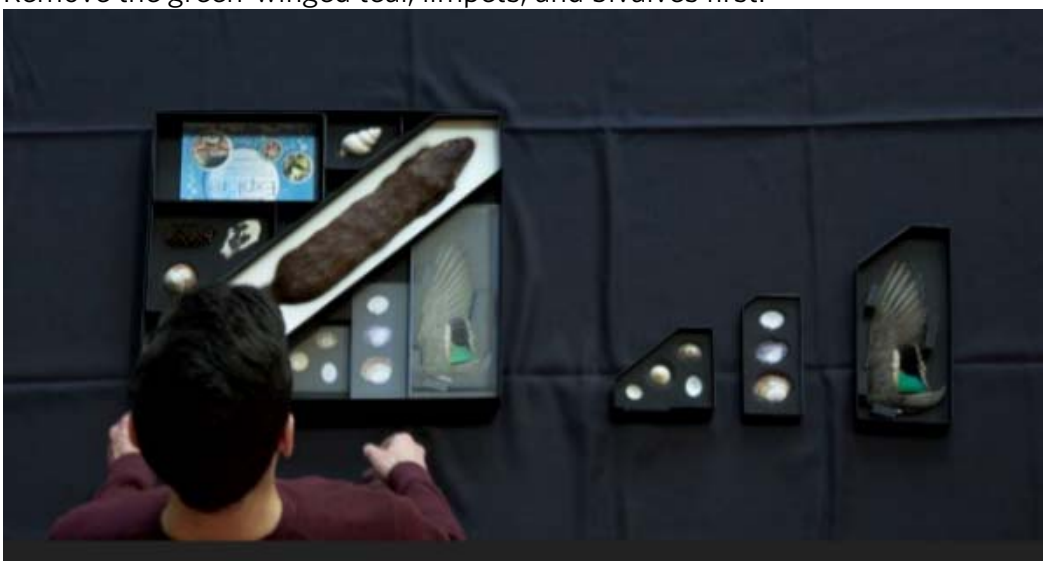
2. Carefully remove specimens individually.



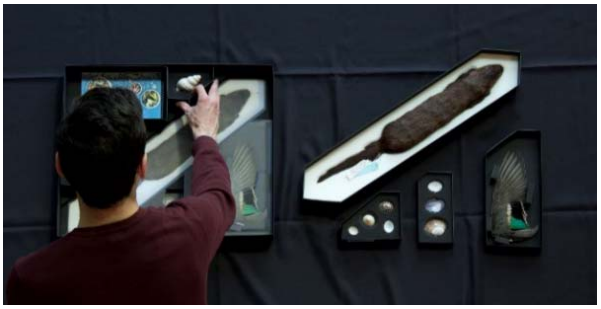
Tray 2:

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 the green-winged teal, limpets, and bivalves first.



3. Take out the American mink specimen, followed by the remaining specimens in the tray.



4. Set the empty tray aside

Tray 3:

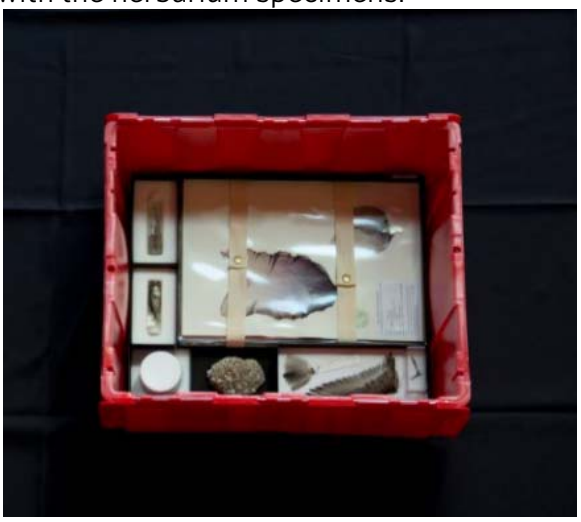
1. Lift entire tray out of Beaty Box, including the specimens. Use both hands and lift by the edge of the tray. Set it on the table.

2. Carefully remove specimens individually.

3. Set the empty tray aside

Tray 4:

1. This tray is very heavy and there is no need to remove it from the box. Should you choose to remove the tray, all of the specimens must be taken out first, starting with the herbarium specimens.



2. After the herbarium specimens have been removed, carefully remove the remaining specimens.

3. The empty tray can now be removed and set aside.

Special Handling Instructions

Jarred Specimens

The Seashore Beaty Box showcases a variety of fish species and contains a significant number of jarred specimens. In the case of a broken jar, spill, or slow leak of a jarred specimen, special care must be taken to insure the safety of your group as well as the safe return of the specimens. Similar to many household products, the alcohol solutions found in jarred specimens are not safe to drink, can cause eye irritation and the possibility of mild skin irritation if touched. See the appendix for Material Safety Data Sheets (MSDS) on alcohol.

To clean up a spill:

1. Clear the area immediately and ensure that students are not stepping on broken glass.
2. Find another jar or closed container to place the specimen in. Regardless of the condition of the specimen, it is important to return it and all its pieces with the Beaty Box. Wear gloves or use a paper towel to protect your hand, then place the labels, specimen, and any liquid you can salvage into the container. Keep the container with the salvaged specimen away from public space and return it inside the Beaty Box. A plastic screw-top jar works well. A zip-top bag can work, too.
3. Pick up any large pieces of broken glass carefully and dispose of them as glass waste.
4. Use paper towels to mop up some of the alcohol and dispose of them in the regular garbage outside of public space (the odour will be very strong).
5. Mop up the area and rinse thoroughly with water to remove any remaining residue.
6. It's important for us to know how the specimen was broken in order to improve the safety standards of future Beaty Boxes. Please fill out the Condition Report form (found at the end of this manual).

If, for any reason you notice any dampness in the Beaty Box, do let us know!
A slow leak can be detrimental to the specimens in the box.

Winged Specimens

The wings and feathers are the only specimens that may be removed from its black box. The following instructions depict western screech-owl wing handling however, wings found in the Seashore box are to be handled in the same way.

Please see the following instructions for handling the wings:

1. Remove the box containing the winged specimen 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.

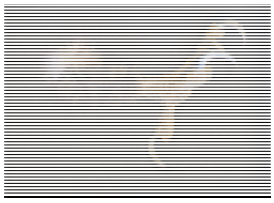
3. Handle the wing. You may choose to stroke feathers in the direction of growth, or even 'flap' the wing to hear how quiet it is. At all times, be gentle and support the wing by the bony part. If the wing is to be moved away from its box, keep it close to a table surface when possible, to reduce the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

4. Place wing gently back into black box.

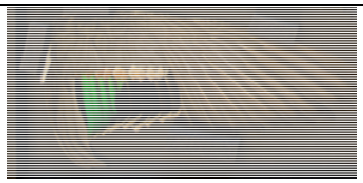
What's in the Beaty Box?

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

Tetrapods	**Specimen**	American mink, *Neovison vison* T(m)40-89
	Image	  Photo: Flickr user tsaiproject used under a creative commons license.
	Habitat	*Native*; native range includes Canada and the U.S. Introduced to many places around the world for fur farming purposes and has become very invasive in certain locations such as in Eastern Europe. Semi-aquatic, can be found near bodies of water, including coastal regions with cover and rockpools.
	Diet	*Carnivore;* fish, small mammals, invertebrates such as crabs and other crustaceans, and birds.
	Predators	Otters, coyotes, birds of prey, and bobcats.
	Description	Up to 68.7cm in body length in BC, American minks are brown coloured with white markings on the ventral (belly side) including chin, throat, chest and groin areas; short ears and short limbs.
	Adaptations	Partially webbed toes and short limbs allow the American mink to easily frequent both aquatic and terrestrial ecosystems. Its wide-ranging diet allows it to adapt to many habitats, which contributes to the invasiveness of introduced American minks.
	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.
	Resources	***Neovison vison* American mink**| Animal Diversity Web http://animaldiversity.org/accounts/Neovison_vison/ ***Neovison vison* (American mink)**| Invasive Species Compendium https://www.cabi.org/isc/datasheet/74428

Tetrapods	**Specimen**	Bald eagle, *Haliaeetus leucocephalus* T(b)30-360
	Image	  Photo: Flickr user Andy Morffew used under a creative commons license
	Habitat	*Native*; commonly nest from Alaska to Labrador, and migrate as far south as Mexico.
	Diet	*Carnivore;* feed on fish in the surface of the water, carrion, especially salmon carcasses in the fall, and can easily kill and consume water birds.
	Predators	Although there are no known natural predators of the bald eagle, animals such as raccoons and ravens are known to eat their eggs.
	Description	Mature bald eagles are dark brown with a white head and tail; juveniles are generally dark and extremely variable. This species can be 84cm in length, with a wingspan of 208cm. A large hooked beak and sharp claws allow this species to hunt a variety of prey. They live up to 28 years.
	Adaptations	Bald Eagles are built to hunt. Noticeably large talons with claws help them grab prey such as fish with force. A sharp beak allows them to tear into flesh, like carrion, with force, speed and accuracy. They can carry twice their body weight.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box. Touch gently with one or two fingers.
	Resources	**Bald Eagle** | National Geographic https://www.nationalgeographic.com/animals/birds/b/bald-eagle/ Cannings, R., Aversa, T., Opperman, H. (2005). *Birds of Southwestern British Columbia.* Toronto, ON: Heritage House Publishing Company Ltd. **Dangers Facing Bald Eagles**| American Eagle Foundation https://www.eagles.org/what-we-do/educate/learn-about-eagles/bald-eagles-current-dangers/#toggle-id-7 Robbins, C. S., Bruun. B., Zim, H. S. (2001). Birds of North America*: A guide to field identification revised and updated*. New York, NY: St. Martin's Press. Snively, G. (1978). *Exploring the Seashore in British Columbia, Washington and Oregon: A guide to shorebirds and intertidal plants and animals.* Vancouver, BC: Gordon Soules Book Publishers.

Tetrapods	**Specimen**	Baird's sandpiper, *Calidris baidii* T(b)30-361
	Image	  Photo: Flickr user Dominic Sherony used under a creative commons license
	Habitat	*Native;* found from the high Canadian Arctic to northern South America. Although this is a shorebird species, it migrates to high altitudes. Often found in relatively barren or short grasslands habitat living in the Arctic tundra, Patagonia and at high altitudes in the Andes.
	Diet	*Carnivore;* eats invertebrates, especially arthropods such as crustaceans and insects.
	Predators	Arctic foxes and snowy owls prey on this species while nesting, while raptors such as falcons eat them along the BC coast.
	Description	14cm to 18cm in length, the Baird's sandpiper has a wingspan of up to 38 cm. Recognizable due to its long legs, and the "scaly" appearance of its beige/brown back.
	Adaptations	Baird's sandpipers are wading birds. Their legs are the perfect length for walking through shallow water or soft substrate to search for food. Scaly appearance and colouring allows this bird to blend in with its surroundings and avoid predation.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box. Touch gently with one or two fingers in the direction of feather growth.
	Resources	**Baird's Sandpiper *Calidris bairdii*** | Cornell- Neotropical Birds https://neotropical.birds.cornell.edu/Species-Account/nb/species/baisan/overview **Baird's Sandpiper *Calidris bairdii*** | National Adubon Society http://www.audubon.org/field-guide/bird/bairds-sandpiper **Baird's Sandpiper** | Cornell Lab of Ornitology https://www.allaboutbirds.org/guide/Bairds_Sandpiper/lifehistory **Baird's Sandpiper *Calidris bairdii*** | Birds of North America https://birdsna.org/Species-Account/bna/species/baisan/behavior

Tetrapods	**Specimen**	Green-winged teal, *Anas crecca* T(b)30-367
	Image	  Photo: Flickr user Frans Vandewalle used under a creative commons license.
	Habitat	*Native*; found in shallow bodies of water, flooding fields, coastal wetlands, coastal marshes and estuaries from north Alaska, south to California, east to Quebec. Winter to central America and west Indies.
	Diet	*Omnivore;* forage for seeds, vegetation, and invertebrates.
	Predators	Humans, skunks, and raccoons. Red foxes prey upon young and eggs.
	Description	30cm to 40cm in length, the green-winged teal is very small compared to other North American duck species. Short, blocky-bodied with a large head, short neck, relatively small bill, and possess a green wing patch. The female is dark brown with a yellowish streak along the tail. Males have a brown head, green ear patch, pale grey sides, pinkish breast, and a vertical strip down the side.
	Adaptations	Green-winged teals are dabbling ducks; they are built to paddle in shallow waters, and have the ability to walk on land. The legs are positioned near the centre of gravity on the belly, which facilitates these abilities.
	Safety & Handling	Touch gently with one or two fingers in the direction of feather growth. Wing may be removed from box: see Seashore Beaty Box manual, page 34.
	Resources	Bull, J., Farrand, J. (1994). *The Audubon Society Field Guide to North American Birds, Eastern Region.* Toronto, Ont.: Random House of Canada Ltd. **Green-Winged Teal; *Anas crecca*** | The Cornell Lab of Ornithology https://www.allaboutbirds.org/guide/Green-winged_Teal/lifehistory **Green-Winged Teal; *Anas crecca*** | Chesapeake Bay Program https://www.chesapeakebay.net/S=0/fieldguide/critter/green_winged_teal **Green-Winged Teal; *Anas crecca*** | Missouri Department of Conservation https://nature.mdc.mo.gov/discover-nature/field-guide/green-winged-teal Robbins, C. S., Bruun. B., Zim, H. S. (2001). Birds of North America*: A guide to field identification revised and updated.* New York, NY: St. Martin's Press.

Tetrapods	**Specimen**	Snow goose, *Chen caerulescens* T(b)40-213a- T(b)40-213e
	Image	  Photo: Flickr user Nazhiyath Vijayan, used under a creative commons license.
	Habitat	*Native*; agricultural fields, lakes, ponds, marshes. Breed in the Arctic Tundra and migrate southward, wintering relatively at the same longitude.
	Diet	*Herbivore;* grasses, aquatic plants, shrubs, grains, berries
	Predators	Include foxes, wolves, and bald eagles.
	Description	Snow geese are known for their long, thick neck and white body; up to 83cm in length, and 138cm wingspan. A colour variation called a "blue morph," where the body is grey, is common. Wing tips are dark, and dark lines on their broad pink bill give a smiling appearance.
	Adaptations	Snow geese have a sturdy bill that allows them to dig up roots in mud. Since 1973, their populations have tripled in the eastern and western Artic, creating problems in habitats where they feed.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box. Touch gently with one or two fingers.
	Resources	**Snow Goose, *Chen caerulescens*** | Cornell Lab of Ornithology https://www.allaboutbirds.org/guide/Snow_goose/lifehistory **Snow Goose, *Chen caerulescens*|** The Nature Conservancy https://www.nature.org/newsfeatures/specialfeatures/animals/birds/snow-goose.xml **Snow Goose|** National Geographic Animals https://www.nationalgeographic.com/animals/birds/s/snow-goose/

Tetrapods	**Specimen**	Ring-billed gull, *Larus delawarensis* T(b)30-365
	Image	  Photo: Flickr user John Sutton used under a creative commons license.
	Habitat	*Native;* present in urban, suburban and agricultural areas. Also found in coastal areas including estuaries, beaches, mudflats, and harbors across the USA and southern Canada.
	Diet	*Omnivore;* varies depending on habitat. Major items include grain, insects, garbage, earthworms, and fish.
	Predators	Red foxes, American minks, bald eagles, coyotes, and raccoons.
	Description	Up to 54cm in length, this species was named after the black ring on the bright yellow bill of adults. Adult ringed-billed gulls have a white head with bluish grey colouring, black wingtips with white spots and yellow legs and feet.
	Adaptations	Ring-billed gulls are excellent scavengers and food thieves which enables them to cope with food scarcity. They have adapted to urban areas by scavenging in parking lots and swarming over landfills.
	Safety & Handling	Touch gently with one or two fingers in the direction of feather growth. Wing may be removed from box: see Seashore Beaty Box manual, page 34.
	Resources	**Ring-billed Gull Life History**| The Cornell Lab of Ornithology https://www.allaboutbirds.org/guide/Ring-billed_Gull/lifehistory# **Ring-billed Gull Identification**| The Cornell Lab of Ornithology https://www.allaboutbirds.org/guide/Ring-billed_Gull/id **Ring-billed Gull*: Larus delawarensis***| National Audubon Society http://www.audubon.org/field-guide/bird/ring-billed-gull **Ring-billed Gull*: Larus delawarensis***| BioKids http://www.biokids.umich.edu/critters/Larus_delawarensis/ Robbins, C. S., Bruun. B., Zim, H. S. (2001). Birds of North America*: A guide to field identification revised and updated*. New York, NY: St. Martin's Press.

Marine Invertebrates	**Specimen**	Pacific blue mussel (Foolish Mussel), *Mytilus trossolus* MI(m)60-136b
	Image	  Photo: Sheila Byers
	Habitat	*Native*; typically form colonies in the intertidal zones of protected areas such as bays, to 180m in deep off the Pacific coast from Alaska to Mexico; known to hybridize with Mediterranean blue mussel, introduced via aquaculture. Found attached to rocky substrate.
	Diet	*Omnivore;* Filter feeders, continuously feed while submerged on floating detritus, plankton, and fragmented algae.
	Predators	Crows and gulls when exposed in the intertidal zone; when submerged, marine organisms such as sea stars, snails, crabs, diving birds, and fishes are threats.
	Description	Up to 11cm in length, the foolish mussel is shiny with smooth growth lines, oval in shape narrowing to a pointed end; most often bluish black in colour.
	Adaptations	Mostly live in areas protected from strong wave action, but anchor themselves to rocks using byssal threads. These tough, strong threads are secreted by the mussel and can also be used to immobilize predators such as snails.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Resources	**Pacific Blue Mussel (*Mytilus trossulus)*** |Slater Museum of Natural History: University of Puget Sound https://www.pugetsound.edu/academics/academic-resources/slater-museum/exhibits/marine-panel/pacific-blue-mussel/ Lamb. A., Hanby, B. P. (2005). *Marine Life of the Pacific Northwest: A Photographic Encyclopedia of Invertebrates, Seaweeds and Selected Fishes.* Harbour Publishing, Madeira Park, BC.

Marine Invertebrates	**Specimen**	Pacific oyster (Japanese oyster), *Crassostrea gigas* MI(m)60-97a
	Image	 Photo: Flickr user Bernadette Hubbart under a creative commons license.
	Habitat	*Invasive;* found attached to hard substrate in coastal and estuarine areas, this species is originally from the Pacific coast of Asia, and was introduced in the early 1900s to North America, New Zealand, Europe, and Australia for commercial harvesting purposes.
	Diet	*Omnivores;* oysters are filter feeders and eat particulate organic matter, and phytoplankton.
	Predators	Include sea stars, crabs, oyster drills, polychaete worms, flatworms, and black oystercatchers.
	Description	8cm to 40cm in length when it reaches maturity, the Pacific oyster varies in appearance based on location. Valves are not identical in size or shape, with one of the valves a deep, cupped shape. Valves usually white with purple markings, rough texture, and irregular fluted folds and edges.
	Adaptations	Pacific oysters are able to tolerate a wide range of salinity and temperature conditions, which has enhanced their ability to invade ecosystems around the world.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box
	Resources	***Crassostrea gigas:* Thunberg 1793**| E-Fauna BC: Electronic Atlas of the Wildlife of British Columbia http://linnet.geog.ubc.ca/efauna/Atlas/Atlas.aspx?sciname=Crassostrea%20gigas ***Crassostrea gigas* (Pacific oyster)**| Invasive Species Compendium https://www.cabi.org/isc/datasheet/87296 **Pacific oyster, *Crassostrea gigas***| GB Non-Native Species Secretariat http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=1013

Marine Invertebrates	**Specimen**	Bent-nosed macoma (Bent-Nosed Clam), *Macoma natsuta* MI(m)60-147
	Image	  Photo: Sheila Byers
	Habitat	*Native;* found on the Pacific coast from Alaska to California in the intertidal zone on sandy, gravelly, and muddy substrate to 50m in depth.
	Diet	*Herbivore;* uses a siphon to sift through marine sediments and consumes phytoplankton such as diatoms.
	Predators	Gulls, crows, moon snails, sea stars, and crabs.
	Description	Up to 7.5cm in length, the bent-nose macoma gets its name from the curvature of the elongated back portion of its valves. Valves are typically chalky white in colour with a thin, dark brown outer coating for protection.
	Adaptations	Buried in 10-20cm of muddy sand, the clam is a surface deposit feeder. Lying on its side, the bent-nose of the valves directs its siphons up to the sediment surface where it vacuums up food in the top millimeter of sediments. It was once an important food of the coastal First Peoples.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box
	Resources	**Bent-nose macoma*: Macoma nasuta*** | Biodiversity of the Central Coast http://www.centralcoastbiodiversity.org/bent-nose-macoma-bull-macoma-nasuta.html ***Macoma nasuta*: Bent-nose Macoma** | Encyclopedia of Life http://eol.org/pages/448732/details#comprehensive_description

Marine Invertebrates	**Specimen**	Purple Mahogany Clam (Varnish Clam), *Nuttallia obscurata* MI(m)60-146
	Image	  Photo: Sheila Byers.
	Habitat	*Non-native*; native to the Pacific coast of Asia, this species was introduced to Vancouver via ships' ballast in 1991 and can now be found intertidally in southern BC, the south coast of Vancouver island, Washington, and Oregon on cobble and muddy sediment.
	Diet	*Omnivores;* filter feeds particulate organic matter, and phytoplankton as well as use their muscular foot to collect detritus from sediments.
	Predators	Gulls and crows, moon snails, red rock crabs, and humans.
	Description	Up to 7cm in length, the purple mahogany clam is distinguished by its uniform purple colour on the inside of its valves, and a shiny brown coating on the outside (which it derives its various common names). This species is flat with an almost a perfect oval shape, and a small black ligament holding the valves together.
	Adaptation	The purple mahogany clam can both filter feed, by pumping water through its siphon to retain food particles for digestion, as well as deposit feed, by consuming food particles that have settled on the seafloor.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box
	Resources	**Aquatic Invasive Species: *Nuttalia obscurata* (Purple varnish clam,varnish clam, or dark mahogany clam)**|Washington Department of Fish and Wildlife Conservation http://wdfw.wa.gov/ais/nuttalia_obscurata/ **Feeding Strategies|** Bioreference http://www.biologyreference.com/Ep-Fl/Feeding-Strategies.html ***Nuttallia obscurata* Reeve, 1857** | E-Fauna BC: Electronic Atlas of the Wildlife of British Columbia http://linnet.geog.ubc.ca/efauna/Atlas/Atlas.aspx?sciname=Nuttallia%20obscurata

Marine Invertebrates	**Specimen**	Butter clam (Washington butter clam), *Saxidormus gigantea* MI(m)60-149
	Image	  Photo: Sheila Byers
	Habitat	*Native;* distributed within the mid to low intertidal to 40m in depth along the Pacific coast from Alaska to California. Found in sheltered locations such as bays and sandy, gravelly, or mixed-shell substrate.
	Diet	*Omnivore;* filter feed on phytoplankton, bivalve larvae, and bits of algae.
	Predators	Gulls and crows, sea stars, moon snails, Dungeness crabs, sea otters and humans.
	Description	Up to 15cm in length, the butter clam is oval to square shaped, and grey to white in colour when mature. The rings are not indicative of age, as multiple rings can be added depending on food supply. A large black, flexible ligament connecting the two valves together is characteristic of this species.
	Adaptations	The butter clam has the unusual adaptation of holding paralytic shellfish poisons, produced by some phytoplankton, in its siphons for up to two years, making them less desirable to siphon-eating predators. Dried butter clams harvested from clam gardens were a staple food for First Peoples.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box
	Resources	**Butter clam** | Encyclopedia of Life http://eol.org/pages/491722/details **Clams: Butter Clams** | Washington Department of Wildlife: Fishing and Shellfishing http://wdfw.wa.gov/fishing/shellfish/clams/butter_clams.html

Marine Invertebrates	**Specimen**	Softshell clam (Sand gaper), *Mya arenaria,* MI(m)60-179
	Image	  Photo: Sheila Byers
	Habitat	*Non-native*; sandy, muddy, or clay bottoms in the intertidal zone of bays and estuaries. Native to eastern North America (from Labrador to North Carolina), northern Alaska, and on the Pacific coast of Asia. This species is now widely found on the Pacific coast from Alaska to California since introduction with Atlantic oysters in 1869.
	Diet	*Omnivore;* filter feed on phytoplankton, bivalve larvae, and bits of algae.
	Predators	Birds such as gulls, ducks, and oystercatchers. Sea stars, crabs, cownose rays, and humans.
	Description	Up to 17cm in length, the softshell clam is oval, pointy at one end, chalky white in colour with a brown to grey protective coating. As the clam ages, this coating largely wears away except at valve edges. A distinctive character is the spoon, a shelf-like projection at the hinge of the valve that neatly fits into a depression in the right valve.
	Adaptations	The softshell clam burrows deep into sediments using its siphons to push sand out of the way. Like many clams when disturbed, this species emits a jet of water when it withdraws its siphons. Sediments can sometimes be low in oxygen, and this species is known to survive in an oxygen-free environment for up to 8 days!
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Resources	***Mya arenaria***| The Exotics Guide: Non-Native Marine Species of the North American Pacific Coast http://www.exoticsguide.org/mya_arenaria **Soft Shell Clam**| Chespeake Bay Program https://www.chesapeakebay.net/discover/field-guide/entry/soft_shell_clam

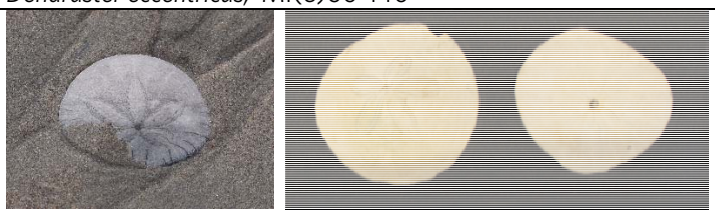
Marine Invertebrates	**Specimen**	Shield Limpet, *Lottia pelta, MI(m)60-206*
	Image	 Photo: Flickr user alisonleighlilly under a Creative Commons license.
	Habitat	*Native*; found on the Pacific coast from Alaska to California, most commonly in the mid to high intertidal zones on or under rocks, seaweeds, or in tide pools.
	Diet	*Herbivore;* uses its radula or file-like tongue to rasp various types of algae, particularly brown seaweeds.
	Predators	Sea stars such as the ochre sea star; whelks; shorebirds such as the black oystercatcher; and fishes like perch, clingfish, and sculpin.
	Description	Up to 5.4cm in diameter and 2cm in height, the appearance and colour of the shield limpet varies widely. The raised, tall (shield-shaped) shell ranges from black, brown, to dark green, with edges smooth or wavy, and with or without radiating white bands or other patterns.
	Adaptations	Lives higher in the intertidal zone to avoid predation by sea stars and is known to have a specific pattern depending on its habitat, whether in mussel beds, on rocks or in seaweeds.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Resources	Lamb. A., Hanby, B. P. (2005). *Marine Life of the Pacific Northwest: A Photographic Encyclopedia of Invertebrates, Seaweeds and Selected Fishes.* Harbour Publishing, Madeira Park, BC. O'Clair, R.M. and C.E. O'Clair. 1998. *Southeast Alaska's Rocky Shores. Animals.* Plant Press Publications. **Shield Limpet** | Marine Ecology Station http://www.mareco.org/rocky/limpet_enemies.html

Marine Invertebrates	**Specimen**	Red turban, *Astraea gibberosa,* MI(m)60-217b
	Image	  Photo: Flickr user Lisa under a creative commons license.
	Habitat	*Native*; found in intertidal zones to 80m in depth on the Pacific coast from Alaska to Mexico, although less common on the Washington and Oregon coasts.
	Diet	*Herbivore;* small giant kelp
	Predators	Sea otters, marine invertebrates such as crabs
	Description	Up to 11cm in diameter, the red turban has a wide conical shape, brown to red in colour. The base of the shell is flat and lined with furrows; the whorls have distinctive wavy, bumpy ridges. The thick, oval, white and pearly trap door (operculum) was used for decoration in wooden bentboxes made by the Haida and First Peoples of southeast Alaska.
	Adaptations	A trap door called the "operculum" seals the shell cavity once the body of the individual has retracted inside, which allows the red turban snail to avoid predation.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Resources	**Checleset Bay Research** | Friends of Ecological Reserves http://ecoreserves.bc.ca/2006/09/28/checleset-bay-research/ Harbo, Rick M. 2010. Whelks to Whales. Coastal Life of the Pacific Northwest. A Field Guide. Revised Second Edition. Harbour Publishing. Lamb. A., Hanby, B. P. (2005). *Marine Life of the Pacific Northwest: A Photographic Encyclopedia of Invertebrates, Seaweeds and Selected Fishes.* Harbour Publishing, Madeira Park, BC.. **Red Turban snail**| Central Coast Biodiversity http://www.centralcoastbiodiversity.org/red-turban-bull-pomaulax-gibberosus.html

Marine Invertebrates	**Specimen**	Whitecap limpet, *Acmaea mitra,* MI(m)60-220
	Image	  Photo: Flickr user Ed Blerman under a creative commons license.
	Habitat	*Native;* mainly found on rocks in the low intertidal, to 60m in depth, of the Pacific coast from Alaska to Mexico.
	Diet	*Herbivore;* mainly red coralline algae
	Predators	Sea stars such as the rainbow star, and shorebirds like oystercatchers.
	Description	Up to 5cm in length and 3cm in height, the whitecap limpet has a round shell with a smooth, thick margin. The shell is white and a distinct conical shape. A knobby coralline algae typically resides on its shell, which gives the whitecap limpet a pink colour. This coralline algae is also its main food source!
	Adaptations	The whitecap limpet has a shell both taller and thicker than that of other limpets. This is especially useful in deterring predation by making its flesh less easily accessible.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Resources	**Acmaea mitra** | Walla Walla University https://inverts.wallawalla.edu/Mollusca/Gastropoda/Prosobranchia/Order_Patellogastropoda/Family_Acmaeidae/Acmaea_mitra.html **Acmaea mitra: Whitecap Limpet** | Encyclopedia of Life http://eol.org/pages/620224/details Harbo, Rick M. 2010. Whelks to Whales. Coastal Life of the Pacific Northwest. A Field Guide. Revised Second Edition. Harbour Publishing. Lamb. A., Hanby, B. P. (2005). *Marine Life of the Pacific Northwest: A Photographic Encyclopedia of Invertebrates, Seaweeds and Selected Fishes.* Harbour Publishing, Madeira Park, BC.

Marine Invertebrates	**Specimen**	Wrinkled dogwinkle (Frilled dogwinkle, Wrinkled purple snail), *Nucella lamellosa* ,MI(m)60-243
	Image	  Photo: Flickr user alisonleighlilly under a creative commons license.
	Habitat	*Native;* from the Bering Strait to California frequently found on rocky substrate of the low to mid intertidal zones to at least 10m.
	Diet	*Carnivore;* barnacles and mussels
	Predators	Red rock crab, crows, other carnivorous snails such as the California hornsnail.
	Description	Up to 12.5cm in length and 5cm in height, the wrinkled dogwinkle has a spiraled horn shape, and varies in shell thickness, texture and colour (grey to white, to pale brown, to purple). This species gets its name from the big frilly lamellae (up to 12 in sheltered areas) but can be smooth in exposed areas. The outer lip is flared with three rounded teeth. Its distinctive yellow egg cases are called 'sea oats'.
	Adaptations	The wrinkled dogwinkle uses its radula to bore a hole through hard shells, and inserts its long proboscis inside the shell in order to consume its prey.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Resources	**Frilled dogwinkle, wrinkled dogwinkle*: Nucella lamellosa*** | Biodiversity of the Central Coast http://www.centralcoastbiodiversity.org/frilled-dogwinkle-bull-nucella-lamellosa.html **Nucella lamellosa (Gmelin 1791)|** Walla Walla University https://inverts.wallawalla.edu/Mollusca/Gastropoda/Prosobranchia/Order_Neogastropoda/Suborder_Rachiglossa/Family_Nucellidae/Nucella_lamellosa.html

Marine Invertebrates	**Specimen**	Nuttall's cockle (Heart cockle), *Clinocardium nuttallii,* MI(m)60-98
	Image	  Photo: Wikimedia Commons user brewbooks under a creative commons license.
	Habitat	*Native;* found on the Pacific coast from Alaska to California, and across the Bering Sea. Burrows just below the surface in sand-gravel sediment of sheltered areas such as eelgrass beds.
	Diet	*Herbivore;* uses siphons to consume plankton.
	Predators	Include sea stars, gulls, and crabs.
	Description	Up to 14.6cm in length, the Nuttall's cockle has a thick, heart-shaped shell, beige and yellow-brown in colour, with 34 to 38 undulating ribs.
	Adaptations	Nuttall's cockle uses its muscular foot to burrow into sediments but is also known for its stunning, leaping escape response to propel itself away from predators such as sea stars.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Resources	**Nuttall's Cockle: Clinocardium nuttallii** | Puget Sound Sea Life http://pugetsoundsealife.sseacenter.org/pugetsoundsealife.com/puget_sound_sea_life/Nuttalls_Cockle.html **Nuttall's cockle, heart cockle, basket cockle: *Clinocardium nuttallii*|** Biodiversity of the Central Coast http://www.centralcoastbiodiversity.org/nuttalls-cockle-bull-clinocardium-nuttallii.html

Marine Invertebrates	**Specimen**	Eccentric sand dollar (Pacific sand dollar, Sea cookie), *Dendraster eccentricus,* MI(e)60-140
	Image	 Photo: Flickr user J. Maughn used under a creative commons license.
	Habitat	*Native;* found on the Pacific coast from Alaska to California down to 90m in depth on sandy substrate.
	Diet	*Omnivore;* use tube-feet and spines to suspension feed on small copepods, detritus, diatoms, and sometimes larvae of their own species.
	Predators	Glaucous-winged gull, starry flounder, and various species of sea stars.
	Description	Up to 10cm in diameter, the eccentric sand dollar has a rounded and flat light-coloured exoskeleton called a "test" coated with grey-purple spines. Sand dollars are easily recognized by their flat shape and the "floral" five-point pattern at the center of the test, on the opposite side of the oral cavity.
	Adaptations	The sucker-tipped tube feet vary in sizes and locations over the eccentric sand dollar and are used for different things: some for movement, respiration, or for eating. Baby sand dollars store heavy sand in their gut, perhaps using them as "weight belts" to help keep them stable on shifting sand.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Resources	**Dendraster excentricus: Eccentric Sand Dollar**| Encyclopedia of Life http://eol.org/pages/598169/details#habitat **Eccentric sand dollar... Dendraster excentricus**| Biodiversity of the Central Coast http://www.centralcoastbiodiversity.org/eccentric-sand-dollar-bull-dendraster-excentricus.html O'Clair, R.M. and C.E. O'Clair. 1998. Southeast Alaska's Rocky Shores. Animals. Plant Press Publications.

Marine Invertebrates	**Specimen**	Barnacle, *Cirripedia,* MI(c)00-258
	Image	  Photo: Sheila Byers
	Habitat	There are approximately 14 barnacle species found in BC, and more than 1,400 species worldwide. Habitat and distribution differs depending on the species.
	Diet	*Filter feeders;* consume plankton and detritus.
	Predators	Predators vary worldwide. Local predators include snails, sea stars, limpets, and humans.
	Description	Appearance varies depending on species and habitat. Typically (but not always) secrete calcium shells.
	Adaptations	Barnacles are filter feeders, and use feathery appendages that extend out of their shells. Many but not all species are sessile, meaning that they attach to substrate. Barnacle species are highly adapted to the environment in which they are found.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Resources	Byers, S. (2009). *Explore the Rocky Shore at Stanley Park*. Vancouver, BC: Vancouver Natural History Society. Lamb. A., Hanby, B. P. (2005). *Marine Life of the Pacific Northwest: A Photographic Encyclopedia of Invertebrates, Seaweeds and Selected Fishes.* Harbour Publishing, Madeira Park, BC. **What are barnacles?**| National Ocean Service https://oceanservice.noaa.gov/facts/barnacles.html

Marine Invertebrates	**Specimen**	Red rock crab (Brick red cancer crab), *Cancer productus,* MI(c)00-259
	Image	  Photo: Sheila Byers
	Habitat	*Native;* Pacific coast from Alaska to California often found in rocky sediment from intertidal zones to 90m in depth.
	Diet	*Carnivore;* barnacles, clams, amphipods, green shore crabs.
	Predators	Fishes such as sculpins, shorebirds including gulls, giant Pacific octopus, and humans.
	Description	Up to 20cm across, adult red rock crabs are brick red in colour with a dirty white underside, and has distinct large claws, or pincers, with dark black tips.
	Adaptations	The red rock crab uses its strong claws to crush its hard-shelled prey, such as clams, in order to eat the soft tissue inside. Be careful, these pincers deliver a nasty nip to humans, too! To grow, crabs frequently moult their protective exoskeleton.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Resources	Byers, S. (2009). *Explore the Rocky Shore at Stanley Park*. Vancouver, BC: Vancouver Natural History Society. ***Cancer Productus*: Red Rock Crab** | Encyclopedia of Life http://eol.org/pages/317369/details **Recreational Crab Fishing** | Department of Fish & Wildlife http://wdfw.wa.gov/fishing/shellfish/crab/identification.html

Marine Invertebrates	**Specimen**	Dungeness crab (Pacific edible crab), *Metacarcinus magister,* MI(c)00-260
	Image	  Photo: Sheila Byers
	Habitat	*Native;* Pacific coast from Alaska to California, in sand-mud, estuaries and eelgrass beds to 230m in depth
	Diet	*Carnivore;* fish, shrimp, mollusks, crustaceans, zooplankton.
	Predators	Humans, fish, seals, sea lions
	Description	Up to 28cm in carapace length, the Dungeness crab has red to brown colouring and yellow-toned legs, with a yellow underside. Claws are yellow with white tips. The female has a broad U-shaped abdomen to carry the eggs. The male has a sharp lighthouse-shaped abdomen.
	Adaptations	This species burrows into sediment for protection, and can host a variety of organisms living on its carapace such as barnacles, algae, and even tube-dwelling polychaetes, which allows for effective camouflage against predators. Like all crabs, the Dungeness moults their protective exoskeleton frequently in order to grow.
	Safety & Handling	Do not remove from black box. Hold by the sides and base of the box.
	Resources	***Metacarcinus magister;* Details Dungeness Crab**| Encyclopedia of Life http://eol.org/pages/328221/details#habitat ***Metacarcinus magister* (Dana, 1852) Schweitzer and Feldmann, 2000**| Walla Walla University https://inverts.wallawalla.edu/Arthropoda/Crustacea/Malacostraca/Eumalacostraca/Eucarida/Decapoda/Brachyura/Family_Cancridae/Cancer_magister.html

Herbarium	**Specimen**	Sitka spruce, *Picea sitchensis,* H(v)50-247
	Image	 Photo: Flickr user Matt Howry used under a creative commons license.
	Habitat	*Native;* found along the Pacific coast from Alaska to California usually growing in areas with high rainfall, well-drained alkaline soils, and cool climates.
	Predators	Red squirrel, Sitka-spruce weevil, and the spruce beetle prey on seeds in cones.
	Description	Up to 80m tall and 500cm in diameter, the Sitka spruce is a coniferous tree with thin brown or grey scale-like bark and hard, light green, very sharp, flattened needles. Its shape is column-like with slightly drooping branches, and a distinct "crown-like" top. Cones green or red-hued to light brown, less than 10cm in length. Cone scales vary from diamond-shaped to elliptically-shaped. This species is often found growing with western hemlock and red alder.
	Adaptations	Since it is susceptible to damage by strong winds, this species features the useful adaptation of dispersing seedlings that are able to germinate on decaying conifer wood. They also tolerate salt spray.
	Safety & Handling	Do not remove from plastic cover.
	Resources	**Forest Pest Leaflet 47: *Sitka-Spruce Weevil*** | U.S. Department of Agriculture Forest Service https://pace.oregonstate.edu/courses/sites/default/files/resources/pdf/fidl-47.pdf ***Picea sitchensis*** | The Gymnosperm Database http://www.conifers.org/pi/Picea_sitchensis.php **Red squirrels pruning spruce trees**| Michigan State University Extension http://msue.anr.msu.edu/news/red_squirrels_pruning_spruce_trees **Sitka spruce, *Picea sitchensis***| BC Government https://www.for.gov.bc.ca/hfd/library/documents/treebook/sitkaspruce.htm **The Spruce Beetle in Alaska Forests**| U.S. Department of Agriculture Forest Service https://www.fs.usda.gov/detail/r10/communityforests/?cid=fsbdev2_038390

Herbarium	**Specimen**	Rockweed, *Fucus sp.,* H(a)00-21
	Image	  Photo: Photo: Flickr user Jeannette S. used under a creative commons license.
	Habitat	*Native*; found in wave-sheltered to moderately exposed areas of the Pacific coast from Alaska to California. Often attached to rocks on the high to mid intertidal zones.
	Predators	Susceptible to grazing. Predators vary depending on species and location; include various grazers such as snails, limpets, chitons, and fishes.
	Description	Up to 40cm in length, rockweed is a very branched species of brown algae. Its blades are flat with a midrib running down each branch. The tips of branches are inflated, which makes this species buoyant in water, and holds egg and/or sperm once the individual is mature.
	Adaptations	Makes a gel which coats the blades and helps to resist desiccation. Produce a chemical defense to herbivory which may also help reduce UV damage.
	Safety & Handling	Do not remove from plastic cover. Do not press against the plastic cover.
	Resources	**Fucus: Genus of Brown Algae** Encyclopedia Britannica https://www.britannica.com/science/Fucus Druehl, L.D., Clarkston, B. (2000). *Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast.* Madeira Park, BC: Harbour Publishing.

Herbarium	**Specimen**	Seagrass, *Surfgrass phyllospadix,* H(a)00-23
	Image	  Photo: Wikicommons user Peter D. Tillman used under a creative commons license
	Habitat	*Native*; found attached to rocks on the Pacific coast from Alaska to Mexico.
	Predators	Grazers such as sea urchins.
	Description	Seagrasses are plants up to 4m in length, found in the intertidal or subtidal zones that have leaves arising from a root system. There are several species of seagrass and appearance is highly variable. Often bright green in colour with blades no wider than 4mm.
	Adaptations	Reproduce with pollen; they are a flowering plant (not seaweed) that spend the entirety of their life cycle under water. Pollen has different shapes to increase odds of successful underwater fertilization.
	Safety & Handling	Do not remove from plastic cover.
	Resources	Druehl, L.D., Clarkston, B. (2000). *Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast.* Madeira Park, BC: Harbour Publishing.

Herbarium	**Specimen**	Mazaella, *Mazaella sp.,* H(a)00-25
	Image	  Photo: Sheila Byers
	Habitat	*Native;* Habitat varies with species. 15 species of *Mazaella* can be found locally.
	Predators	Vary depending on species and location; include various grazers such as snails, limpets, chitons, and fishes.
	Description	This species of red algae is known for its iridescent qualities, and is sometimes referred to as "rainbow leaf". Appearance varies widely, from red, to green-yellow, to brown. Non-red forms of *Mazaella* can be distinguished by their elastic qualities.
	Adaptation	Species found in wave exposed areas commonly have longer, thinner, and often elastic blades which help prevent damage caused by strong waves.
	Safety & Handling	Do not remove from plastic cover.
	Resources	Druehl, L.D., Clarkston, B. (2000). *Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast.* Madeira Park, BC: Harbour Publishing. Byers, S. (2009). *Explore the Rocky Shore at Stanley Park*. Vancouver, BC: Vancouver Natural History Society.

Herbarium	**Specimen**	Pyropia, *Pyropia* sp., H(a)00-27
	Image	 Photo: Wikimedia Commons user Anonymous Powered used under a creative commons license.
	Habitat	*Native;* 21 species of *Pyropia* locally, mostly found in the mid to high intertidal, although specific distribution varies among species.
	Predators	Humans process this into what we know as "nori." Grazers vary depending on species and location, include snails, limpets, chitons, and fishes.
	Description	This type of red algae has very thin (1-2 cells thick), almost transparent blades, up to 1m in length, brownish yellow to red and purple. Appearance is highly variable, as well as morphologically very similar to *Porphyra,* from which it can only be distinguished with genetic analysis.
	Adaptation	Unlike other types of algae, which avoid desiccation using a variety of adaptations, *Pyropia* can dry out completely on the shore during periods of exposure, and rehydrate while submerged.
	Safety & Handling	Do not remove from plastic cover.
	Resources	Druehl, L.D., Clarkston, B. (2000). *Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast.* Madeira Park, BC: Harbour Publishing.

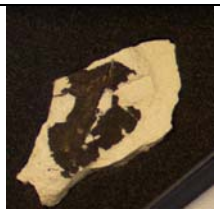
Herbarium	**Specimen**	Red Coralline Algae, *Bossiella* sp., H(a)00-29
	Image	  Photo: Flickr user Luke McGuff used under a creative commons license.
	Habitat	*Native;* ranging from Alaska to Mexico, habitat differs between species of this genus.
	Predators	Grazers vary depending on species and location, and include the red turban snail, on which it can also live.
	Description	Up to 15cm long, red, hardened (calcified), flattened branches coming off of a thicker stem, sparse branching or in dense mat. Appearance varies between species.
	Adaptation	Some species resist desiccation by attaching to other intertidal organisms, such as the red turban snail.
	Safety & Handling	Do not remove from plastic cover.
	Resources	Druehl, L.D., Clarkston, B. (2000). *Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast.* Madeira Park, BC: Harbour Publishing.

Herbarium	**Specimen**	Turkish Towel, *Chondracanthus exasperates*, H(a)00-31
	Image	  Photo: Flickr user Fitzgerald Marine Reserve Docent used under a creative commons license.
	Habitat	*Native;* on rocks of low intertidal regions of the Pacific coast from Alaska to California.
	Predators	Chitons, algae-nibbling fishes such as pricklebacks, and humans.
	Description	Up to 80cm in length, this species is red to yellow in colour. Blades are irregularly shaped, pointed near the top, and flat and rubbery in texture. Known for the lollipop shaped, often spiked bumps (papillae) on the blades. Attach to substrate using a short stipe, and more than one branch is typically seen on each stipe.
	Adaptation	Blade thickness varies between populations found in wave exposed regions compared to those found in sheltered regions. Thicker blades are more resistant to high wave stress, and are therefore a more desirable trait in wave exposed regions.
	Safety & Handling	Do not remove from plastic cover.
	Resources	**Turkish towel: *Chondracanthus exasperatus*|** Biodiversity of the Central Coast http://www.centralcoastbiodiversity.org/turkish-towel-bull-chondracanthus-exasperatus.html Druehl, L.D., Clarkston, B. (2000). *Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast.* Madeira Park, BC: Harbour Publishing. Byers, S. (2009). *Explore the Rocky Shore at Stanley Park*. Vancouver, BC: Vancouver Natural History Society.

Herbarium	**Specimen**	Sea lettuce, *Ulva* sp., H(a)00-33
	Image	 Photo: Sheila Byers
	Habitat	*Native;* found in BC, and from Alaska to Mexico, abundant in nutrient rich environments, subtidal and intertidal found on all of the world's coasts!
	Predators	Important food source for crustaceans such as amphipods, molluscs such as snails. Geese and sea urchins also graze on sea lettuce.
	Description	Sea lettuce is a type of green algae, pale to emerald green, although appearance varies widely with species. There are 15 species locally, at least 8 of which have flat blades. Bladed species are only 2 cells thick!
	Adaptation	Thin, wide blades give *Ulva* a high surface area to volume ratio which facilitates nutrient uptake and allows for rapid growth and reproduction, sometimes causing what is known as "green tide". Can spend a lot of time out of the water, translucent blades help reflect light and avoid desiccation.
	Safety & Handling	Do not remove from plastic cover.
	Resources	**Sea Lettuce**| Capital Regional District https://www.crd.bc.ca/education/our-environment/wildlife-plants/marine-species/sea-lettuce Druehl, L.D., Clarkston, B. (2000). *Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast.* Madeira Park, BC: Harbour Publishing.

Herbarium	**Specimen**	Wire weed, *Sargassum muticum* H(a)00-35
	Image	  Photo: Flickr user JC7001 used under a creative commons license.
	Habitat	*Invasive;* introduced from Japan, this species ranges from Alaska to Mexico and can also be found on the western coasts of Europe. Often found forming dense beds in the upper subtidal of wave-sheltered areas.
	Predators	Grazers such as sea urchins and gastropods
	Description	This species is yellowish-brown to olive-brown with a darker, thicker base. Characterized by lots of lateral branching basal blades (up to 10m in length), as well as smooth oval floats.
	Adaptation	Distinctively cigar-shaped floats that allow for efficient dispersal of eggs and sperm, coupled with fast growth rates make this a highly invasive species.
	Safety & Handling	Do not remove from plastic cover. Do not press against the plastic cover.
	Resources	Druehl, L.D., Clarkston, B. (2000). *Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast.* Madeira Park, BC: Harbour Publishing. ***Sargassum muticum* (wire weed)**| Invasive Species Compendium https://www.cabi.org/isc/datasheet/108973

Herbarium	**Specimen**	Western redcedar, *Thuja plicata, H(v)00-429*
	Image	  Photo: Flickr user brewbooks used under a creative commons license
	Habitat	Native; Pacific coast (California to Alaska); shade-tolerant, most common in moist, nutrient-poor forests
	Predators	Deer, birds, insects prey on seedlings and leaves of this species.
	Description	The western redcedar is the provincial tree of British Columbia. It is a conifer with scale-like leaves (not needles) 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.
	Adaptation	The western redcedar can grow on various substrate types, and they most commonly grow on moist substrate here in BC. Although not considered to be very fire resistant, the western redcedar often survives fires due to its large size, and is ideal for reforestation on moist substrates in coastal areas.
	Safety & Handling	Do not remove from plastic cover. Do not press against the plastic cover.
	Resources	**Index of species information- Species: Thuja plicata**| U.S. Forest Service https://www.fs.fed.us/database/feis/plants/tree/thupli/all.html Pojar, J. and Andy MacKinnon. Plants of Coastal British Columbia. Lone Pine Publishing, 2004. **Thuja plicata Donn ex D. Don— Details Western Redcedar**| Encyclopedia of Life http://eol.org/pages/1034889/details

Fossils	**Specimen**	Fossilized Leaf, FO50-52
	Image	  Photo: Flickr user Louis du Mont 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.
	Adaptation	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**	Pacific madrone (Arbutus), *Arbutus menziesii, H(v)00-427*
	Image	  Photo: Flickr user brewbooks used under a creative commons license.
	Habitat	*Native;* found in mixed evergreen forests of the Pacific southwest from British Columbia to California, in soils that lack moisture (such as rocky soils), generally within 8km of the ocean
	Predators	Grazers such as deer eat berries and shoots
	Description	An evergreen tree with smooth orange-red deciduous bark. Broad leaves 7 to 12cm in length, white flowers, red-orange berries. This species is up to 120cm in diameter, 30m in height. Leaning trunk divides into several twisted branches and an irregularly rounded crown. This tree is not only the only broad leaf evergreen tree in BC, but it is also the only one in Canada!
	Adaptation	Since this species is found in soils that lack moisture, it is necessary for it to have ways to conserve water. The waxy leaf cuticle helps reflect light and acts as a barrier to prevent the evaporation of water, giving the leaf its thickness and gloss.
	Safety & Handling	Do not remove from plastic cover. Do not press against the plastic cover.
	Resources	Arbutus ***Arbutus menziesii*** | Government of British Columbia https://www.for.gov.bc.ca/hfd/library/documents/treebook/arbutus.htm **Pacific Madrone (*Arbutus menziesii*)**|Oregon Wood Innovation Center http://owic.oregonstate.edu/pacific-madrone-arbutus-menziesii

Herbarium	**Specimen**	Beach Pea, *Lathyrus japonicas, H(v)00-425*
	Image	  Photo: Flickr user Alastair Rae used under a creative commons license
	Habitat	*Native;* found in BC from Vancouver to Prince Rupert. Widely distributed on coasts of temperate North America, Chile, Asia, and Europe.
	Predators	Humans and seed-feeding beetles
	Description	Found on beaches, this pea species has thread-like appendages for grabbing and seed pods that explode! Notice on the specimen how the seed pods twist, this is how they fling their offspring a far distance. Stems can reach up to 150cm long and alternating leaves from 6 to 12 egg-shaped or oblong leaflets to make up an "entire" leaf. Flowers are often 2 coloured, red-purple to blue.
	Adaptation	This species is able to disperse across long ocean distance due to its adaptation of its reproductive pods to survive in salt water over long periods of time. The plant drops its pods in the ocean; these float away, and produce new individuals far from the parent plant.
	Safety & Handling	Do not remove from plastic cover. Do not press against the plastic cover.
	Resources	***Lathyrus japonicus* Willd.beach pea (sea pea; sea vetchling) Fabaceae (Pea family)**| E-Flora http://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Lathyrus%20japonicus Nakai, Z. Tetsuya, K., Akimoto, S. 2011. Parasitoid attack of the seed-feeding beetle *Bruchus loti* enhances the germination success of *Lathyrus japonicus* seeds. Arthropod-Plant-Interactions. Retrieved January 19, 2018 from: https://link.springer.com/article/10.1007%2Fs11829-011-9132-9#citeas

Herbarium	**Specimen**	Oceanspray, *Holodiscus discolor, H(v)50-416*
	Image	  Photo: by http://www.nwplants.com/business/catalog/hol_dis.html used under a creative common license.
	Habitat	*Native;* BC to California; dry, rocky slopes, coniferous forests. Understory shrub found in forested areas. Sometimes present on the beach edge.
	Predators	Preyed upon by aphids; this species is also susceptible to the disease fireblight and the root parasite, pine broomrape.
	Description	This multi-trunked, deciduous tree is in the rose family and grows up to 2m. It makes a beautiful display of white cascading flowers in the spring and summer and its seeds are so light, they are wind dispersed.
	Adaptation	This species' ability to live on dry soils and resist drought enables it to settle after a fire has occurred.
	Safety & Handling	Do not remove from plastic cover.
	Resources	***Holodiscus discolor* (Oceanspray, Creambush)**| Hansen's Northwest Native Plant Database http://www.nwplants.com/business/catalog/hol_dis.html ***Holodiscus discolor***| US Forest Service https://www.fs.fed.us/database/feis/plants/shrub/holdis/all.html **Comprehensive Description**| Encyclopedia of Life http://eol.org/pages/301218/details

Herbarium	**Specimen**	Codium (Oyster thief, Dead man's fingers), *Codium fragile* *H(a)00-38*
	Image	 Photo: Bridgette Clarkston
	Habitat	*Native* to North Pacific (Japan) and invasive in many parts of the world. Found attached to rocks in low intertidal zone.
	Predators	*Elysia* sea slugs suck on green seaweeds like *Codium* in order to extract chloroplasts, which are used to photosynthesize inside a special organ in the slug.
	Description	Up to 40cm long, dark green dichotomously branched with a spongy texture. Branches are cylindrical and 0.5cm in diameter with a scale-like surface. Resembles fat green spaghetti.
	Adaptation	A highly invasive species, has invaded Atlantic Canada, the Mediterranean, among others. Easily dispersed via small fragments or even when entire plant is dislodged by waves. Small fragments can grow new individuals, which can take over a habitat.
	Safety & Handling	Do not remove from plastic cover. Do not press against the plastic cover.
	Resources	Druehl, L.D., Clarkston, B. (2016). Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast. Madeira Park, BC: Harbour Publishing.

Herbarium	**Specimen**	Bull Kelp, *Nereocystis luetkeana H(a)00-40*
	Image	  Photo: Bridgette Clarkston
	Habitat	*Native*; attached subtidally from Alaska to California; found in fully wave exposed areas to sheltered areas.
	Predators	Sea urchins, limpets and other invertebrate grazers.
	Description	Olive brown to yellow-brown in colour. This species has a strong holdfast used to grip sediment, a long cylindrical stipe up to 36m in length, and a large pneumatocyst also known as a gas "float" that contains carbon monoxide. The blades are narrow and can grow up to 4m in length.
	Adaptation	Gas-filled floats help *Nereocystis* float to the surface where light is more abundant for photosynthesis. The body of *Nereocystis* is highly extendable (can be lengthened without breaking), allowing it to withstand strong waves and tides without breaking.
	Safety & Handling	Do not remove from plastic cover.
	Resources	Druehl, L.D., Clarkston, B. (2016). Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast. Madeira Park, BC: Harbour Publishing.

Herbarium	**Specimen**	*Saccharina* (Sugar Kelp), *Saccharina latissima*. H(a)00-42
	Image	  Photo: Flickr user brewbooks used under a creative commons license.
	Habitat	*Native;* found from Alaska to California; exact habitat specifications differ between species.
	Predators	Sea urchins and other invertebrate grazers.
	Description	Appearance highly variable between species. Five species locally. Some species are described as being dark brown while others more yellowish brown.
	Adaptation	Individuals living in areas with little water flow (e.g., sheltered bays) often have "ruffled" or dimpled bodies—these features help increase water movement over the body (needed for nutrient exchange with the water)
	Safety & Handling	Do not remove from plastic cover.
	Resources	Druehl, L.D., Clarkston, B. (2016). Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast. Madeira Park, BC: Harbour Publishing. **Sugar kelp, sugar wrack kelp** | Central Coast Biodiversity http://www.centralcoastbiodiversity.org/sugar-kelp-bull-saccharina-latissima.html

Fish	**Specimen**	Bay pipefish, *Syngnathus leptorhynchus* F(b)10-60
	Image	 Photo: Flickr user Jean, used under a creative commons license
	Habitat	*Native:* found in eelgrass beds of British Columbia and ranges from Alaska to northern Mexico
	Diet	*Carnivore:* consume fish fry, zooplankton, and small crustaceans
	Predators	Fish, crabs, otters.
	Description	Up to 39cm in length, the bay pipefish is long, thin and closely resembles the eelgrass beds in which it is found. Bony rings reduce the flexibility of the bay pipefish, and they have a fairly rigid body. This species has a small mouth and long thin snout, small pectoral fins, rounded tail, and a short dorsal fin.
	Adaptations	The narrow body shape and colouration that matches its habitat allow the bay pipefish to blend into surrounding eelgrass beds either by floating or anchoring themselves, and avoid predation. Small fin sizes limit the swimming power of these fish, and living eelgrass beds helps the bay pipefish avoid strong currents.
	Safety & Handling	Do not open vial. Do not shake the vial. Hold by the sides of the box (the vial is attached to black box for safe viewing). Fluid: Isopropanol
	Resources	**Bay Pipefish** | Point Defiance Zoo and Aquarium https://www.pdza.org/bay-pipefish/ **Bay Pipefish** | Oregon Coast Aquarium http://aquarium.org/animals/bay-pipefish/ **Bay Pipefish- Sygnathus leptorhynchus** | Biodiversity of the Central Coast http://www.centralcoastbiodiversity.org/bay-pipefish-bull-syngnathus-leptorhynchus.html/ Lamb. A., Hanby, B. P. (2005). *Marine Life of the Pacific Northwest: A photographic encyclopedia of invertebrates, seaweeds and selected fishes.* Madeira Park, BC: Harbour Publishing.

Fish	**Specimen**	Starry flounder, *Platichthys stellatus,* F(b)10-62
	Image	  Photo: Wikimedia Commons user Joseph R. Tomelleri used under a creative commons license.
	Habitat	*Native:* found from Alaska to Santa Barbara, California, in Korea, Japan, Siberia, and in the Canadian Arctic. This species lives in the intertidal zone and offshore down to 375 meters in depth.
	Diet	*Carnivore:* exact diet depends on where it is found and its life stage. The young eat small planktonic organisms, then develop the ability to swallow small animals whole, before being able to eat parts of invertebrates with exoskeletons (like clams) and other fish. Includes shrimp, copepods, amphipods, insect larvae, and crabs.
	Predators	Birds, marine mammals, and other fishes
	Description	Up to 90 cm long, the starry flounder is flat with orange patches and black stripes along its dorsal and anal fins.
	Adaptations	The starry flounder has evolved to undergo metamorphosis early in its life. During this process, one eye migrates to the top of the head, and it develops the ability to eat more rigid organisms with hard exoskeletons. This fish has also adapted to have a flat body, and sandy or muddy colouring, which serves as camouflage that helps it hide from predators.
	Safety & Handling	Do not open vial. Do not shake the vial. Hold by the sides of the box (the vial is attached to black box for safe viewing). Fluid: Isopropanol
	Resources	**California Fish Species |** University of California http://calfish.ucdavis.edu/species/?ds=241&uid=95 **Creative Feature: Starry Flounder**	Marine Science Institute https://sfmsi.wordpress.com/2012/10/12/creature-feature-starry-flounder/ **Platichthys stellatus**	The IUCN Red List of Threatened Species http://www.iucnredlist.org/details/19014407/0 **The Life History of the Starry Flounder Platichthys stellatus (Pallas)|** State of California Department of Natural Resources Division of Fish and Game Bureua of Marine Fisheries http://www.oac.cdlib.org/view?docId=kt1f59n4tn&brand=oac4&doc.view=entire_text Lamb. A., Hanby, B. P. (2005). *Marine Life of the Pacific Northwest: A photographic encyclopedia of invertebrates, seaweeds and selected fishes.* Madeira Park, BC: Harbour Publishing.

Fish	**Specimen**	Threespine stickleback, *Gasterosteus aculeatus,* F(b)10-64 OR F(b)10-65
	Image	  Photo: Flickr user Jack Wolf used under a creative commons license.
	Habitat	*Native:* found from Alaska to Mexico, and from Hudson's Bay to Chesapeake Bay, Japan, and Siberia. It lives in the intertidal zone down and offshore to 27 meters in depth.
	Diet	*Carnivore:* eat mostly invertebrates, crustaceans, larval insects, and some eat zooplankton.
	Predators	Fish, marine birds such as herons and kingfishers. Macroinvertebrates feed on their young.
	Description	Up to 10 cm in length, the threespine stickleback gets its name from the 3 or 4 isolated spines "sticking out" in front of its dorsal fin. This adaptable fish is studied in order to learn more about animal behaviour, evolution, genetics, and toxicology.
	Adaptations	The threespine stickleback has evolved dorsal spines which make it more difficult to eat, and therefore less desirable to predators. This is an interesting species because some isolated populations have undergone rapid evolution, including the origin of new species (within 10,000 years instead of millions of years).
	Safety & Handling	Do not open vial. Do not shake the vial. Hold by the sides of the box (the vial is attached to black box for safe viewing). Fluid: Isopropanol
	Resources	**Gasterosteus aculeatus** | University of Michigan Museum of Zoology http://animaldiversity.org/accounts/Gasterosteus_aculeatus/ Lamb. A., Hanby, B. P. (2005). *Marine Life of the Pacific Northwest: A photographic encyclopedia of invertebrates, seaweeds and selected fishes.* Madeira Park, BC: Harbour Publishing. **Threespine stickleback** | Dolph Schluter lab https://www.zoology.ubc.ca/~schluter/wordpress/stickleback/ **Threespine Stickelback, Gasterosteus aculeatus** | University of Guelph http://www.arctic.uoguelph.ca/cpl/organisms/fish/fresh/stickleback/ThreespineStick.htm

Fish	**Specimen**	Chinook salmon, *Oncorhynchus tschawytscha,* F(b)10-66
	Image	  Photo: Flickr user USFWS- Pacific Region used under a creative commons license
	Habitat	*Native:* Chinook salmon spawn in large rivers from California to Alaska, including British Columbia. Introduced to large bodies of water such as the Great Lakes.
	Diet	*Carnivore:* eat insects, crustaceans when young, while adults mainly eat other fish.
	Predators	Preyed upon by a variety of large animals such as orcas, bears, seals, large birds of prey, and humans.
	Description	The Chinook salmon is the largest Pacific salmon species and can grow up to be 90cm long and can weigh over 45kg. The Chinook salmon has a different appearance depending on the stages of its life cycle. They have silvery sides, a dark back with a green sheen when feeding in tidal waters, and darken to have a red hue before spawning.
	Adaptations	When approaching fresh water, they develop a larger belly and fins that help them survive their upstream swim, and become redder in colour. Adult males also develop distinctively large teeth and a hook-like snout.
	Safety & Handling	Do not open vial. Do not shake the vial. Hold by the sides of the box (the vial is attached to black box for safe viewing). Fluid: Isopropanol
	Resources	**Do You Know: Chinook Salmon?**| Fisheries and Oceans Canada http://www.pac.dfo-mpo.gc.ca/fm-gp/species-especes/salmon-saumon/facts-infos/chinook-quinnat-eng.html/ **Chinook Salmon**| National Wildlife Federation https://www.nwf.org/Educational-Resources/Wildlife-Guide/Fish/Chinook-Salmon

Fish	**Specimen**	Staghorn sculpin, *Leptocottus armatus,* F(b)10-68
	Image	 Photo: Flickr user Eva Funderburgh used under a creative commons license
	Habitat	*Native:* found from Alaska to Mexico mostly in estuaries and sandy bottoms.
	Diet	*Carnivore:* mostly crabs, shrimps, amphipods, fish, and various invertebrates.
	Predators	Birds such as great blue herons, western grebes, other staghorn sculpins, and large mammals such as sea lions and seals.
	Description	Up to 48 cm in length, the staghorn sculpin can be identified by the antler-shaped spine present on both cheeks. Its fins have altering green and slightly yellow stripes, and its back is olive green to yellow in colour, and it is notable that it has no scales.
	Adaptations	The staghorn sculpin has adapted to breathe air, which is helpful when moving from one tidepool to the next in order to escape harsh conditions.
	Safety & Handling	Do not open vial. Do not shake the vial. Hold by the sides of the box (the vial is attached to black box for safe viewing). Fluid: Isopropanol
	Resources	**Pacific staghorn sculpin: Leptocottus armatus** | Biodiversity of the Central Coast http://www.centralcoastbiodiversity.org/pacific-staghorn-sculpin-bull-leptocottus-armatus.html **Leptocottus armatus Girard, 1854 Pacific staghorn sculpin** | Fish Base http://www.fishbase.ca/summary/4112 Paglianti, A., & Domenici, P. (2006). The effect of size on the timing of visually mediated escape behaviour in staghorn sculpin Leptocottus armatus. Journal of Fish Biology, 68(4), 1177-1191. doi:10.1111/j.0022-1112.2006.00991.x Lamb. A., Hanby, B. P. (2005). *Marine Life of the Pacific Northwest: A photographic encyclopedia of invertebrates, seaweeds and selected fishes.* Madeira Park, BC: Harbour Publishing.

Introduction: What is the Seashore?

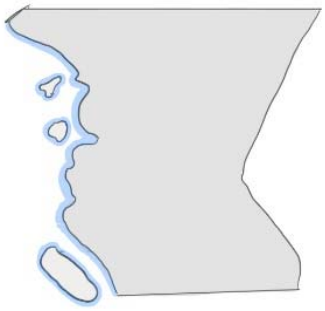


Image 1: BC Coastline, Illustration by Camille Belanger

What is the seashore? Also known as the intertidal zone, the seashore is the area between the peak of the highest tide and the lowest tide. It is a diverse environment and living things have adapted to survive some unique conditions and challenges.

Part of what makes living on the seashore difficult is tides! In Vancouver we experience semi-diurnal tides, which means that we get two high tides and two low tides of different sizes every day. At high tide, water covers the seashore up to the high tide mark. At low tide, water only covers the low intertidal zone. See Image 3 and 4. The organisms found on the seashore all have creative methods of surviving in a challenging environment.

Image 2: Zones on the seashore. Photo by Flickr user Christian Barette used under a creative commons license.

What creates the distinct zones along the seashore?

We tend to think of what keeps organisms from living closer to the water as their "lower limit", and what keeps them from getting too far from the water as being their "upper limit". The distribution of organisms on the seashore is thus determined by a balance of interactions between living and non-living things.

An organism's lower limit is generally thought of as being due to interactions with other living things. Some examples of biotic interactions are predator prey interactions, or competition with other organisms for light, space, and nutrients. Think about it: if you were a mussel living on the seashore and your predator is a sea star, would you want to live closer to the water, where the sea star lives, or settle higher on the shore where it is less likely that you will be eaten?

The upper limit is caused by interactions between living things and non-living (abiotic) things. As you move higher in the intertidal, abiotic factors such as temperature, light, and salinity become more extreme and more difficult to survive.

Since each organism has different needs, the limits on the seashore will all be different from each other. The unique balance between both biotic and abiotic limits of organisms on the seashore is what causes their distributions to be different from one another, and why we're able to see such distinct bands of organisms! The wide variation in environmental stresses results in highly specialized organisms that inhabit the intertidal zone.

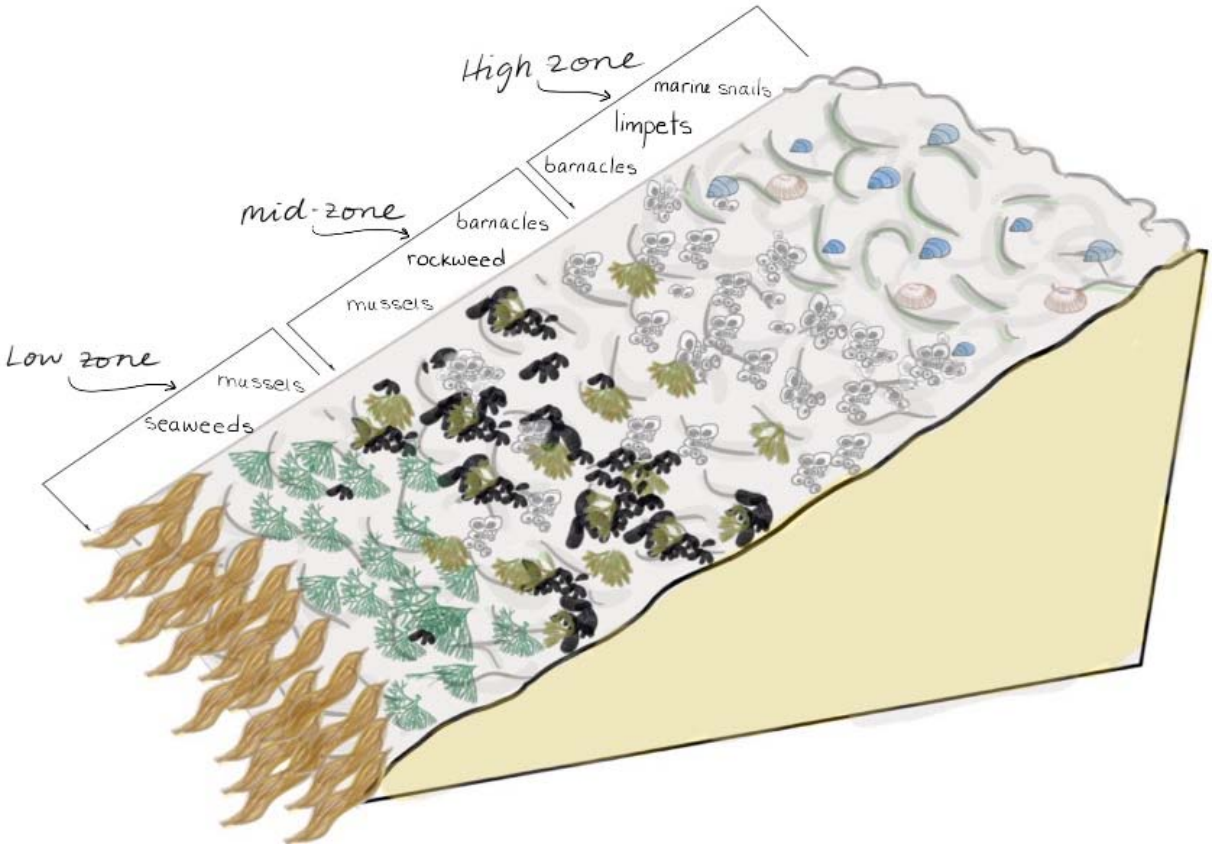


Image 3: Zones of intertidal organisms, illustration by Camille Belanger.

What types of organisms live on the seashore?

There is such a diversity of organisms inhabiting the seashore that it was not possible to encompass them all in a single Beaty Box. Although the Spencer Entomological Collection is not represented in this Beaty Box, there are insects on the seashore! *Oedoparena* spp. is a fascinating example of a type of fly that lives on the intertidal, and preys on barnacles. Visit the resource mentioned below to find out more about this intertidal insect!

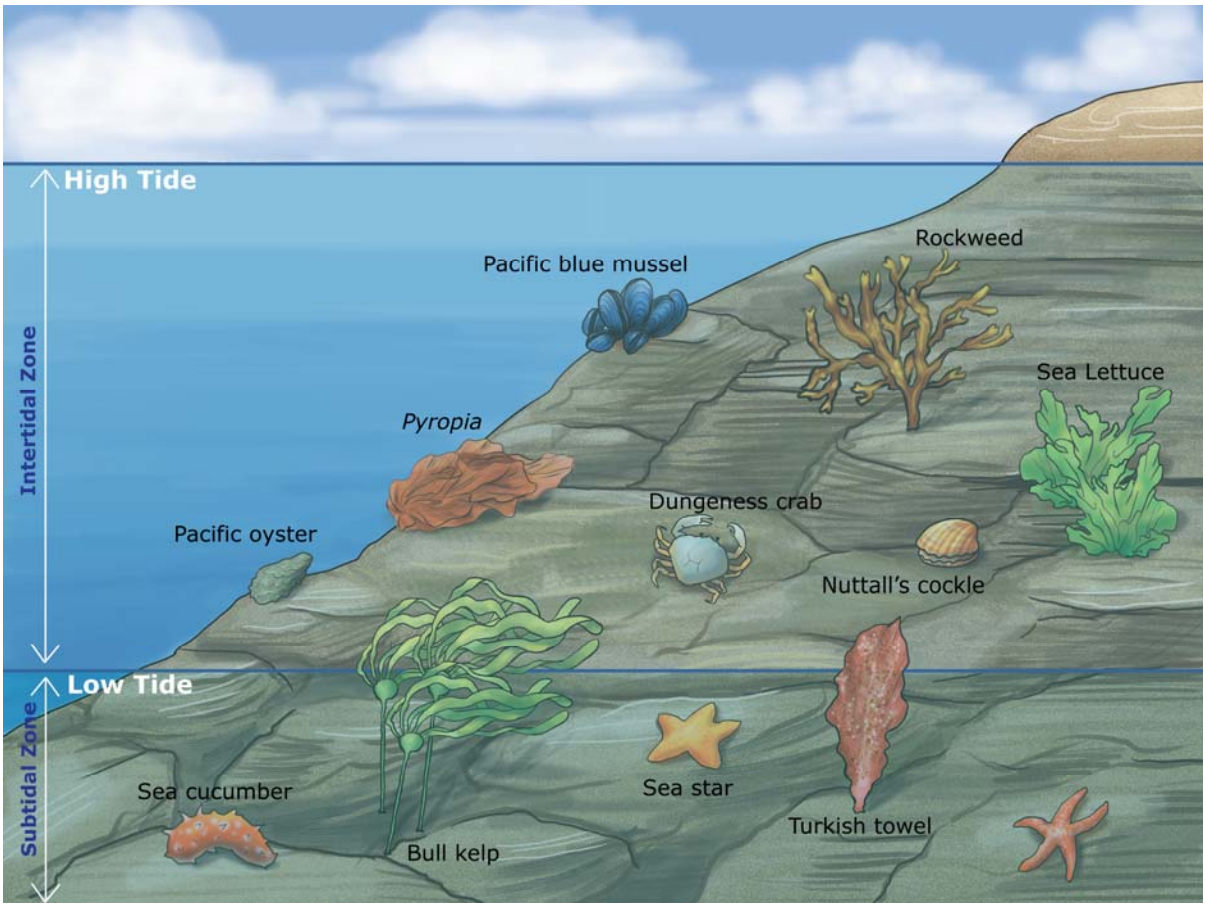


Image 4: Species on the seashore. Illustration by Christine Shan.

Challenges in the Intertidal Zone

Interactions with Living Things

Predation	Everyone needs to eat! That means organisms on the seashore are predators who eat other organisms (prey).
Competition	The seashore can be a crowded place. Competition occurs both within a species and between different species, for space, nutrients, and light.

Interactions with Non-Living Things

Light intensity	This is the amount of sunlight that reaches an organism. Organisms that use photosynthesis, such as seaweeds, need light in order to survive, but too much sunlight can damage their light-sensing cells.
Nutrient, food availability	Living things need a food source in order to survive. Many organisms on the seashore need to be under water in order to feed themselves, so this can limit how much time they can spend out of water.
Wave action	You might have noticed waves crashing onto the beach before. Currents might cause the water to move really fast, or drag things off the seashore. Strong waves can cause organisms to be damaged or moved away from their habitat.
Temperature	The chemical properties of water make it more difficult to heat up and cool down than air. Spending more time out of water makes seashore organisms more likely to experience temperatures that are hotter or colder than they can tolerate. Water helps aquatic organisms to maintain their body temperature. It is far easier to get too hot or too cold when spending less time in the water. Organisms have a better chance of surviving on parts of the seashore where they can be underwater for just the right amount of time, so this will affect where they are found in this habitat.
Desiccation	Desiccation is a scientific term that means organisms drying out. Most of the organisms found on the seashore are marine, but spend a certain amount of time outside of water. The amount of time spent outside of water depends partly on the organism's ability to keep from drying out.

Resources:

Exploring the Seashore| Parks Canada
https://pcacdn.azureedge.net/-/media/pn-np/bc/pacificrim/pdf/rivage-shore_e.pdf?la=en&modified=20121106001500&hash=2AE0930A915B3D1A672177A1C14C1FB1730B955B

Predators and Defenses| A Snail's Odyssey
http://www.asnailsodyssey.com/LEARNABOUT/BARNACLE/barnInse.php

Snively, G. (1978). *Exploring the Seashore in British Columbia, Washington and Oregon: A guide to shorebirds and intertidal plants and animals.* Vancouver, BC: Gordon Soules Book Publishers.

Seaweeds Fact Sheet

What's the difference between seaweeds and land plants?

Although they may just look like plants of the sea, seaweeds differ from land plants in a lot of ways.

- They do not get their nutrients from a root system
- They do not use seeds, flowers, or cones for reproduction
- They are (almost always) aquatic
  *keep in mind that these are generalizations and exceptions do exist

Seaweeds often also have things in common with land plants, like photosynthesis and often look like land plants.

What is seaweed?

Mainly aquatic organisms that can photosynthesize but do not have flowers, roots, or seeds, flowers, or cones for reproduction.

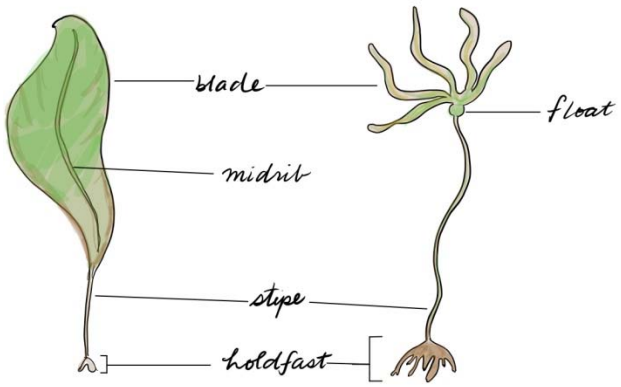


Image 5: Seaweed morphology. Illustration by Camille Belanger, inspired by Pacific Seaweeds: A Guide to Common Seaweeds of the West Coast (2000).

How do we classify seaweeds?

The three big taxonomic groups in which we classify seaweeds are "Red" (Rhodophyta), "Brown" (Phaeophyceae), and "Green" (Chlorophyta). You can ***generally*** tell them apart using the following guidelines:

- If the alga is green-grass green, it's probably a Green
- If it's almond-brown, it's probably a Brown
- If it is neither, then it is probably a Red

What threatens the survival needs of seaweeds in the intertidal zone?

Like other organisms on the seashore, the distribution of seaweeds is determined by the balance of interactions with living things and non-living things *(see page 79)*. Some examples are given below:

	The Issue	Adaptations
Challenges from Living Things		
Herbivory	Grazers feed on seaweeds: what are some ways to keep them from doing so?	Some seaweeds produce chemicals that taste bad or harm their predators, while others produce materials that are more difficult to bite into or digest.
Competition	The seashore can be a crowded place. Competition for space, light, and nutrients can be intense. Many intertidal species don't move around so they are unable to quickly escape bad conditions.	Some seaweeds can live below or on top of seaweeds or other organisms when competition for space is intense.
Challenges from Non-Living Things		
Light intensity	Seaweeds photosynthesize, which means that they use the energy from sunlight to make their own food. If they receive too little light, they will not be able to feed themselves; too much light can damage their tissues.	Some pigments can help reduce the amount of light that gets absorbed by seaweeds, and a shiny, rubbery texture can help reflect light.
Nutrient availability	Although seaweeds photosynthesize, they need a few more ingredients to feed themselves (nitrogen, phosphorus and iron are some of the important ones)	Since seaweeds do not have a root system where nutrients can be absorbed, surface area of blades is important to maximize the amount of nutrients they can get. Growing in areas where more nutrients can reach them through high water flow can help them get more nutrients too. Keep in mind that having both large blades and living in a place with lots of wave action may not be ideal since it would be easier to get swept up in the current!
Wave action	Having water flowing through their habitat can be a good thing to bring in nutrients and help disperse offspring. Strong currents and large waves can rip seaweeds from rocks or damage their blades	Some seaweeds have elaborate holdfasts that keep them well anchored to their habitat. They may even have blades that are elastic, or more difficult to tear apart.
Temperature	The chemical properties of water make it more difficult to heat up and cool down than air. Spending more time out of water makes intertidal organisms more likely to experience temperatures that are hotter or colder than they can handle.	Most seaweeds have adapted to spend more time in water, which allows them to avoid rapidly changing air temperatures.
Desiccation	Desiccation is a scientific term that means organisms drying out. Most seaweeds need to hold in water in order to survive.	Some seaweeds have a spongy texture, or little sacs filled with mucous that help them retain water when they are out of water.

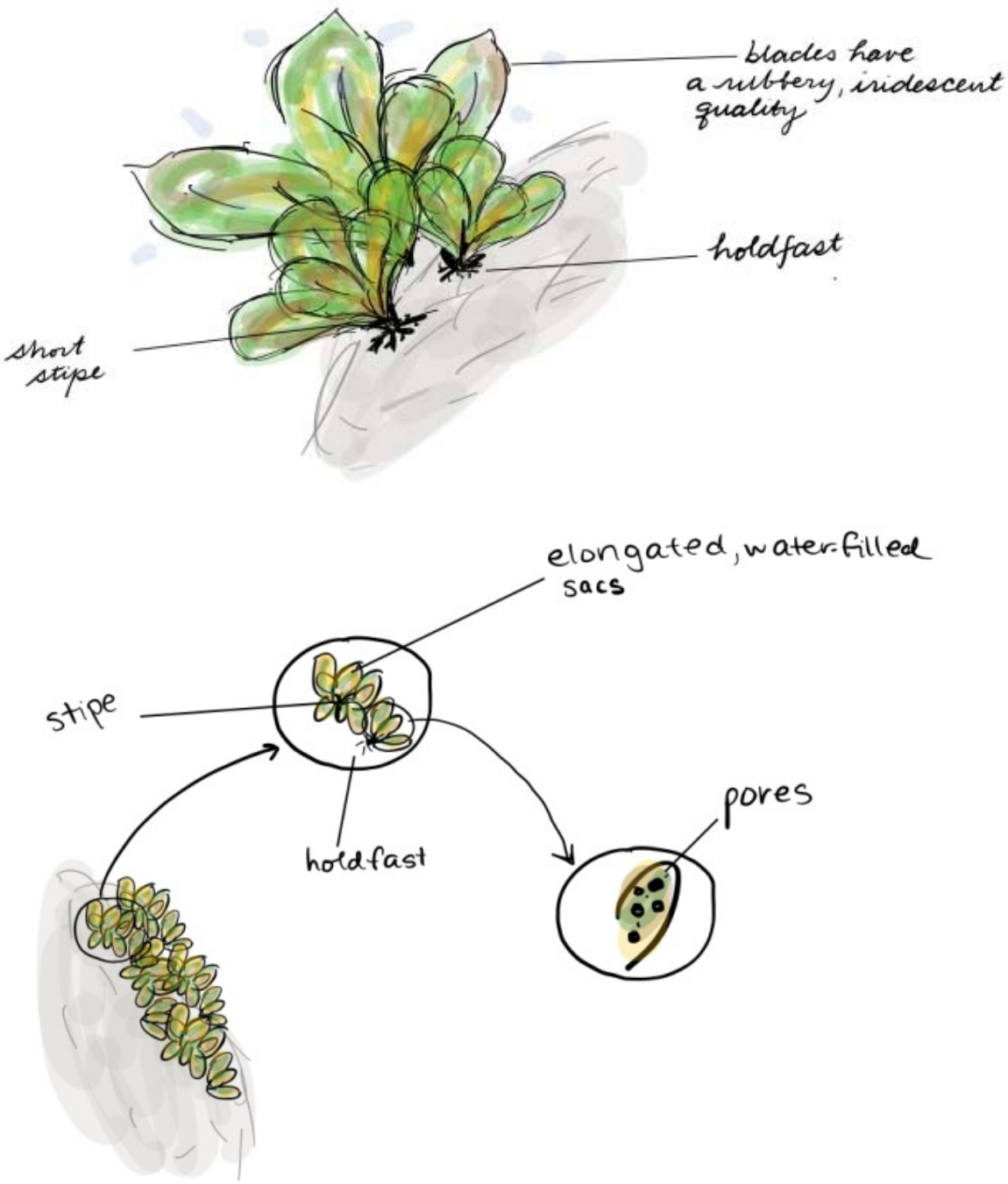


Image 6: The figure above illustrates some examples of the diverse adaptations of seaweeds. Illustrations by Camille Belanger

Bivalve Fact Sheet

What is a bivalve?

Bivalves are soft bodied invertebrate animals that have a two hinged shell. They breathe through gills and filter feed. Some have a muscular "foot" which extends outside of the shell and can dig into substrate, allowing them to move or burrow. An easy way to remember this is that each half of a clam's shell is called a valve, and that since there are two of them, it is considered a bivalve!

What/how does a bivalve eat?

Bivalves are filter feeders, which means that they strain small food particles out of the water such as plankton and detritus.

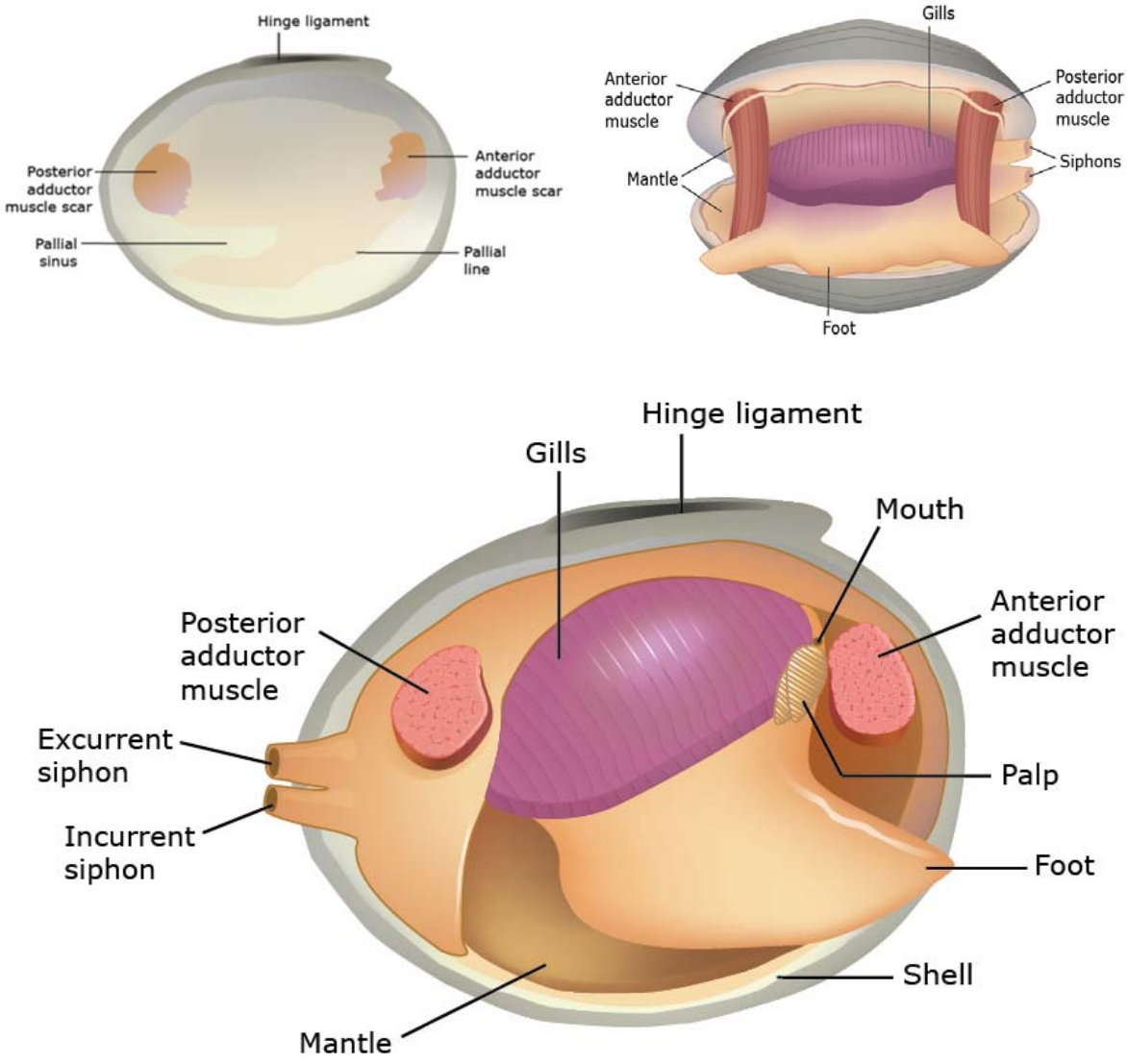


Image 7: Morphology of a bivalve. Illustrations by Christine Shan.

How to tell them apart?

The shape, thickness, size, and colour of valves vary depending on species and location.

What are the things that threaten the survival needs of bivalves in the intertidal?

Since bivalves breathe by filtering water through their gills, they essentially have to hold their breath while the tide is out. Can you imagine trying to hold your breath for that long? This also means that they can't eat when they are not submerged in water. To avoid losing too much water and undergo desiccation, bivalves keep their valves closed at high tide.

Resources:

What is a bivalve mollusk?| National Ocean Service
https://oceanservice.noaa.gov/facts/bivalve.html

Evolution Fact Sheet

What does it mean to evolve or to adapt?

Adaptations do not occur within the span of an individual's lifetime. When we talk about evolution in biology, we are talking about traits that are *hereditary*, meaning that they can be passed on from one individual to their offspring through their genetic information (genes).

How do genes get passed on?

When passing on their genes to their offspring, parents make copies of their DNA. You can think of DNA as the instruction manual for the traits of an organism. This copying is not always perfect and some of the code can get jumbled… imagine copying out a whole dictionary by hand… you might make some mistakes too. This is one of the ways that mistakes, or 'mutations' get introduced in someone's genes.

Mutations happen for lots of reasons and in lots of ways – they could add new code, change the code that is there, or take out some of the code. This changes how the cell reads the instruction manual and may have neutral, positive, or negative effects on the organism. The new mutant genes might interact differently with other genes or the environment, and end up creating brand new traits. These traits might be helpful, and over time can get passed on to many individuals in a population, and get more and more mutations in each generation, or copy of genes, so that complex traits like the ability to fly can eventually arise.

What is a species?

A species is a group of individuals that are similar enough that they could potentially reproduce with each other in nature.

What is speciation and how does it occur?

Speciation is the process in which new species occur over time. As traits evolve and become more different than other populations, these two populations may not interbreed anymore for different reasons – such as separation on the landscape. Over time the traits become so different that even when the two species may live in the same area, they don't create offspring with each other. Traits of organisms can evolve and lead to new species over time! Adaptations don't just occur due to random mutations; they can also happen due to the environment in which a species lives. Sometimes populations get separated and their new habitat puts pressure on them, changing which traits are more advantageous than others. Over time, these traits will become more common in the population, and eventually create new species.

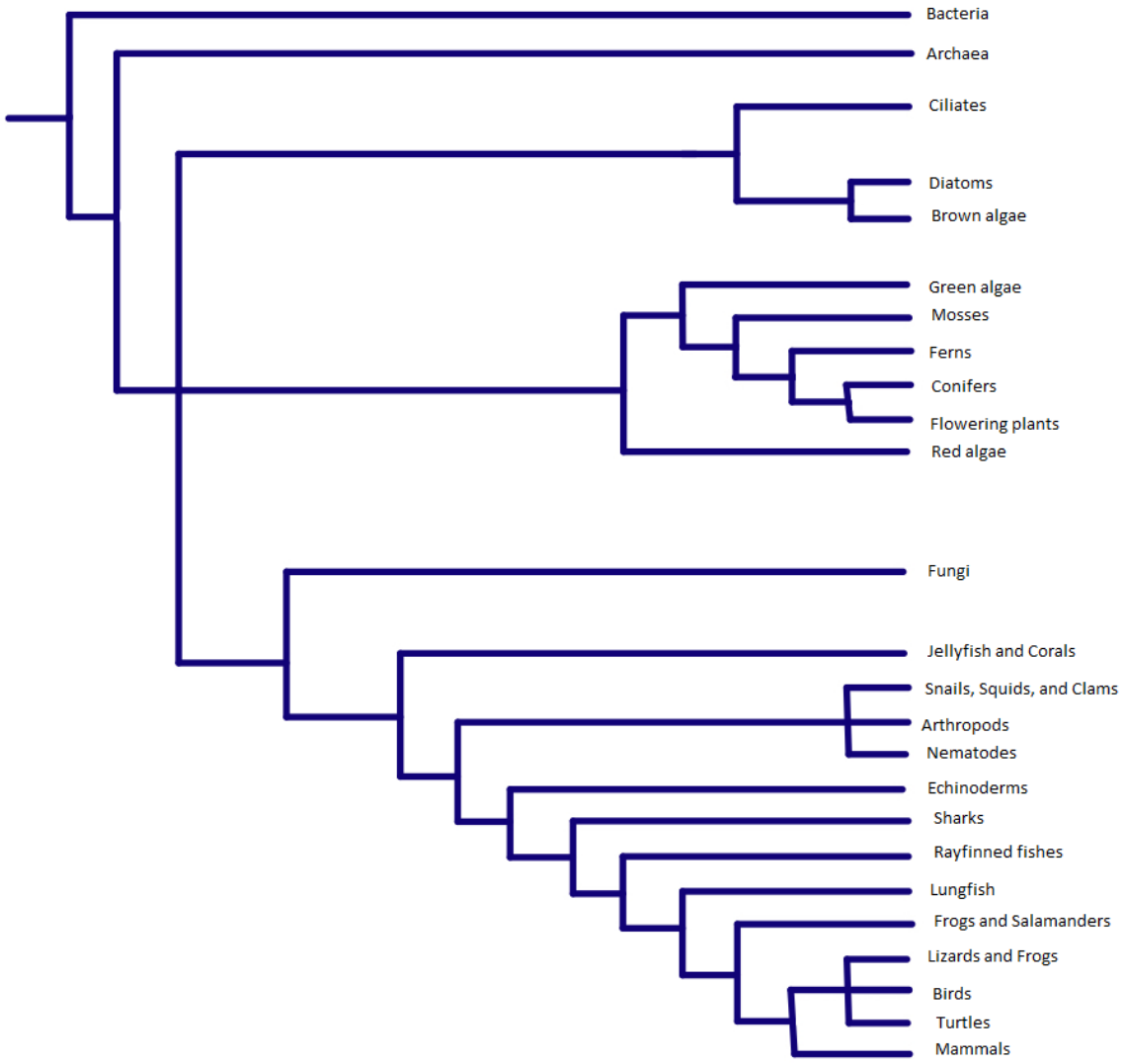


Image 8: This diagram is a phylogenetic tree called the “tree of life”

What is a phylogenetic tree?

A phylogenetic tree is a visual representation of the evolutionary history and relationships between different species of organisms. It is constructed based on the physical and genetic traits they have in common that come from sharing a common ancestor. A large phylogenetic tree, which encompasses all animals, bacteria, single-celled organisms and plants, is called the "tree of life".

How do I interpret this? Individual lines on a tree of life are called 'branches'. On this particular representation of the tree of life, the tips of the branches represent different groups of organism. 'Nodes' are we call the parts of the branches that divide are common ancestors

When we talk about two groups of organisms being more closely related to each other than they are to something else, we look at the number of common ancestor that they share, and not necessarily their position on the tree. For example, lungfish are more closely related to tetrapods than to rayfinned fishes.

What kinds of adaptations are there?

There are many kinds of adaptations! There are physiological adaptations, which change how the organism works inside. Think about how a salmon can survive in both salt water and fresh water in different parts of their lives. Some are morphological, for example, some birds have longer bills that are more equipped to handle slippery fish. While others are behavioral adaptations, like the ability to learn about where there are more fish through their day-to-day life, or having a specific mating dance to attract a partner.

Resources:

Adaptations| BBC
https://www.bbc.com/education/guides/z7sdmp3/revision

Defining a Species| Understanding Evolution https://evolution.berkeley.edu/evolibrary/article/0_0_0/evo_41

Exploring Evolution Package| Beaty Museum
http://beatymuseum.sites.olt.ubc.ca/files/2016/01/BBMExploreEvolutionResourcePackage-copy.pdf

Zimmer, C. (2009). The Tangled Bank: An Introduction to Evolution. Roberts.

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

Resources:

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

Vocabulary List

Abiotic	Relating to non-living things
Adaptation	Inherited trait or set of traits that increases an organism's chances of surviving and/or reproducing in an environment
Arthropod	An arthropod is a jointed limbed animal with an exoskeleton. An exoskeleton is similar to a suit of armor – it is a hard exterior that protects the animal. Arthropods are jointed to allow for movement. All insects are arthropods, but not all arthropods are insects. Other examples of arthropods include arachnids and crustaceans.
Algae	Algae are mainly aquatic organisms. They create their own food through photosynthesis. Algae are food for almost all aquatic life. They do not have true roots, stems, or leaves.
Biodiversity	The distribution and variety of relationships, organisms, and ecosystems on Earth. The biodiversity on Earth is constantly changing. The range of organisms we see today are much different from those 300 million years ago! (*Beaty Biodiversity Volunteer Training Manual)*
Biotic	Relating to something that is living
Bivalve	A shellfish having two shells hinged together by muscle (Gloria Snively, Exploring the Seashore)
Byssal threads	Thin, strong, stretchy fibers that mussels produce to anchor themselves down
Camouflage	A colour pattern enabling some animals to hide in, or blend in with with their surroundings
Carapace	The hard upper shell of a crab, other crustaceans, and turtles.
Carnivore	Organism that eats animal material
Carrion	Decaying flesh of dead animals
Cuticle	the protective coating of certain types of leaves
Conifer	Evergreen tree that produces cones and needles

Crustacean	Group of arthropods including crabs, lobsters, shrimp, woodlice, and barnacles
Detritus	Waste produced by the decaying of organisms
Estuary	The wide mouth of a river that flows into the sea and into which the tide flows
Evolution	Descent with modification; the process by which species change over time
Fish	Animals that live and swim in the water, breathe using gills (with the exception of lungfish), have vertebrae, generally have scaly skin, and generally have fins instead of limbs. Fish are an important food source worldwide, which has resulted in many fish species being at risk.
Filter-feeding	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
Fossil	A remnant of an organism that has been preserved in the crust of the Earth. The hard parts of organisms, such as a shell or bone, may be preserved and fossilized over time. It is unlikely that a soft-bodied organism will fossilize however there have been a few rare instances where this happened.
Foot (of bivalves)	Used by most clams to burrow in sediments
Gene	Segments of DNA that together make up the blueprint for proteins or an RNA molecule.
Gill	An organ used for underwater breathing by fishes, gilled worms, snails, limpets, and nudibranchs
Herbivore	Organism that eats plant material
Hinge	A spring-like structure joining together the two shells of a bivalve
Holdfast	A structure anchoring seaweeds to rocks and other hard surfaces
Isopod	An animal with a long, flattened body, usually quite small and having seven pairs of short legs of about equal size.

Invertebrate	Animal without a backbone (e.g. arthropod, mollusk)
Larva	The free-swimming stage in the development of an animal after birth: egg, larva, adult; or, egg, larva, puppa, adult
Lamella	A thin, flat layer of a membrane
Mollusk	Soft-bodied invertebrates usually partially enclosed by a calcium carbonate shell, belonging to the Mollusca genus.
Native species	A species that lives in its natural range.
Non-native species	A species that lives outside its natural range.
Invasive species	A species that lives outside its natural range and is having some sort of impact on the ecosystem that it now inhabits.
Nutrient	Chemical element or molecule that living things need to survive and grow
Organism	A single living plant, animal, or other living thing (bacteria, fungi, algae, etc)
Photosynthesis	Where an organism uses sunlight, carbon dioxide, and water to make oxygen and food in the form of sugar
Plankton	The minute plants and animals drifting or swimming in the ocean; the food of filter-feeders
Predator	An animal that eats other animals
Prey	An animal eaten by another animal
Radula	The structure of teeth of mollusks resembling a file-like tongue
Seaweed	Mainly aquatic organisms that can photosynthesize but do not have flowers, roots, or seeds, flowers, or cones for reproduction.
Siphon	Tubes in bivalve mollusks that draw water into the mouth and gills, and gets rid of the wastewater.
Substrate	The base layer on which an organism lives.

Species	A particular kind of animal or plant able to breed with one another, but not so likely to breed with those of other species
Specimen	An animal or a part of an animal preserved for scientific or educational use; an individual plant or animal
Stipe	The stem-like part of many types of seaweed.
Talon	A claw belonging to a bird of prey
Test	The hard shells of a sea urchin, sea star, or sand dollar through which the spines project and the tube feet extend
Valve	One of the two halves of a clam shell, or one of the plates covering a barnacle when it is withdrawn into its shell
Ventral	The lower side of the body; opposite dorsal
Vertebrate	Animal with a backbone (e.g. fish, bird)
Whorl	A spiraling turn of a snail shell, the largest whorl being the body whorl containing most of the snail's body
Zonation	An arrangement of plants and animals in horizontal layers on the shore.

Adaptation Lesson Plan

The time needed for this activity differs depending on the direction you choose. Allot 1 to 2 hours for this activity.

Learning Objectives

After this lesson, students should be able to:

- Name some interactions between organisms and their seashore environment
- Understand the factors that lead to the banding patterns on the seashore
- Have a working understanding of evolution and the diverse adaptations of organisms

Big Ideas & Concepts

Science Curriculum (K-9)

- *Kindergarten*: Plants and animals have observable features; daily and seasonal changes affect living things
- *Grade 1:* Living things have features and behaviors 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; 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; the motions of Earth and the moon cause observable patterns that affect living and non-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
- *Chemistry 11*: Organic chemistry and its applications have significant implications for human health, society, and the environment; chemical reactions and their applications have significant implications for the environment
- *Life sciences 11*: All living things have common characteristics; living things evolve over time; organisms are grouped on the basis of identifiable similarities
- *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
- *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

Materials & Supplies

The models can be drawn, made out of clay, or construction paper, depending on the time and resources you would like to dedicate to this activity.

- Paper, clay, or other artistic medium of choice
- Colouring crayons, pencils, markers, or paint
- Computer with projector or other form of media to show pictures and diagrams included on the USB drive provided inside the Seashore Beaty Box

Image 9: Flickr user neil banas used under a creative commons license

ACTIVITY 1: Stress on the Seashore

The goal of this activity is to familiarize students with the interactions between organisms living on the seashore and non-living factors, and how these relate to the adaptations we see in these organisms.

Before the Lesson

You may choose to take out some (or all) of the specimens in the box ahead of the activity. Specimens can be grouped in a variety of ways. You can do so by **collection type** (tetrapod, herbarium, fish etc. separated into different areas), by putting each **individual tray** in a different area, or by **mixing up the trays** so that there are specimens from each collection present at each station. It is helpful to decide on this system ahead of time in order to organize specimen flashcards. When choosing which way to display specimens, keep in mind what is right for your particular group and space.

It is recommended that a projector be used to show supplementary videos and images provided on the USB drive. Please note that if you have previously used the "Stress on the Seashore" lesson plan, you may find that some of the following lesson points are repeated here. These activities are meant to complement each other and promote understanding of both biotic and abiotic factors that affect the evolution of organisms living on the seashore.

Part One: Provide background information to your group about the environment in which their organism lives.

1. Introduce the seashore:
    - Define what the seashore is.
    - Show images of seashore (linked on the USB)

2. Introduce the challenges of living in the intertidal zone
    - Show video of high tide and low tide (link on the USB)
    - Show diagram of intertidal zones
        - Point out the different tidal heights. Ask students to share their ideas with a group or partner about the following points:
            - How might conditions differ at each tidal height (exposure to air, light intensity…)?
            - Why might it be a challenge to live in a highly variable environment?

Image 10: Flickr user Geoff Penaluna used under a creative commons license.

Part Two: Give your group an understanding about evolution and how it might relate to some visible features on an organism

1. Introduce students to the concept of adaptations

2. Reinforce that organisms do not "evolve" within their lifetime and explain how beneficial mutations might lead to adaptations

Part Three: Provide your group with a brief overview of commonly seen organisms on the seashore which are also abundant in the Seashore Beaty Box: seaweeds and bivalves.

1. Show pictures of diverse bivalves and seaweeds

2. Show bivalve and seaweed specimens in the box

3. Show diagrams of morphology and point out key features both on the diagram and the physical specimens
    - Highlight how these features vary (diversity!)

Part Four: Now is the time to have students interact with the specimens in order to explore biodiversity on their own. Review specimen handling procedures with your group. There are many ways to cover specimen handling. Here is one option:

1. Hold up a specimen of your choice (e.g. American mink).
    a. Hold the box 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 about the following:
    b. Describe what museum specimens are. Chances are that many students will never have seen or touched a specimen before.
    c. Demonstrate proper specimen handling. Encourage use of the 'pinky finger rule' in the direction of the fur. Have students practice 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.
    d. Discuss the differences in handling furry/feathery specimens, plants, shells, etc. Point out which specimens require extra care (shells are fragile, feathers must be touched gently, see page 34).

2. Ensure that students are fully aware that all specimens (except Ringed-billed gull and Green-winged teal; see pages 10 and 34) should be left in their boxes at all times, and that extra handling details can be found on the flash cards.

3. When in doubt, be as gentle as you can!
    a. Refer to pages 10-13 of the Beaty Box Manual for general details on specimen handling.

4. Allow 15-30 minutes for your class to explore the specimens. Take as many specimens out of the box as you feel comfortable with.
    a. Ask students to look for traits that could help them survive interactions with the non-living components of the seashore environment.
    b. Ask students to decide which specimens are bivalves, and which ones are seaweeds.
        i. How might their adaptations differ from those of land plants or fish?

Part Five: Put their learning into practice!
Now that students have seen many examples of seaweeds, bivalves, and other organisms in the box, they will think about what they've seen in order to combine features into a bivalve or seaweed that is well-suited to the seashore's conditions. You could assign different zones to different students, or have them all work in the same area. Perhaps ask students to select which organism to build.

1. For younger students, we suggest showing the basic seaweed/bivalve morphology diagrams on the projector, outlining key features (ex: holdfast, stipe, and blade) and asking them to produce an organism that has these features.

2. You may want to ask the students to produce written summary about their creation.
    a. Some good questions to ask would be:
        i. What features help your organism survive in the intertidal (i.e. strong holdfast helps them hang on to rock, shiny blades help reflect sun, or maybe they taste bad to grazers)?
        ii. At what tidal height/ where on the seashore does their organism live?
    b. This activity can be adapted for older students by asking them to complete this table. You can find it as a worksheet on the USB key.

Abiotic factor	What is it/what does it do?	How does this impact your organism?	What adaptations might an organism have that could overcome this?
Light intensity			
Nutrient/food availability			
Wave action			
Temperature			
Desiccation			

ACTIVITY 2: "DON'T EAT ME!"

This activity will familiarize students with the ways that competition and predation affect the evolution of traits in intertidal organisms.

Before the Lesson

You may choose to take out some (or all) of the specimens in the box ahead of the activity. Specimens can be grouped in a variety of ways. You can do so by collection type (tetrapod, herbarium, fish etc. separated into different areas), by putting each individual tray in a different area, or by mixing up the trays so that there are specimens from each collection present at each station. It is helpful to decide on this system ahead of time in order to organize specimen flashcards. When choosing which way to display specimens, keep in mind what is right for your particular group and space.

Hand out flash cards that correspond to the specimens displayed for your students. It is recommended to form small groups of students in order to promote group discussions during the activity.

Please note that if you have previously used the "Stress on the Seashore" activity, you may find that some of the following lesson points are repeated here. These lessons are meant to complement each other and promote understanding of both biotic and abiotic factors that affect the evolution of organisms living on the seashore.

Part One: Find out what your students already know and promote their engagement in this lesson:

1. Ask students whether they have been to the beach and encourage them to visualize the habitat you are talking about.
    - Can they describe the beach?
    - What types of organisms live at the beach?
        - What do they look like?
        - What do they eat?
        - How are they similar/different?
        - Can you see the same types of organisms at high and low tide?

Image 11: Flickr user Ingrid Taylar

Part Two: Provide background information to your group about the environment in which their organism lives: the seashore

1. Introduce the seashore:
    a. Define "intertidal zone"
    b. Show images of seashore

2. Introduce the challenges of living in the intertidal zone
    a. Show video of high tide and low tide
    b. Show a diagram of intertidal zones

3. Point out the different tidal heights and how there are different types of organisms living in each zone.
    a. Explain that both interactions with living and non-living things affect the habitat of each organism on the seashore

Part Three: Give your group an understanding about evolution and how it might relate to some visible features on an organism

1. Introduce students to the concept of adaptations

2. Highlight that organisms do not "evolve" within their lifetime and explain how beneficial mutations might lead to adaptations

Part Four: It is recommended that you allow the students to interact with the specimens in order to explore biodiversity on their own. If you do so, please review specimen handling procedures with your group. There are many ways to cover specimen handling. Here is one option:

1. Hold up a specimen of your choice (e.g. American Mink).
    a. 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.
    b. Describe what a specimen is. Chances are that many students will never have seen or touched a specimen before.
    c. Explain why taking care of the specimens is important.
    d. Demonstrate proper specimen handling. Encourage use of the 'pinky finger rule'. Have students practice 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.
    e. Discuss the differences in handling furry/feathery specimens, plants, shells, etc. Point out the fragility of the bivalves and glass specimen jars, as well as the gentle care that should be taken when touching feathered specimens.

2. Ensure that students are fully aware that all specimens (except Ringed-billed Gull and Green-winged Teal; see pages 10 and 34) should be left in their boxes at all times, and that extra handling details can be found on the flash cards.

3. When in doubt, be as gentle as you can!
    a. Refer to pages 10-13 of the Beaty Box Manual for general details on specimen handling.

Part Five: After they explore, divide the students into groups of 3-5. Each student will be the "researcher" for one specimen. Give them the flashcard so they can learn a bit more.

1. In their groups, ask students to briefly introduce their specimen
    a. What is it? Where does it live? What does it eat? What kind of adaptation does it have (behavioural, morphological, physiological)?
    b. You can choose to show them the specimen that corresponds to their flash card.
        i. Can they think of what other features help them not get eaten (i.e. hard to eat because they are hard or thick-shelled, spiny, etc.)

Part Six: Put their learning into practice!
The goal of this activity is to get students thinking about features that help organisms on the seashore in their interactions with other living things (ex: predation, competition). This could be an elaborate art project, a detailed report, a poem, or a simple drawing based on some outlines provided on the USB.

1. The main instruction to your group should be to create a creature that lives on the seashore (birds, fish, bivalves, seaweeds) and be able to explain its adaptations. Introduce the project/activity and the way you have chosen to do it.

2. You may want to ask the students to produce a written summary about their creation.
    a. Some good questions to ask would be:
        i. What features help your organism avoid predation in the intertidal (i.e. strong holdfast helps them hang on to rock, shiny blades help reflect sun, or maybe they taste bad to grazers)?
        ii. What kinds of adaptations are these?
            1. Behavioural, morphological, or physiological?

Resources:

Feeding Strategies| Biology Reference
http://www.biologyreference.com/Ep-Fl/Feeding-Strategies.html

Debrief

Today, you learned about the extraordinary adaptations of intertidal organisms and how they relate to the biotic and abiotic factors they experience. Students should now understand that the interactions between organisms and their seashore environment, the factors that lead to the banding patterns on the seashore as well as the role of evolution on the diverse adaptations of organisms.

1. Ask students to share their creations with a small group of students.
    a. What do their creations have in common? How do they differ?
    b. Where do these organisms live on the seashore?

2. You may choose to display your group's creations to inspire future discussions about the lesson.

Extension Activity

Consider how some of these interactions might change as a response to climate change:

- Increasing temperatures
- Rising sea levels

Not all organisms can survive such changes. How can the loss of species in the intertidal zone affect the biotic interactions taking place?

- What are some ways you can change your habits to reduce these effects?
    - Some ideas can include:
        - Reducing consumption of non-reusable materials
        - Walking, taking public transportation, or riding a bicycle to get to school instead of taking a car
        - Picking up and sorting garbage on the beach
        - Being careful not to disturb the seashore organisms when visiting
        - Your class may want to make a pledge to help the oceans now that they are so familiar with it!

Planning an excursion to the seashore may be a good way to apply what your group has learned through the Adaptation Lesson Plan. Just remember to be gentle and to leave things exactly how you found them, or better!

- Consider picking up trash along the seashore during your visit. https://oceanconservancy.org/trash-free-seas/international-coastal-cleanup/cleanswell/
- See any marine mammals? Report them at https://www.vanaqua.org/act/direct-action/bc-cetaceans-sighting-network

Additional Resources for Adaptations Lesson Plan

Image 12: UBC seaweed scientist, Patrick Martone, has developed a tool to help identify local seaweeds.

Additional Resources

First Peoples and Traditional Knowledge

British Columbia itself is home to over 200 First Peoples 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. 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)

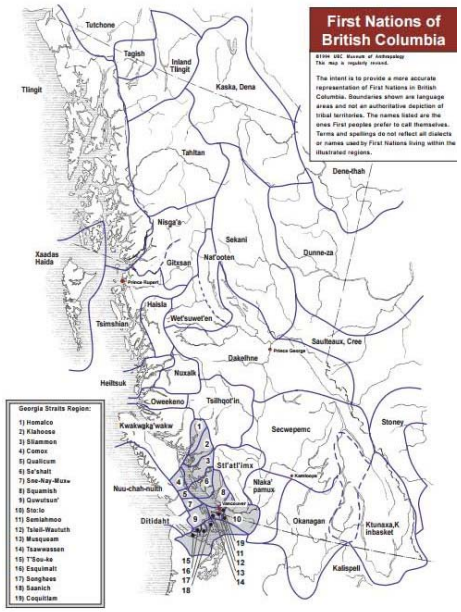


Image 13: First Nations of British Columbia.

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 is a form of aquaculture called "clam gardening".

What is a clam garden?
A clam garden is a beach that was tended with great care and a lot of work. Rocks were gathered up from the sandy beach area and piled in a ring along the low-tide mark. Removing the rocks made more room for the clams, and the wall of stones prevented the sandy beach from eroding.

What are some uses for the clams?
For the coastal First Peoples, the butter clam represented a significant component of their diet long before the 1900s. The meat of the butter clam preserved well. Butter clams were roasted by the fire or braided into chains, woven onto ironwood sticks, smoked, dried (sun-dried), strung on cedar strands, stored, and traded.

Why are clam gardens important?
Clam gardens are a way of managing and enhancing the productivity of the intertidal ecosystem and providing food security.

Are there any ongoing projects?
Since 2014, research dedicated to a better understanding and documentation of clam gardens has been conducted primarily by SFU professors and their graduate students. Want to know more? Visit some of the resources mentioned below!

Links to media resources about research and conservation efforts regarding clam gardening

- SFU Study finds ancient clam beaches not so natural (April 2015) (John Harper survey): https://www.youtube.com/watch?v=eWvkmcsXhtQ
- SFU research on Ancient Clam Gardens (Anne K Salomon) https://www.youtube.com/watch?v=9nZFV9GVRRk
- Quadra Island Clam Gardens time lapse https://www.youtube.com/watch?v=hqWC5CeVQy8
- Royal Roads students: place-based learning in Fulford Harbour, Salt Spring island https://www.youtube.com/watch?v=bdFUXlO1gjg
- Film: Ancient Sea Gardens: Mystery of the Pacific Northwest. 2005. A Szimanski, Director, DJ Woods Producers

Resources:
Judith Williams. 2006. Clam Gardens. Aboriginal Mariculture on Canada's West Coast. Transmontanus 15. 128pp.

BBM "Butter Clams and Ancient Clam Gardens Fact Sheet"

http://www.fnesc.ca/wp/wp-content/uploads/2016/08/PUBLICATION-61460-FNESC-Authentic-Resources-Guide-2016-08-26.pdf

Meet a Researcher!

Some UBC scientists think about the ocean and the seashore every day!

Maite Maldonado

Primary productivity (photosynthesis) in the ocean has a big impact on the global carbon cycle, and the amount of carbon dioxide in our atmosphere. Dr. Maite Maldonado is a biological oceanographer and professor here at UBC whose research combines cell physiology, ecology, and ocean biochemistry. The goal of Dr. Maldonado's research is to understand how speciation and the distribution of trace metals in the ocean may control global primary productivity today and over longer periods of time. Want to know more? Visit https://www.eoas.ubc.ca/people/mariamaldonado for more details.

Chris Harley

Dr. Christopher Harley is a professor at UBC and studies how climate change impacts rocky coasts. He is interested in how climatic factors, such as temperature, carbon dioxide, and pH, and biological relationships, such as predation and facilitation, interact to create ecological patterns in time and space. For more information, visit his website: https://www.zoology.ubc.ca/~harley/Harley_Lab/Research.html

Patricia Schulte

Dr. Patricia Schulte is an evolutionary physiologist, and a professor at UBC. She is interested in the differences between populations of a single species, and her research looks to understand the physiological adaptations that allow animals to live in particular environments. For more on Dr. Schulte, please visit http://www.zoology.ubc.ca/person/pschulte

Worksheets and Activities

Our website contains a number of supplementary resources 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:

Feather Identification Tool (The Feather Atlas)| U.S. Fish and Wildlife Service Forensics Laboratory
https://www.fws.gov/lab/featheratlas/idfeather.php

All About Feathers| Cornell University
https://academy.allaboutbirds.org/features/all-about-feathers/#what-is-unique-to-birds.php

Marine Invertebrate Classification | Beaty Biodiversity Museum
http://beatymuseum.sites.olt.ubc.ca/files/2016/01/BBMMarineInvertebrateClassification.pdf

For use in the classroom with a museum visit:

Adaptation Exploration: Bird Beaks| Beaty Biodiversity Museum
http://beatymuseum.sites.olt.ubc.ca/files/2016/01/BBMBirdBeaks.pdf

Videos

Sea Stars on the North American Pacific Coastline

https://youtu.be/jXGija1RuWc

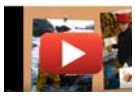
Mussel Glue is Way Cool (Byssal threads)

https://youtu.be/ZBDiKWAdqxU

Insect-Devouring Birds are Way Cool

https://youtu.be/XGfEgki3QbY

Seaweeds are Way Cool



https://youtu.be/ceS9egsncok

Clam Digs into Sand

https://youtu.be/hsBVvlJjNtc

Sand Dollar Tube Feet Movement

https://youtu.be/3uwOURjneWQ

Wild Kratts: Stars of the Tides

This episode depicts the challenges of the intertidal zone for a young audience.

Photos: Repacking Your Beaty Box

Please view http://bit.ly/BeatyBoxPacking for details.

Tray 4:

1. Place the empty tray inside the Seashore Box.

2. Stack the herbarium sheets together using the straps provided, and place them inside the tray.

3. Carefully place the jarred specimens, barnacle rock, and Baird's sandpiper in their place inside the tray. Make note of any dampness inside the box and refer to page 34 for details on what to do in case of a spill.

Tray 3:

1. Place the empty tray on a clean table.

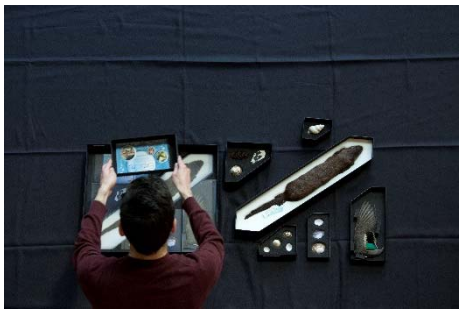
2. Carefully place specimens, following the dots, photos, and labels to help put boxes away in the right places inside the tray.

3. Return the full tray to the Seashore Box.

Tray 2:

1. Place the empty tray on a clean table.

Place the frilled dogwinkle, red turban, fossilized leaf, and book back into the tray.



2. Carefully place the American mink in position inside the tray

3. Place the limpets, purple mahogany clam, green-winged teal, following the dots, photos, and labels to help put boxes away in the right places inside the tray.

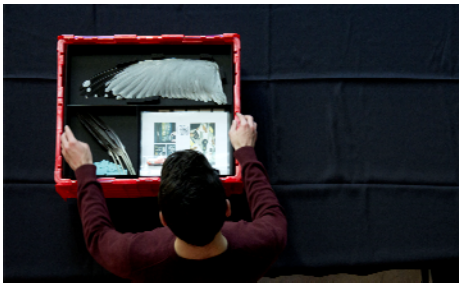
4. Return the full tray to the Seashore Box

Tray 1:

1. Place the empty tray on a clean table.

2. Place the ring-billed gull wing inside the tray, and the remaining specimens inside the tray, following the dots, photos, and labels to help put boxes away in the right places inside the tray.

3. Return the full tray to the Seashore Box



Seashore Beaty Box 007 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 Section 1 for more information on sending the Beaty Box back to the museum.

Tray 1

Check (Yes/No)	**Item**	**Notes**	**Catalogue Number**
	Educator's Manual	Binder & USB Stick	
	Ring-billed gull wing		T(b)30-365
	Snow goose feathers		T(b)40-213a T(b)40-213b T(b)40-213c T(b)40-213d T(b)40-213e

Tray 2

Check (Yes/No)	**Item**	**Notes**	**Catalogue Number**
	Explore the Rocky Shore of Stanley Park, Sheila Byers		
	American mink		T(m)40-89
	Green-winged teal		T(b)30-367
	Wrinkled dogwinkle		MI(m)60-243
	Fossilized leaf		FO50-52
	Sitka spruce cone		H(v)50-247
	Red turban		MI(m)60-217b
	Sitka Spruce		H(v)50-247
	Purple mahogany clam		MI(m)60146
	Whitecap limpet		MI(m)60-220
	Shield limpet		MI(m)60-206

Inventory list continued on next page →

Tray 3

Check (Yes/No)	Item	Notes	Catalogue Number
	Pacific oyster		MI(m)60-97a
	Nuttall's cockle		MI(m)60-98
	Softshell clam		MI(m)60-179
	Bald eagle talon		T(b)30-360
	Bent-nosed macoma		MI(m)60-147
	Red rock crab		MI(c)00-259
	Dungeness crab		MI(c)00-260
	Pacific blue mussel		MI(m)60-136b
	Eccentric sand dollar		MI(e)60-140
	Butter clam		MI(m)60-149

Tray 4

Check (Yes/No)	Item	Notes	Catalogue Number
	Chinook salmon		F(b)10-66
	Bay pipefish		F(b)10-60
	Starry flounder		F(b)10-62
	Threespine stickleback		F(b)10-64
	Staghorn sculpin		F(b)10-68
	Baird's sandpiper		T(b)30-361
	Barnacles on rock		MI(c)00-258
	Rockweed		H(a)00-21
	Seagrass		H(a)00-23
	Mazaella		H(a)00-25
	Pyropia		H(a)00-27
	Red coralline algae		H(a)00-29
	Turkish towel		H(a)00-31
	Sea lettuce		H(a)00-33
	Wire weed		H(a)00-35
	Western redcedar		H(v)00-429
	Pacific madrone		H(v)00-427
	Beach pea		H(v)00-425
	Codium		H(a)00-38
	Bull kelp		H(a)00-40
	Saccharina		H(a)00-42
	Oceanspray		H(v)50-416

Appendix 1

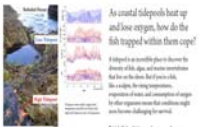
Additional Resources provided on the USB key:

Additional Resources for Stress on the Seashore activity |
Beaty Biodiversity Museum
PDF can be found on the USB drive inside the box

Additional Resources for DON'T EAT ME activity |
Beaty Biodiversity Museum
PDF can be found on the USB drive inside the box

Seashore Supplementary Worksheet | Beaty Biodiversity Museum
PDF of this worksheet and its answer key can be found on the USB drive inside the box

Adaptations Lesson Plan Exit Slips | Beaty Biodiversity Museum
PDF of these slips are available on the USB drive inside the box to check on your groups' interests and comprehension.



Researchers Revealed: Milica Mandic | Beaty Biodiversity Museum
PDF of this research story is available on the USB drive inside the box

Appendix 2

Seashore Box Dimensions:

- *Length:* 60.9 cm (24″)
- *Width:* 50 cm (19.5″)
- *Height:* 33 cm (13″)
- *Weight:* 12.2 kg (26.9 lbs.)

See next pages for alcohol MSDS information.