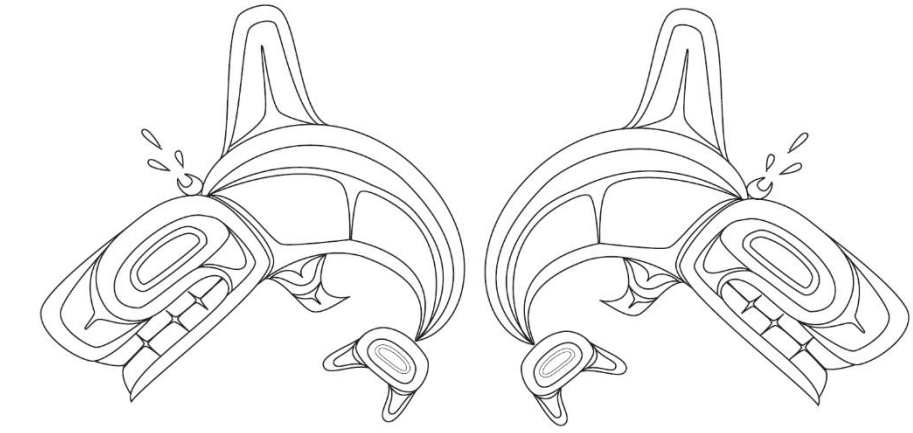
Science and Fishing

"Estuaries: the connection between land and sea"

The Skeena River - Ts'msyen Territory

This document has been developed in partnership between Ocean Networks Canada and Aboriginal Education School District 52 Prince Rupert, Wap Sigatgyet.



Art by: Kelli Clifton, Gitga'at Nation

AN INITIATIVE OF University of Victoria

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Global Concept
Estuaries are the bridge between fresh and saltwater ecosystems.

Curricular links
For alternative links, check out the curricular links document.

Grade	**Subject area** *Big Idea*	Content (bold indicates a particular focus)
6	**Science** *Everyday Materials are often Mixtures*	● Heterogeneous Mixtures ● **Mixtures** ○ **Separated using a difference in component properties. (Density)**
		Curricular competencies
		● Experience and interpret the local environment ● Identify First Peoples Perspectives and knowledge as sources of information ● **Express and reflect on personal, shared, or others' experiences of place**

Roadmap

Science Principles Emphasised	**Cultural Connection Emphasised**	**Career Profiles**	**Cultural/ Scientific Background**
The density of water is variable and depends on salinity and temperature	The Ts'msyen people closely interact with the Skeena estuary	Allan Miller Kitsumkalum Ryan Flagg	Perspectives from Ts'msyen peoples Principles of Density

Lesson Plan

Hook/ Preamble	**Building Connections**	**Student Activity/Challenge**	**Application of observations and information (Critical Thinking)**
Discussion: How do we get the foods we eat and how has this changed over time?	Passage reading: Highlighting Ts'msyen fishing practices	Building your own boat	How are buoyancy and density related to fishing boats?

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Background

Scientific Principles Emphasised
The density of water is variable and is influenced by the water's temperature and salinity. These differences in density can cause different water masses to resist mixing together, creating different layers of temperature or salinity within the ocean.

Cultural Connection Emphasised
In British Columbia, estuaries have, and continue to be, a cornerstone of Indigenous Peoples territory. Estuaries, including the Skeena River estuary, are nursery habitats, where ocean bound salmon smolts adjust to seawater and prepare for their migration at sea. Salmon are a culturally iconic species which support most Indigenous communities throughout coastal BC spiritually, culturally, economically, ecologically and socially. For millennia, Ts’msyen people have been, and continue to closely interact, observe, study, monitor, and record the processes and cycles of estuary environments within their territory. This comprehensive Ts’msyen knowledge of estuaries includes details of the biological production and renewal of natural systems. This strong cultural connection to place contributes to long-term Indigenous knowledge that is a valuable part of the overall understanding of the ocean.

Career Profiles

See Allen Miller and Ryan Flagg’s career profiles to learn more about their work using the CTD instrument.
CTDs (Conductivity, Temperature, Depth) are important instruments for monitoring river, estuary, and ocean environments. Many Ts’msyen fisheries departments use CTDs to monitor and record data on critical fisheries habitat within their territory. A CTD can be used to measure the temperature and salinity of the water at different depths and locations. Allen Miller is profiled as a Kitsumkalum (one of the Ts’msyen Nations) career mentor who uses a CTD on a regular basis as part of his work.

CTD instruments are a key part of almost every underwater cabled observatory and scientific mooring. Ryan Flagg has been the lead on Ocean Networks Canada’s collaboration with the Pacific Salmon Foundation’s “Citizen Science” project. This project provides experienced boat operators from several communities along the coast of the Strait of Georgia with CTDs and other sampling equipment. They go out to collect data almost every week and send it back to Ocean Networks Canada using a tablet.

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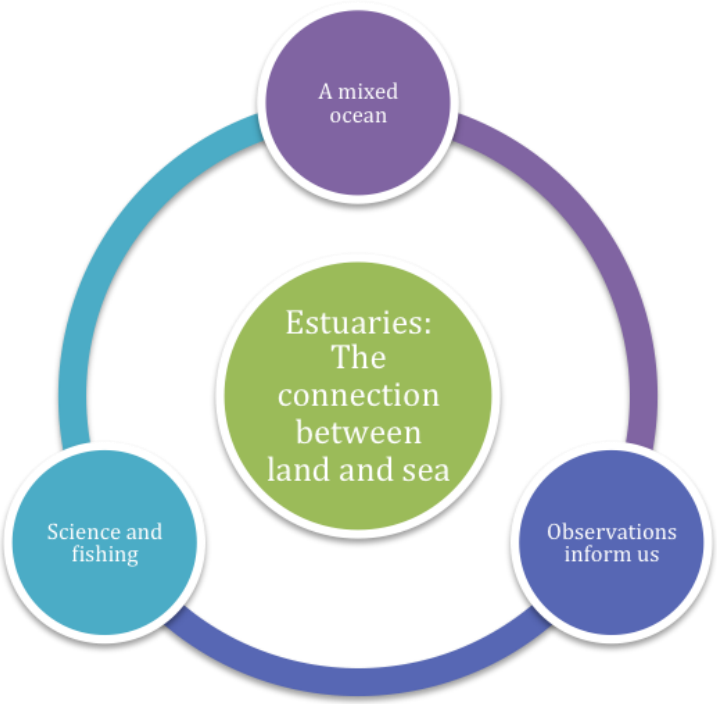
Branched lessons



Cultural/ Scientific Context and Background Information

Ts'msyen Fishing Practices

In Ts'msyen Territory, a variety of fishing techniques have been and continue to be used. New fishing technologies have been introduced throughout Ts'msyen Territory over time to suit the developments and needs of large-scale industrial fishing, while many of the traditional Ts'msyen fishing methods continue to be used today.

Traditional fishing methods were developed and used based on the species of fish that was being harvested, where the fish was both in terms of habitat (river, estuary, or ocean) and depth the species preferred (Salmon being known as a 'deep' fish), as well as the specific time of year. Most marine species have preferred levels of salinity and temperature which determine where they can be found in the water column. The Ts'msyen knowledge surrounding seasonal cycles and depth preferences (based on salinity and temperature) for fish were used to help people fish effectively, with different fishing methods and tools being used based on the specific situation.

Alex Campbell of Lax Kw'alaams, explains that the "science of the time" (also known as a seasonal indicator) plays an important role in determining which species can be harvested during which season. The knowledge of where the species can be found within the water column helps determine which

method of fishing will be used to harvest it. This detailed knowledge of each specific species and method of fishing has been developed over thousands of years and passed on from one generation to the next (Campbell, 2016).

As an example, through observation, and interactions with their territory, Ts'msyen people have come to know when specific salmon runs will be returning to their river systems to spawn. Also, extensive knowledge exists surrounding the places where marine species can be most commonly found as well as when and how to harvest them at sea. The detailed knowledge of salmon includes information on where a species prefers to stay in the water column: on the warmer freshwater surface or in the deeper, cooler, and more salty areas. In Ts'msyen Territory, Gayniss (Chum salmon) are fished for using a spear, Misoo (Sockeye salmon) are fished for at a specific section of the Skeena using a small net, and St'moon (Pink salmon) are fished for using a dip net (Campbell, 2016).

Buoyancy and Density

Buoyancy is a force exerted on an object that is in a fluid. If the upward force exerted by the fluid below the object is greater than the downward force of gravity, the object will float in the fluid. Buoyancy is impacted by the density of the fluid and the volume of the fluid displaced. A fluid with a higher density has a higher "pushing force" on objects within that fluid. For example, saltwater has a higher density that fresh water, and is therefore capable of exerting more upward force on an object placed in it.

Displacement, as well as density, is also key to buoyancy. For example, a tinfoil boat floats because its total volume is greater than the amount of water it displaces due to its mass. The same amount of tinfoil, rolled into a ball, contains a volume that is smaller than the amount of water it displaces and will sink. In saltwater, the tinfoil boat will have a greater pushing force against it and it will float 'higher' in the saltwater than the freshwater.

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Lesson Plan

Materials

Student activity	**Demonstration**
● Tinfoil – one sheet/piece per student (as close to the same size as possible) ● Pennies, or marbles, or small weights such as nuts and bolts ● Foam or rubber washers - small and light ● Tank/basin of fresh water ● Tank/basin of cold salt water (to recreate average ocean water you'll need an approximate ratio of 7 teaspoons of salt for every 4 cups of water) *Tip – the results of this experiment can be exaggerated for effect by providing the students with supersaturated salt solutions rather than near sea water. This creates more of a challenge as the density of the salt solution greatly enhances the amount of 'catch' each boat can carry and allows each boat to sit much lower in the fresh water (possibly increasing the likelihood of sinking).* ● Slotted spoon/scoop/colander to move the boats without changing their shape ● *optional, scale for weighing the boats and determining the amount of water displaced	● 1 raw egg ● 2 large beakers /clear containers /jars ● Saturated salt solution

Preparation

1. Have copies of the 2 passages ready for students.
2. Tear the tinfoil into sheets for the students. One sheet per student is recommended.
3. Make a salt solution, or get a few buckets of seawater.
4. Set out two water baths (15-20cm deep), one of fresh water and one of sea water.
5. Divide washers, marbles, and nuts into bowls for students.

Hook/ Preamble

1. How do technologies and methods change over time? For example, think about what your family eats and where this food comes from. Is this different from how your grandparents got food? How about your grandparents' grandparents? Are there any methods that are the same?

Building connections

1. Have students read the following two passages from the *Łuutigm Hoon*
   Honouring the Salmon: An Anthology Told in the Voices of the Tsimshian that discuss two traditionally used fishing methods. These are just two of the many different fishing methods. Traditionally, it was very common for Ts'msyen people to work with wood and rock to make canoes, spears, fish hooks and traps to harvest a variety of ocean species (Beynon, 1999).

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Fishing with Spears

The last salmon that run up the river they call steelheads. They are just like trout, and they are pretty large. They come late in the fall, and the way they catch them they get long poles and they make at the end something like clamps or tongs, and they have a gaff at the end so they get the whole salmon, and they pull it back. They have one on the end of the tongs and it goes into the flesh of the fish. It was made of very thin and springy boards. That is the way they caught trout sometimes. And they used very this trap at night. They would take a torch cut out of pitch wood and they could see into the water to spear the fish, and they would load up the boat, and in the morning they would give the fish away. They didn't smoke them, they just ate them fresh.

Sidney Campbell, Metlakatla Alaska, 1917
From page 50: *Łuutigm Hoon: Honouring the Salmon: An anthology told in the voices of the Tsimshian.*

Ts'mluulp, Stone Trap

In the olden days it was with the greatest difficulty that the people were able to catch salmon before these went to the streams and rivers. In the rivers they could use traps made of pliable split cedar saplings and basket-like. They could only use those when the salmon headed for the streams. They also used weirs, a fence-like trap.

On the coast they made a *luulp*, a circular trap made of boulders and built up to the height of about three to four feet and covering a very wide area. The operation was very difficult. As the salmon approached in schools the many canoes on the water would endeavour to direct or force these schools of salmon into this enclosure, choosing a time of the falling ebb tide. Once the school was over the enclosure, it had to be kept there and long poles from the many canoes were used to shy the fish in whatever direction they were to be led. This was done until the tops of the *luulp* showed and thus the salmon would be trapped and when the tide left the *luulp* completely dry, then the salmon would be gathered up. Very nearly every salmon stream had a *luulp*.

Saelaban (John Tate), Gispaxlots with William Beynon
From page 51: *Łuutigm Hoon: Honouring the salmon: An anthology told in the voices of the Tsimshian.*

2. Explore with students, what information do these passages give us about Ts'msyen fishing and harvesting methods?

Highlight: in both these passages, observation and knowledge of specific events and water properties informed how people gathered fish. For example, in the second passage, people would use canoes to guide fish into the stream at ebb tide. Careful observation of the tides and changes in water properties would inform people how to best interact their environment, without putting themselves at undue risk. Although it could be challenging, their knowledge helped them catch fish safely, sustainably, and effectively.

Today, similar observations and knowledge can help us make informed decisions about how to safely harvest fish.

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Student Activity/Challenge

Explain to students that prior to colonization and into the early 1900's, Ts'msyen people used canoes as their primary method of transportation on rivers, tributaries, and at sea. One of the reasons Ts'msyen people traveled out to sea in their canoes was to harvest a wide variety of fish from the ocean including salmon, cod, and halibut. The species being harvested were caught and processed in parallel with the Ts'msyen seasons and seasonal indicators. Reference the attached Ts'msyen seasonal rounds posters to make a connection between months and harvesting seasons. Some tribes would use the blooming of salmonberry flowers, while others used the migration patterns of other species.

An example of a seasonal indicator was shared by Alex Campbell of Lax Kw'aalams:

> "When the sockeye is on our coastline… we see a swallow flying around on the coast that means the sockeye is here on our coast...outside Digby… ready to go up the river, the swallows are there. When they lay their eggs and the little ones hatch that means the sockeye is finished. Now here comes the chums, pinks, mixed with Coho, and when the little one flies out of the nest, that means the Coho are now on our water. And that's how we know what type of gear to use" (Campbell, 2016).

Scenario: You have become lead on a fishing canoe heading into the Pacific to bring back a fish harvest. You are to construct your boat out of tinfoil (you can use any design you like) and then 'launch' it and collect as many fish as possible. As the environment is healthy and pristine, you can bring back as much catch you choose- as long as you do not sink. Further, feel free to be innovative when designing your craft- the only rule here is **do not sink**. When you are satisfied with the amount of your catch, you will take your boat (without changing anything) into the estuary, on the way back home. You'll only be considered successful if you can make it home with all of your catch. If you're too greedy and lose fish - or worse, sink your boat - you'll never hear the end of it.

1. Using the tinfoil, create a boat of your choosing. Keep in mind: points are awarded for the size of your catch, not the style of your boat. Also consider how you might transport your catch and if you can devise any way of transporting your catch alongside your vessel, rather than directly in your boat as practiced by the Ts'msyen pre-colonization.
2. Launch your boat in the saltwater bath and then add as much 'catch' as you like. Observe how the boat sits in the water, noting the waterline on the edge of the boat and the edge of the tank.
3. Next, move the boat (without changing anything) into the freshwater bath using the slotted spoon. Observe the boat and its level in the water. Have there been any changes?

Application of observations and information (Critical thinking)
Explore with students, why do they think their boats sat lower in the second tank? Did any of them sink completely in the freshwater bath?

Highlight for students that there is a scientific way of explaining what is happening; challenge the students to describe it in their own words. Using both scientific information and what you've learned about Ts'msyen fishing practices, how would you explain what you learned to someone who has never experienced it before?

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Explore the following demonstration with students:

1. Fill 2 large beakers, one with a saturated salt water solution and one with fresh water. Have students note that each represents a homogenous solution.
2. Ask the students to make predictions about what will happen when an egg (still in the shell) is added into the water. Will the egg float or sink in the solution? Using the spoon, move the egg from one beaker to the other.
3. Discuss buoyancy with the students. Highlight how the volume, and the amount (mass) of water the egg displaces remains the same, but the increased density of the saltwater causes the egg to float in the solution.
4. Brainstorm with the students, how these same factors impact boats today. What do they think will happen when the boat travels from the ocean to an estuary where the water may be fresher? What other factors might be changing the water?

Final remarks

Ts'msyen people did not overload canoes with their catch, rather, they only took what they needed. Canoes were about 40 feet in length and could hold around 300 sockeye. Instead of filling their canoes with fish they would often string together their catch of 500 - 600 fish so that they would float together alongside the canoe. This method of bringing back ocean species harvested at sea wouldn't weigh down the canoe and affect buoyancy when returning upstream. Bull kelp was placed on top of the fish to prevent them from being damaged by the sun. Selective fishing methods were used depending on the season, area, and the species being harvested.

References and Collaborations

This unit - Estuaries: the connection between land and sea - was developed in collaboration and partnership with Aboriginal Education SD52, Prince Rupert, Wap Sigatgyet. Ocean Networks Canada would like to thank Wap Sigatgyet staff for their ongoing support in assisting with the development of authentic and accurate Ts'msyen resources.

Ocean Networks Canada would also like to thank all Ts'msyen community contributions that were shared with us to make this a meaningful resource.

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