Lesson Plan 2: Beach Clean

Subject: Environmental Science	**Grade: 1-5**	**Duration: Approx half a day**
Lesson Overview	To engage students in place based learning by understanding the impact of plastics in the oceans by their presence on local beaches. Learn how to effectively and efficiently clean the beach, collect marine debris data, and then discuss how the debris can be used and / or recycled. You will learn about ocean currents and gyres, and how these systems impact the dissemination of marine debris.	

Curriculum Ties (in addition to satisfying multiple core competencies)

Core Competencies:

Subject	Grade	Curriculum Points
Science	1	• Local First People's knowledge of the local landscape, plants & animals.
Science	2	• Local First People's knowledge of water: ○ Water cycles ○ Conservation ○ Connection to other systems - cultural significance of water (i.e., water is essential for all interconnected forms of life)
Science	5	• The nature of sustainable practices around BC's resources • First People's knowledge of sustainable

			practices ● First Peoples concepts of interconnectedness -everything in the environment is one / connected (e.g sun, sky, plants, and animals) and we have a responsibility to care for them.

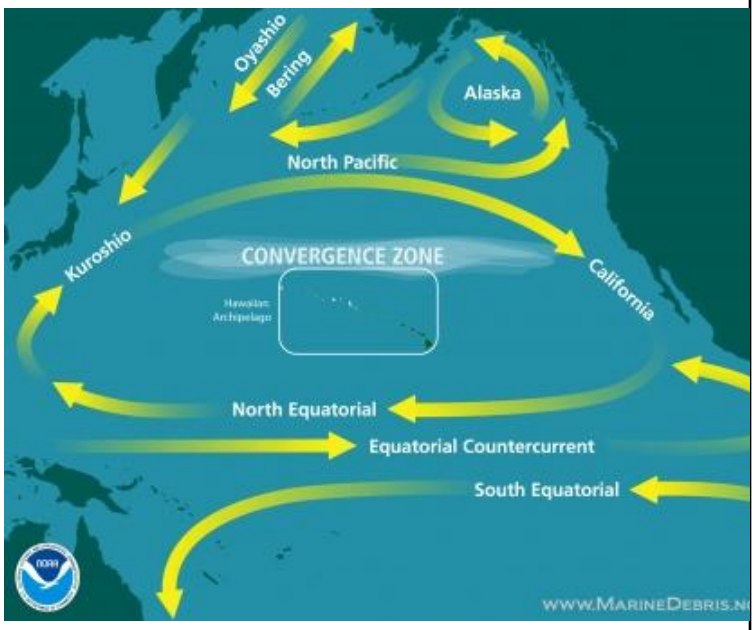
Content Objectives	● Understanding the impact of plastics in the oceans by their presence on local beaches. ● Learn how to effectively and efficiently clean the beach, collect marine debris data, and then discuss how the debris can be used and / or recycled. ● You will learn about ocean currents and gyres, and how these systems impact the dissemination of marine debris.

Materials and Equipment Needed for this Lesson
● Transport to your clean-up location, and potentially transport for your debris (scout the area beforehand to get a sense of the type of debris you're likely to encounter) ● Gardening gloves, 1 pair per person ● Reusable bags for debris collection ● Field trip safety equipment (first aid kit, communication device etc) ● Camera (phone camera is great!)

Lesson Stages	**Learning Activities**

Introduction	**Begin with a discussion:** Recap on zones of the ocean, plastic pollution and microplastics, and students hypothesize on what kind of debris they will find at the location of their beach clean and why they have washed onto the shores based on discussion of ocean gyres and currents. Some key questions: What oceanic forces affect debris dissemination? (wind & currents). Which gyre / current systems affect your local beach? Where might the debris come from? Will the debris you find change throughout the year? How will winter storms affect beach debris? *See Teacher Information section below for support with this.*
Activity	**ACTIVITY: Beach Clean** Some tips for effective beach cleaning: ● Split your group into teams and designate clear sections of beach ● Clean 'backwards' (i.e. walk to the furthest point away from your meeting place and pick up debris on your way back to minimize unnecessary carrying) ● Have a 'sweep' - a pair of beach cleaners that follow the group to check for missed debris *See Teacher Information section below for more suggestions for a successful beach clean!*
Closure	**DISCUSS & WRITE:** ● What were your top 5 trash trends? ● Did you find any items that you use in your day-to-day life? ● How could you REDESIGN some of these items to create reusable alternatives? What materials could we use instead of plastic? ● How can YOU take responsibility for reducing plastic pollution? *(use appendix 3, page 25 in the student workbook "Ten Ways To Rise Above Plastic" for inspiration if needed)* *Remind students to continue thinking about how to make their school more sustainable and ocean friendly!*

Modifications / Extensions	● You can have students extend this by writing a letter. Using their list of top things they found on the beach, they can write a letter to a business or someone in their community they think could make a difference, with the intent to ask them to help make a change with an idea that students come up with.

Additional Information for Teachers	**Teacher Information for class 2:** Info source: www.marinedebris.noaa.gov "How does marine debris move and where does it go? Wind, gyres, and ocean currents all impact how marine debris gets around. Floatable marine debris items, once they enter the ocean, are carried via oceanic currents and atmospheric winds. Factors that impact currents and winds, such as El Niño and seasons, also affect the movement of marine debris in the ocean." **How Debris Accumulates:** Many different ocean features can cause debris to accumulate, and it can do so on a very large scale or small scale. For example, gyres, which spin over huge swaths of ocean, can aggregate debris in their centers. Smaller scale debris aggregations can result from eddies or other tiny features.  **What is a gyre?** A gyre is a large system of rotating ocean currents that spiral around a central point, clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere. Worldwide, there are five major subtropical oceanic gyres: the North and South Pacific Subtropical Gyres, the North and South Atlantic Subtropical Gyres, and the Indian Ocean Subtropical Gyre. The most studied and notable gyre, the North Pacific Subtropical Gyre, has the tendency, similar to any circulating body of water, to collect debris near its center. This anticyclonic gyre rotates in a clockwise direction and is comprised of four major ocean currents – North Pacific current, California current, North Equatorial current, and Kuroshio current. Because it is a dynamic system, a gyre's exact size is difficult to measure, but the North Pacific Subtropical Gyre is estimated to be 7 to 9 million square miles. This is equivalent to approximately three times the area of the continental United States (three million square miles).

Marine debris items can become entrained within the North Pacific Subtropical Gyre and accumulate in the center, based on its overall convergence. Gyres can accumulate debris on a very large scale, but they do not produce “garbage patch”-like concentrations.

Another area known to concentrate marine debris is the North Pacific Subtropical Convergence Zone (STCZ). This convergence feature concentrates food sources for many species, making it a high productivity area for feeding and breeding. However, the same forces concentrate marine debris, which comes ashore on the uninhabited Northwestern Hawaiian Islands as the Convergence Zone shifts north and south, passing debris through the island chain.

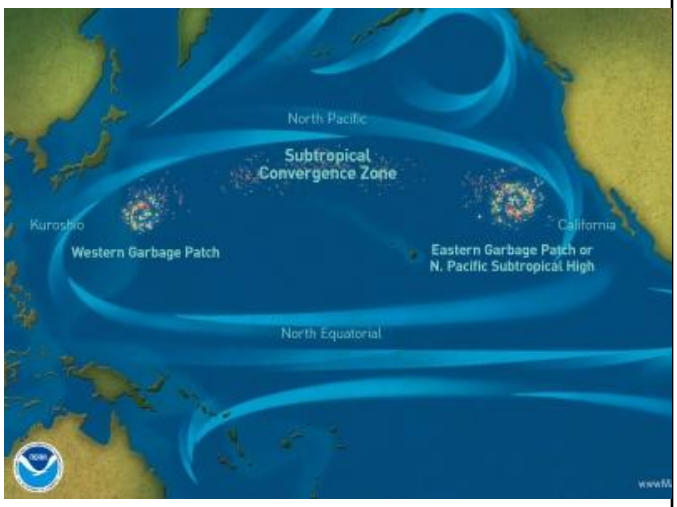
Meanders, eddies, and other medium-to-small features

Within the transition and convergence zones there are a multitude of medium-scale features such as oceanic eddies and frontal meanders. Think of meanders as the deviation from a straight line. As energy (wind/currents) hit the front, there are undulations and "curvature" which are described as frontal meanders (movements to the north and south along the front).

These features can concentrate and scatter debris within the convergence zone depending on the location and type of feature. They produce the accumulations, such as the one that occurs in the North Pacific Subtropical High, that are sometimes referred to as “garbage patches.”

On a small-scale, marine debris may be concentrated by Langmuir circulation. Langmuir circulation is the result of the interaction between wind-driven surface currents and surface waves. Though Langmuir circulation may be present in weak or no-wind situations, it is most often seen when the wind speed is 1.5 m/s or greater.

Great Pacific Garbage Patch



The name “Pacific Garbage Patch” has led many to believe that this area is a large and continuous patch of easily visible marine debris items such as bottles and other litter —akin to a literal island of trash that should be visible with satellite or aerial photographs. While higher concentrations of litter items can be found in this area, along with other

debris such as derelict fishing nets, much of the debris is actually small pieces of floating plastic that are not immediately evident to the naked eye.

The debris is continuously mixed by wind and wave action and widely dispersed both over huge surface areas and throughout the top portion of the water column. It is possible to sail through the "garbage patch" area and see very little or no debris on the water's surface. It is also difficult to estimate the size of these "patches," because the borders and content constantly change with ocean currents and winds. Regardless of the exact size, mass, and location of the "garbage patch," manmade debris does not belong in our oceans and waterways and must be addressed.

What types of currents affect British Columbia?

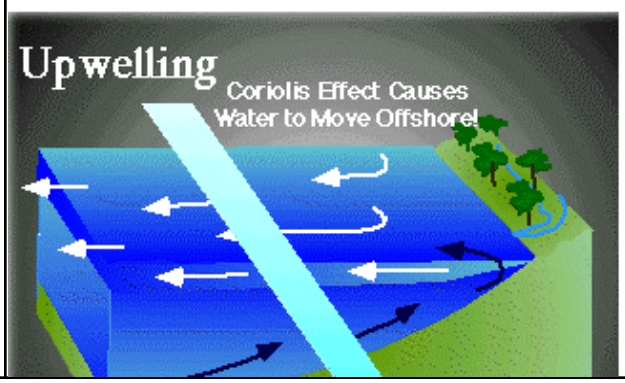
From https://www.crd.bc.ca/education/our-environment/geology-processes/global-ocean-currents

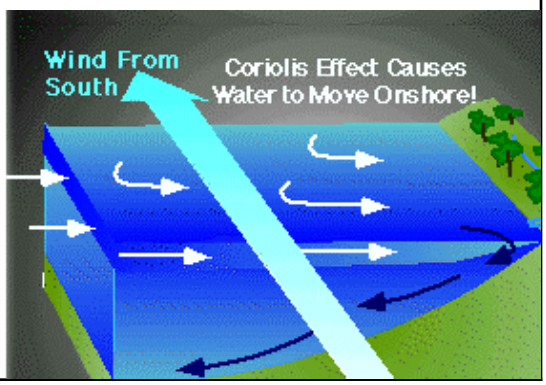
BC is not directly affected by the deep ocean currents, but these currents are important regulators of the global climate. Cold water from polar regions is circulated to warmer latitudes, and warm water is brought to the poles. This natural heating/cooling system helps to absorb changes in air temperature.

The North Pacific surface current flows with prevailing westerly winds and encounters North America near southern British Columbia. The current splits into two when it encounters the land mass; the Alaska current, which flows north along the BC coast, and the California current, which travels south. The North Pacific current is relatively warm, and brings mild, moist weather to the coast of BC.

Upwelling / Downwelling

Upwelling and downwelling are caused by surface currents and have important effects on marine life. As discussed above, Coriolis force causes water to move to the right in the northern hemisphere. Therefore, a surface current flowing southward along a western coast (or northward





along an eastern coast) is drawn to the right and water must rise from below to replace it (see diagram below). This condition is called upwelling, and occurs along the southern coast of B.C. and California. Upwelling brings cold, nutrient-rich water to the surface. Plankton feed on these nutrients and form the basis of a rich marine food web.

Downwelling occurs in the northern hemisphere when a north-flowing current travels along a western coast, such as the Alaska current does along the northern B.C. coast and Alaska panhandle. Coriolis still forces the water to turn to the right, but in this case the land forces the water downward and it is replaced by surface water. The surface water is not as high in nutrients as deeper water.

Upwelling vs. downwelling

Depending on the seasons and on climate fluctuations such as El Niño, the exact position of the surface currents varies. Because Vancouver Island is near the point where the North Pacific Current encounters the coast of North America, it is actually in a "transition zone" where the surface currents can vary considerably. Consequently, the types of marine species that live here also vary. The extent to which shorelines are exposed to currents also determines the types of plant and animal communities that occur there.

Implications for marine debris on Vancouver Island

The NPC forms the northward portion of the North Pacific Subtropical Gyre. As the eastward extension of the Kuroshio, the westward flow of the NPC can lead to the transport of material from the western Pacific to the coast of North America. For example, some of the marine debris from the Japanese earthquake and tsunami of 2011 was transported by the NPC across the Pacific, leading to deposition of tsunami debris along the shores of Alaska, British Columbia, Washington and Oregon.

How To Lead a Beach Clean

-Before heading out on your next walk or beach clean, check the weather and the tides to make sure conditions are safe while you're out!

-Bring an adult to help you with the clean up, and invite any friends! More hands make work light!

-Bring your own reusable bag to put litter/debris in.

-Dress for the weather and be sure to wear gloves to protect your hands!

-While walking, scope out different areas of the ground and see what stands out, it may be small pieces like a plastic straw or a large item like a tire. Make sure to only pick up foreign debris, and leave any natural elements in their respective environment.

-If you're on the beach, you will most likely be able to find all kinds of microplastics. Look behind driftwood and in the vegetative line to find tiny colourful pieces of plastic!

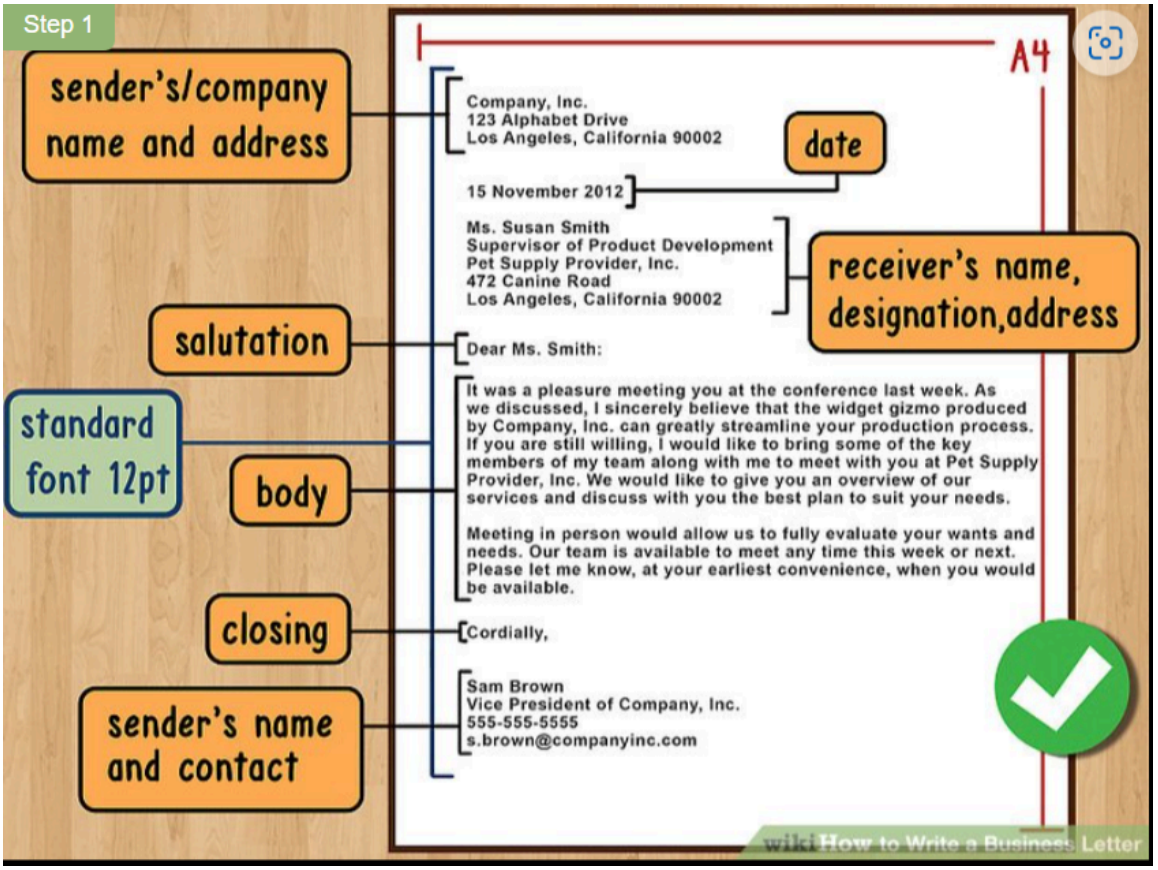
-Take photos, visuals help to tell a story and serve as evidence for the data you collect.

-Bring all materials home to sort, with the goal of diverting as much material from landfill as possible. Recycle all materials you can locally, and look into alternative recycling options available through Terracycle, or even your local Surfrider chapter.

-Once you've ended your clean up, you can send photos to Surfrider Pacific Rim to share on the public forum to celebrate your success and involvement.

-Reflect on your clean up and how you can prevent plastic pollution through your own actions. Discuss your ocean friendly behaviours with your friends and work together to make a difference!

How to Write a Letter:


Step 1
sender's/company name and address
A4
Company, Inc.
123 Alphabet Drive
Los Angeles, California 90002
date
15 November 2012
Ms. Susan Smith
Supervisor of Product Development
Pet Supply Provider, Inc.
472 Canine Road
Los Angeles, California 90002
receiver's name, designation,address
salutation
Dear Ms. Smith:
standard font 12pt
body
It was a pleasure meeting you at the conference last week. As we discussed, I sincerely believe that the widget gizmo produced by Company, Inc. can greatly streamline your production process. If you are still willing, I would like to bring some of the key members of my team along with me to meet with you at Pet Supply Provider, Inc. We would like to give you an overview of our services and discuss with you the best plan to suit your needs.
Meeting in person would allow us to fully evaluate your wants and needs. Our team is available to meet any time this week or next. Please let me know, at your earliest convenience, when you would be available.
closing
Cordially,
sender's name and contact
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