Science Unit: Marine Biodiversity: Global Ocean to the Salish Sea
Lesson #2 Design Your Own Salish Sea Creature

Summary:	Based on what students learned in lesson 1, they will apply their new knowledge of adaptations to new habitats in the Salish Sea as they design and build their own creature and describe the adaptations it has to its environment
Lesson type:	Creative arts
Grade level:	Presented to grade 3; appropriate for grades 2 – 10 with age appropriate modifications
Duration of lesson:	75 min
Developed by:	Jonathan Kellogg (Scientist); Andrea Teschner and Gillian Wilson-Haffenden (Teachers)
Developed for:	Lord Kitchener Elementary
School Year:	*2016-2017*

Connections to BC Curriculum

Living things are diverse, can be grouped, and interact in their ecosystems; Demonstrate curiosity about the natural world; Make predictions based on prior knowledge; Wind, water, and ice change the shape of the land; Biodiversity in the local environment; Major local landforms; Co-operatively design projects; Transfer and apply learning to new situations; Represent and communicate ideas and findings in a variety of ways, such as diagrams and simple reports

Objectives

Students will learn fundamentals of the Linnean taxonomy classification system and apply their knowledge of adaptations to design a creature that would survive in various Salish Sea biomes.

Materials

- Print Salish Sea biomes cards, enough for 1 card per team
- Print phylum description cards, enough for 1 card per team
- Craft supplies (sculpting, colouring, etc.)

Background Information for the Teacher

Linnean taxonomy is the foundation for classifying life on earth for centuries and is still widely used even as genomic techniques dominate some fields of biology. Starting with the Last Universal Common Ancestor (LUCA), the three domains of life (Bacteria, Archaea, Eukaryota) underlie the Linnean system, with the Kingdom, Phylum, Class, Order, Family, Genus, and Species levels of increasing uniqueness. This lesson is designed to simply touch of the fact that life is classified and that organisms are grouped based on their similar structures.

In the marine environment, scientists often introduce phylum that can be seen in the intertidal zone. This is in part so students may draw from their own previous experiences when learning about biodiversity. For this lesson, introduce the phyla: Chordata, Echinodermata, Arthropoda, Mollusca, and Cnidaria. If your class size would lend itself to another phylum, Annelida may be a good choice. Since one of the defining characteristics of some phylum are related to symmetry, it is also good to introduce this concept as well.

All of these phyla are common along the coast of British Columbia and in marine environments worldwide. For this lesson, ask students to design organisms that would be well adapted to survival in the BC coastal marine biomes of: Fjord Estuary, Rocky Outer Coast, Tidal Rapids, Mudflats, Eelgrass, Benthic. These biomes reflect the geologic history of the BC coast which used to be covered by the Cordilleran Ice Sheet around 2.5 million years ago. The ice sheet and glaciers scoured the rock to create a coastline that is littered with long narrow fjords from the Strait of Juan de Fuca to the border with Alaska (and beyond).

Fjords estuaries are characterized by having steep sides and typically have a topographic high, or sill, at the mouth that restricts circulation at the seaward end. The sill is the result of the end moraine that forms at the toe of the glacier where it leaves a large sedimentary deposit. Fjords tend to be especially deep compared to other types of estuaries (like those formed by drowned river valleys or tectonic forces) which provides a wide range of habitats for life. Freshwater flows into the basin along the length of the fjord, but due to its low density, this freshwater tends to float on top of the seawater, which primarily enters the fjord basin at depth.

The sill forces the currents in the system to be distinguished from other coastal embayments. Waters flowing over the sill in both directions are forced through a constriction which leads to vigorous mixing. This mixing leads to abundant nutrients and dissolved oxygen in the water which enhances production landward of the sill. Some fjords have shapes such that the basin behind the sill is very deep and has not had any new marine water influence in tens to hundreds of years (or longer). In these basins the benthic ecosystem has had to adapt to extremely low oxygen conditions.

Introducing the classification system of life adds richness to the component of the lesson exploring biomes of the Salish Sea and BC coast, but is not necessary depending on your goals. Including this element did lead to many creative creatures since students were asked to develop animals beyond fish.

Vocabulary

- **Phylum** – A principal taxonomic category that ranks above class and below kingdom.
- **Chordata** – Phylum that includes humans. Characteristics: tail, nerve cord that runs down the back, anus that forms before mouth, and has bilateral symmetry
- **Echinodermata** – Phylum exclusively living in the ocean. Characteristics: able to regenerate, spiky, water vascular system, anus that forms before mouth, and has radial (usually 5 sided) symmetry. Fun fact: since the anus forms before the mouth, echinoderms are closely related to chordates.
- **Arthropoda** – Phylum that includes 80% of all described animals. Characteristics: exoskeleton, segmented body to allow movement, molt to grow, compound eye, bilateral symmetry.
- **Mollusca** – Phylum that includes ~1/4 of all marine species. Characteristics: soft mantle, radula (scraping tongue), nervous system, and most have a muscular foot. Generally bilateral symmetry.
- **Cnidaria** – Phylum that is only found in water. Characteristics: jelly-like bodies, stinging cells, one hole for all food, waste, and respiration, no central nervous system, may be swimming or fixed and have radial symmetry.

- **Estuary** – where freshwater and saltwater meet
- **Fjord** – A narrow, deep inlet of the sea between steep hills or mountains.
- **Tidal rapid** – A natural constriction where the tidal currents become fast moving and create hazardous waves and currents. Locations of some high current areas in BC: https://drive.google.com/open?id=1rI2QpiiFSSfb00bs8sEsHDX2prI&usp=sharing
- **Mudflat** – A stretch of muddy land left uncovered at low tide. Generally located near the mouth of a river which supplies the sediment. Both Roberts Bank and Spanish Banks are examples of large mudflats in BC. Map of large mudflats as a layer in the Tidal Rapids map, above.
- **Benthic** – The near-bottom zone of a water body. In the Salish Sea, many of the fjords are deep enough that the seabed is extremely light limited and in many cases oxygen limited as well.
- **Eelgrass** – A marine plant that grows in the nearshore sandy bottom up to 1 m in length. Provides crucial habitat for many smaller organisms, including salmon, during the early phase of their life.

Classroom Set-up

- Students may work individually, in pairs, or groups up to 4.

Lesson Detail

Introduction

Remind students about the various adaptations that they learned about when studying how creatures lived in the various ocean biomes. What adaptations were common to the open ocean? To the polar ocean? If there are adaptations to the various ocean conditions, do students think that there are habitats within the BC coast that require specialization? If so, do they have any ideas?

Lead students to think about how the organisms from the previous lesson might be grouped as a way to introduce taxonomy and Linnean classification. For grade 3, we simply addressed that classification was possible and that multiple levels are used with increasing specialization. The third level of classification is called Phylum and this level is broad enough to cover a wide number of species, but also narrow enough to show the relevance of classifying organisms. Keeping this introduction brief will allow the students to have the most time for their creature development.

Science Activity

Students will create a creature that will thrive in an assigned habitat. In order to distribute the types of creatures being designed, assign the phylum to the ecosystem types. Here is one suggestion of how to distribute habitats and phyla.

	ROCKY COAST	FJORD ESTUARY	TIDAL RAPID	MUDFLAT	EELGRASS	BENTHIC
Chordata		x	x			x
Arthropoda				x	x	x
Echinodermata	x				x	
Cnidaria		x	x			
Mollusca	x			x		

1. Give each student or team the card describing their habitat and phyla. Students should design their creatures with adaptations that address the challenges for life in their habitat. Their creature must include the bold characteristics of their assigned phyla.
2. Provide students with materials to create their creatures through 2D drawings or paintings, or 3D sculpting using clay or other crafting materials. Allow them roughly 30 minutes to create their creatures before presenting them to the class.
3. Have students present to the class where they describe their habitat, characteristics of the phyla, and their creature where they point out the adaptations that they have chosen that will help it survive specifically in their assigned habitat.

Closure Discussion

Examples of questions to help students share their results and observations…

1. Could your creature survive in another habitat? Why?
2. Is there a habitat that it would not survive in? Why not?

Videos are available on YouTube describing each of these phyla and many show the types of habitats.

Extensions of Lesson

1. Students could conduct further investigations of their habitats and the conditions for life in them.
2. More formal presentation of the creature than standing in front of the class.
3. Introduce other phyla. What about the various algae types that thrive in each of these habitats?
4. Investigate real organisms that live in these habitats.

References

- Wikipedia pages for each phyla were accessed.
- Geologic history of the cordilleran ice sheet: http://faculty.washington.edu/dbooth/Ch_02_INQUA_volume.pdf
- Eelgrass Fact Sheet: http://www.gibsons.ca/include/get.php?nodeid=387
- Nearshore Eelgrass Habitat Mapping: http://www.islandstrustfund.bc.ca/initiatives/marineconservation/eelgrass-mapping.aspx
- Intertidal Mudflats: https://www.crd.bc.ca/education/our-environment/ecosystems/coastal-marine/intertidal-mud-flats