Lesson Guide: Seaweed

Vocabulary:

- Macroalgae
- Phycology
- Intertidal Ecology
- Bioremediation
- Carrying Capacity
- Iodine Deficiency
- Food Sovereignty
- Terrestrial food source
- Phenology
- Sustainable Aquaculture

Engage:

- Read the passage: *'What the Water Has Always Known: Indigenous Seaweed Science, Food Sovereignty, and the Battle to Preserve Both'*
- **Before reading,** ask students…
  - Have you ever seen seaweed before? If so, what did it look like?
  - Have you ever tried eating seaweed before? If so, what did it taste like?
- For a more in-depth introduction to seaweed and importance of kelp forests:
  - Tribal access to the ocean can help save the kelp
  - Kelp: Hidden Treasure of the Salish Sea | Changing Seas
- **After reading** and reviewing resources above, ask students…
  - How does Traditional Ecological Knowledge (TEK) show a relationship of responsibility rather than ownership between people and the ecosystem?
  - What can modern science learn from Indigenous harvesting protocols, such as leaving the holdfast intact or using phenological indicators?
  - In what ways does practicing TEK help protect ecosystems from long term damage, and why might these practices be more effective than some modern approaches?
  - What responsibilities do people have today—Indigenous and non Indigenous—to ensure that local food systems (like seaweed or kelp habitats) remain healthy for future generations?

Explore and Explain:

- **Activity 1: Indigenous Language Vocabulary**
  - Students review the provided definitions to learn key vocabulary terms about seaweed. Students then write the closest term from their own language or research the Tlingit term (or other Indigenous language) that closely matches the word/s.
  - This activity builds academic vocabulary, strengthens language connections, and helps students understand how cultural knowledge and meaning are embedded in words and how naming something in a language reflects a community's deep relationship with it.

Activity 2: Reading the Coastal System — Intertidal Ecology, Trophic Cascades, and Stewardship Zones

- Students read a structured passage introducing three foundational ecological concepts, including intertidal zonation, trophic cascades, and hereditary stewardship zones, then respond to three guided analysis questions requiring them to trace the ecological consequences of the sea otter fur trade, explain why leaving the holdfast intact is a habitat preservation practice and not simply a harvest rule, and interpret Melissa Poe's phrase "looking to the past to prepare for the future" in concrete ecological and practical terms.
- This activity builds ecological systems literacy and causal reasoning skills, helping students understand that the collapse of Pacific Coast kelp forests was not a natural environmental event, but a documented chain reaction triggered by colonial commercial extraction, and that the hereditary stewardship zones disrupted by colonial policy were functional, ecologically designed resource management systems, not merely territorial or cultural designations. Students develop the analytical vocabulary needed to connect food sovereignty arguments to ecological science throughout the remainder of the unit.

- **Activity 3: Traditional vs. Contemporary Seaweed Harvesting Venn Diagram**
    - Students compare traditional Indigenous seaweed harvesting practices, as documented through ethnobotanical research, oral histories, and community records, with modern commercial seaweed aquaculture, using a Venn diagram to identify what is unique to each approach and what they share across dimensions of water use, knowledge systems, scale, community relationship, species diversity, seasonal awareness, and stewardship responsibility.
    - This activity builds systems thinking and scientific comparison skills and helps students recognize that traditional ecological knowledge is not outdated but represents a sophisticated, multi-variable management framework developed across generations, and that modern conservational science is only now beginning to formally document and validate what Indigenous people have known for generations.

Elaborate:

- **Activity 4: Seaweed Nutrition Deep Dive**
    - Students investigate the nutritional profile of three major commercial seaweed types: Nori, Wakame, and Kelp/Kombu. Students use provided data to calculate percentages of daily recommended values for key nutrients including iodine, Vitamin B12, calcium, iron, and omega-3 fatty acids, then answer questions connecting nutrition science to Indigenous coastal food systems and public health history.
    - This activity builds quantitative nutrition literacy and data interpretation skills while helping students understand that seaweed is a biochemically sophisticated food source — and that Indigenous coastal peoples demonstrated an empirical, observationally derived understanding of its health benefits, including iodine's role in preventing thyroid disease, long before modern nutritional science confirmed the biochemistry.

- **Activity 5: Carrying Capacity and Sustainable Seaweed Harvest**
    - Students apply ecological carrying capacity concepts to a real-world scenario: calculating the total harvestable seaweed from a family's 200-meter hereditary stewardship zone, determining the maximum sustainable harvest using the 40% rule documented in traditional protocols, and comparing that yield to the nutritional needs of a family of six across an eight-month season.
    - This activity develops quantitative reasoning and ecological literacy while demonstrating that hereditary stewardship zones were not merely cultural or territorial designations — they were functional resource management units, sized and governed in ways that enabled sustainable yield across generations. Students come to understand that food sovereignty and ecological science are deeply intertwined in Indigenous coastal resource governance...

Evaluate

- **Activity 6: TEK, Colonialism, and Food Sovereignty Analysis**
    - Students research four specific colonial policies; the residential school system, the Indian Act potlatch ban (1885–1951), commercial fisheries licensing barriers, and the sea otter fur trade collapse. Students complete a structured analysis table documenting how each policy disrupted Indigenous seaweed harvesting knowledge and practice, as well as the documented long-term nutritional and ecological consequences of that disruption.
    - This activity builds historical analysis and critical thinking skills, helping students understand that the erosion of Indigenous food systems was not accidental but the result of specific, documented policy decisions — and that the nutritional and ecological harms of those policies persist today. Students develop the ability to connect policy history to public health outcomes and ecological change, a core competency in food sovereignty literacy.

- **Activity 7: Critical Analysis Essay (1-2 pages)**
    - Students write a 1–2 page evidence-based analytical essay responding to the prompt: 'Traditional Indigenous seaweed harvesting practices represent a sophisticated convergence of nutritional science, ecological management, and cultural knowledge systems.' The essay must include a clear thesis connecting all three domains, evidence-based analysis referencing at least three content areas from the unit, discussion of at least one colonial policy and its documented impact, a conclusion connecting traditional knowledge to a contemporary challenge, and correct use of at least five unit vocabulary terms with at least three cited sources.
    - This activity consolidates students' learning across the full arc of the unit — science, nutrition, history, and policy — into a structured academic argument, developing analytical writing skills, evidence-based reasoning, and the ability to synthesize knowledge across disciplines. It also asks students to practice the kind of integrative thinking required to connect historical injustice to present-day challenges, a critical literacy skill for engaged, informed citizenship.

Suggested Lesson Activities:

- Indigenous Language Vocabulary

- Traditional vs. Contemporary Seaweed Harvesting Venn Diagram
- Seaweed Nutrition Deep Dive
- Carrying Capacity and Sustainable Seaweed Harvest
- TEK, Colonialism, and Food Sovereignty Analysis
- Critical Analysis Essay (1-2 pages)

Additional Educator Resources:

- Farming Kelp the Heiltsuk Way
- Advancing regenerative kelp practices for coastal communities present and future
- Species of the Kelp Forest
- B.C. scientists have developed a technique to restore kelp forests for future generations
- By cultivating seaweed, Indigenous communities restore connection to the ocean
- Seaweed Harvester Information, Maine Seaweed Council
- Indigenous knowledge of key ecological processes confers resilience to a small-scale kelp fishery
- Students connect with tradition and language at Hoonah culture camp
- Black Seaweed Concerns Prompt Native Groups, Scientists to Meet, Map Out Action Plan
- Alaska Harvesters and Scientists Share Concern Over Black Seaweed
- NPS Indigenous Knowledge and Traditional Ecological Knowledge
- Lepofsky, Dana & Caldwell, Megan. (2013). Indigenous Marine Resource Management on the Northwest Coast of North America. Ecological Processes. 2. 10.1186/2192-1709-2-12.
- Indigenous Peoples' food systems
- Canopy Kelp Forests Persist in Coastal Alaska Despite Century of Climatic and Ecosystem Change
- The Interconnected Nature of Food Security and Food Sovereignty
- Tribal access to the ocean can help save the kelp
- Seaweed Harvard Nutrition Source

Teacher's Note: This unit engages directly with colonial history and its ongoing impacts on Indigenous communities, food systems, and ecological knowledge. Center the voices of Indigenous scholars, scientists, and community members. Where possible, connect students with local or regional Indigenous environmental educators. The science of seaweed ecology and nutrition is best understood alongside — not instead of — the cultural and historical context that made this knowledge possible.

What the Water Has Always Known: Indigenous Seaweed Science, Food Sovereignty, and the Battle to Preserve Both

A Documentary Narrative for Grades 9-12, Grounded in Published Research, Primary Sources, and the Documented Words of Indigenous Scientists and Community Members

How to Read This Narrative

This is not a fictionalized story. It is a narrative that synthesizes documented, peer-reviewed research and the published words of Indigenous knowledge holders, researchers, and community members. Quotations are real and attributed. Place names, species names, and cultural protocols are documented and verified. Source notes appear throughout so you can investigate further. The peoples discussed — primarily the Tlingit, Haida, Tsimshian, Heiltsuk, Kwakwaka'wakw, and Native Hawaiian communities — represent thousands of years of coastal ecological knowledge that modern marine science is only beginning to formally validate.

A Cornerstone of the Diet and Identity

"Black seaweed is a significant and favorite food source for our tribal members. Our Native foods contribute to our health and well-being."

— Rosita Worl, Tlingit scholar and President of the Sealaska Heritage Institute (2022)

Among the coastal people of the Pacific Northwest and Southeast Alaska, including the Tlingit, Haida, Tsimshian, Heiltsuk, and Kwakwaka'wakw, seaweed has been a dietary cornerstone, a trade commodity, a medicine, and a ceremonial food for thousands of years. The single most prized species across the region is a thin, ribbon-like red algae (Pyropia abbottiae, or related Porphyra species) known as “Laak'ásk” (pronounced: laak-ask) in Tlingit, “Sgi'w” (pronounced: sgyoo) in Haida, and “La'axsk” (pronounced: lah-ask) in Tsimshian. Modern scientists who have studied the ethnobotanical literature describe it as "mentioned everywhere" in the historical record; "a paragraph, a sentence in all these different ethnographic studies", but rarely documented in depth.

That underrepresentation is itself a form of erasure. What has been dismissed as a footnote in Western scientific literature is, in the words of the communities who harvest it, one of the cornerstones of their diet, their economy, their ceremonial life, and their relationship to the ocean.

The Science Embedded in Practice and Thousands of Years of TEK

Traditional Ecological Knowledge is not oral history preserved in amber. It is a living, adaptive, tested knowledge system developed through generations of direct interaction with specific ecosystems. In the case of Pacific Coast seaweed, the sophistication of this knowledge is extraordinary.

What Traditional Seaweed Harvesting Protocols Actually Accomplish, Ecologically

- Leaving the holdfast intact: Documented Tlingit and Haida harvesting protocols require cutting or pulling only the upper portion of the seaweed plant, leaving the holdfast, which is the root-like anchor, attached to the rock. Research conducted in partnership with the Heiltsuk Nation and Simon Fraser University found that following this partial-harvest protocol caused kelp to regrow "more enthusiastically than if left alone." Thirty

years after Western marine ecology "discovered" the ecological benefit of partial harvesting, it confirmed what coastal Indigenous peoples have practiced since before any living memory.

- Never stripping a rock bare: Leaving seaweed coverage on intertidal rocks maintains the microhabitat for dozens of species of invertebrates, juvenile fish, and the organisms that are themselves prey for commercially and culturally important species. The Native Village of Eyak's harvest guidelines explicitly state: "Never leave a rock bare of seaweed or the habitat is negatively impacted."
- Sharing with elders and distributing harvest: This cultural practice, often framed in Western literature as simply "generosity", functions ecologically as a distributed harvesting network that prevents localized depletion. When harvest is shared across the community, no single beach is over-harvested.
- Phenological timing: The use of ecological indicators (nettle and alder bloom, herring spawn activity, whale movements, tide level) to determine harvest readiness represents a multi-variable biological monitoring system that has been maintained and refined over millennia. Published ethnobotanical literature confirms that these phenological signals correspond accurately to optimal harvest windows for multiple seaweed species.

What modern conservation science calls "sustainable harvest", taking no more than the ecosystem can regenerate, timing harvest to reproductive cycles, rotating harvesting areas, maintaining habitat structure, is precisely what documented Indigenous harvest protocols do. The difference is that Indigenous communities developed and maintained these practices through cultural transmission across hundreds of generations, not through peer-reviewed journals.

Nutrition, Medicine, and the Iodine Problem

The nutritional logic of traditional seaweed consumption is equally well-documented. The same coastal people who were sustained by Laak'ásk, bull kelp, ribbon seaweed, and sea lettuce were, for thousands of years, protected from one of the world's most serious nutritional deficiencies: iodine deficiency.

Iodine is essential for the body to produce thyroid hormones, which regulate metabolism, brain development, thermoregulation, and growth. Iodine deficiency is, as of the present, still the leading preventable cause of intellectual disability worldwide. It is rare in populations with regular access to seafood and seaweed, because marine algae concentrate iodine from seawater at levels far exceeding any terrestrial (land based) food source. Tlingit oral tradition and recorded Sugpiaq practice both document the consumption of black seaweed specifically to prevent goiter, which can cause the visible thyroid swelling, a hallmark symptom of iodine deficiency. This was not coincidence. It was empirical medicine derived from observation.

The Tsimshian used black seaweed poultices to control bleeding and treat wounds. New mothers were given boiled black seaweed to support postpartum recovery. The Tlingit used seaweed to soothe stomach and bowel troubles. Dr. Dolly Garza, a Tlingit/Haida traditional foods educator with a PhD in Marine Policy and a former University of Alaska professor, puts it directly: "Although I grew up harvesting seaweed, as a child I didn't realize that there was science involved. But to gather food on the beach, you are a botanist, a biologist, and a climatologist all in one, because you have to be able to correctly identify the plants and animals you are collecting, you need to know how to read the tides, understand the seasons, and study the clouds to learn about the weather conditions."

The Hawaiian Limu; A Parallel Tradition, Parallel Losses

The seaweed knowledge system of Pacific Northwest and Alaska Native people has a remarkable parallel in the Hawaiian Islands, where Native Hawaiians have cultivated deep relationships with many species of "limu"- the collective Hawaiian term for seaweed and aquatic plants. Native Hawaiians developed distinct uses, names, and protocols for dozens of limu species across the islands, representing one of the most sophisticated ethnobotanical relationships with marine algae documented anywhere in the world. Among the most culturally significant is Limu kala (*Sargassum echinocarpum*), a brown algae found in Hawaiian coastal waters, whose name carries layered meaning: *kala* means both "to free" and "to forgive" in 'Ōlelo Hawai'i. This particular species was used in the traditional conflict resolution and reconciliation practice of “ho'oponopono”-- a use found in no other culture in the world.

In traditional Hawaiian culture, limu was the third essential component of a nutritionally complete meal, alongside fish and poi (fermented taro). It provided minerals, vitamins, and the distinctive flavor that made the diet of coastal communities nutritionally robust. Women were traditionally the limu experts, gathering and preparing seaweed for entire communities under the kapu system that restricted them from certain other foods.

Dr. Isabella Aiona Abbott, the first Native Hawaiian woman to earn a PhD in science, and recognized as the world's leading expert on Hawaiian limu spent her career documenting the hundreds of uses that Indigenous Hawaiians had developed for limu species. Her work bridges the worlds of Western taxonomy and Native Hawaiian cultural knowledge in precisely the way that the field of ethnobotany aspires to do.

The Loss, and What Is Being Rebuilt

Over the past 50 years, many native Hawaiian limu species became far less common along the islands' shores, the result of urban development, unsustainable commercial harvesting, introduction of invasive species, and ocean warming. As limu declined, so did the knowledge: many of the younger generation of Native Hawaiians grew up without learning the culinary, medicinal, and spiritual uses their ancestors had practiced.

In 2014, at the request of kūpuna (elders) who were alarmed by this loss, the community organization Kuaʻāina Ulu 'Auamo (KUA) partnered with the 'Ewa Limu Project to "gather the gatherers", which brought together more than 30 traditional limu practitioners representing six Hawaiian Islands for four days of knowledge sharing and collaboration. The resulting organization, Limu Hui, now works to both restore limu populations through community-based aquaculture and to pass ancestral knowledge to younger generations.

As Limu Hui co-founder Wally Ito explains: "The idea of limu restoration is not so much just limu planting; it's a pathway for community cohesion. To get younger kids out of the house and get them to touch the limu. Smell the limu. Taste the limu. We have this taste, this 'ono, of limu. But we cannot pass on that taste to the next generation if the limu isn't there."

Food Sovereignty, Colonial Disruption, and What Is at Stake

The parallel declines of limu in Hawai'i and black seaweed knowledge in Southeast Alaska are not only ecological events. They are the downstream consequences of policies that deliberately severed Indigenous communities from their food systems, their waterways, and the knowledge systems built around them.

In Canada, the Indian Act potlatch ban (1885-1951) made it illegal for coastal First Nations to hold the ceremonial gatherings where traditional foods, including seaweed, were central. Residential schools removed generations of children from the communities, coastlines, and elders who would have taught them harvest protocols, species identification, and preparation methods. Fisheries regulations imposed licensing requirements that treated traditional seaweed harvest as commercial activity, a legal redefinition that made Indigenous harvest criminally chargeable while privileging commercial non-Indigenous operators.

In Hawai'i, the transition from subsistence-based coastal communities to tourist-driven urban economies, combined with the introduction of invasive seaweed species by heavy maritime traffic, disrupted both the ecological basis and the cultural practice of limu harvesting simultaneously.

The Food Sovereignty Frame

Food sovereignty is defined as the right of peoples to define their own food systems, meaning what they grow, harvest, eat, and trade, according to their own cultural, ecological, and economic values. Melissa Poe, a social scientist at Washington Sea Grant and coordinator of the Indigenous Aquaculture Collaborative Network, describes what is at stake in Indigenous seaweed work this way:

"If I were to list goals that various community members have expressed, healing from the harms of colonization is one goal, along with food sovereignty and security. These projects also enable the 'awakening of knowledge' around resource management from an Indigenous framework--one that recognizes the kinds of inherent responsibilities and kinship that Indigenous, place-based peoples have with their environments."

"Sometimes the community members in our network use the phrase: 'looking to the past to prepare for the future.'"

The Science Is Catching Up

In 2026, researchers at the Sealaska Heritage Institute, funded by a $350,000 National Science Foundation grant, are conducting the first comprehensive documentation of black seaweed as a cultural keystone species across seven Southeast Alaskan communities. The project is led by Dr. Kelly Monteleone, an underwater anthropologist, working with a team that includes multiple Tlingit and Tsimshian researchers, a structure that intentionally centers Indigenous expertise rather than treating it as supplementary to Western scientific authority.

The project was partly catalyzed by Irene Dundas, a lifelong Tlingit black seaweed harvester in the Ketchikan area, who in 2021 noticed that the seaweed she was harvesting looked and tasted different; it was oddly shaped, discolored, and off-flavor. She reported her concerns to the Sealaska Heritage Institute. Scientists are now investigating whether ocean warming linked to climate change is altering the chemistry, morphology, or distribution of Laak'ásk--changes that a Western scientific monitoring program had not detected, but that a lifelong harvester with generational knowledge of the resource noticed immediately.

This is the epistemological argument for Traditional Ecological Knowledge in its most practical form: when a community has practiced careful, attentive stewardship of a specific resource across hundreds of generations, community members become the most sensitive ecological

monitors available. The lived relationship with the resource, the ability to compare what the seaweed looks like today with what your grandmother described, with what elders in seven communities are observing simultaneously, is a distributed, longitudinal monitoring system that no university design study has yet to replicate.

A Final Word — From the Shore

The ocean along the coast of Southeast Alaska, British Columbia, Washington, Oregon, and Hawai'i has always known what researchers are now beginning to write down. The seaweed has always been there. The knowledge of how to harvest it, prepare it, share it, and protect it has always been there too. Held by families, passed between grandmothers and granddaughters on rocky shores at minus tide, encoded in the names of the species in a dozen languages, and demonstrated in every spring harvest that leaves the holdfast intact.

What is at stake in the preservation of this knowledge is not nostalgia. It is nutrition, ecology, sovereignty, and the capacity to feed communities from living, renewable, local systems, which is exactly what the global food system urgently needs more than ever.

The water has always known. The question is whether people will listen.

Sources: Sealaska Heritage Institute (2022); KCAW/KNBA coverage of Dr. Kelly Monteleone's NSF-funded documentation project (2026); ResearchGate: Turner & Grevstad, Ethnobotany of Edible Seaweed (2021)

Source: Mongabay: "By Cultivating Seaweed, Indigenous Communities Restore Connection to the Ocean" (2022); Native Village of Eyak Harvest Guidelines; ResearchGate ethnobotany review (2021)

Source: Dr. Dolly Garza, quoted in IndAquaculture.org; The Cordova Times: "Native Voices: Traditional Uses for Seaweed" (2023); OSPI Seaweed Curriculum materials

Source: Holomua Marine Initiative / Hawai'i DLNR: "Algae in Coral Reefs"; Common Ground Kauai: "Seaweed as Savior" (2022); Kuaʻāina Ulu 'Auamo (KUA) / Limu Hui documentation

Source: KCAW: "It's one of the cornerstones of our diet" (March 2026); Sealaska Heritage Institute seaweed documentation project (NSF-funded, ongoing)

Source: Melissa Poe, Washington Sea Grant, quoted in Mongabay (2022)

Source: Mongabay (2022); KUA / Limu Hui (kuahawaii.org); Common Ground Kauai (2022); Governor Ige's "Year of the Limu" Proclamation, January 2022

Name: _____ Date: _____

Activity 1: Indigenous Languages Vocabulary Sheet (9-12)

Review the provided definitions to vocabulary words below. Write the closest term from your own language or research the Tlingit term (or other Indigenous language) to find Indigenous language terms that closely match the word/s. On the back: Use each word in a complete sentence.

Vocabulary Word	English Rewrite / Definition	Indigenous Language Rewrite
Macroalgae	Large, multicellular algae visible to the naked eye; includes kelps, rockweeds, and red seaweeds	
Phycology	The scientific study of algae	
Intertidal Ecology	The study of biological communities in the zone between high and low tide marks	
Bioremediation	The use of living organisms to remove or neutralize environmental contaminants	
Carrying Capacity	The maximum population size an environment can sustain given available resources	
Iodine Deficiency	A nutritional condition caused by insufficient iodine intake, leading to thyroid disorders; historically prevented in coastal communities by seaweed consumption	
Food Sovereignty	The right of peoples to define their own food systems — culturally, ecologically, and economically	
Terrestrial food source	Refers to any land-based plant, animal, or fungal organism that provides nourishment for other living beings.	
Phenology	The study of cyclic and seasonal natural phenomena — used in traditional harvest timing	
Sustainable Aquaculture	The cultivation of aquatic organisms in ways that protect ecosystem health and can continue long-term	

Write sentences below (or several paragraphs), using each of the vocabulary words.

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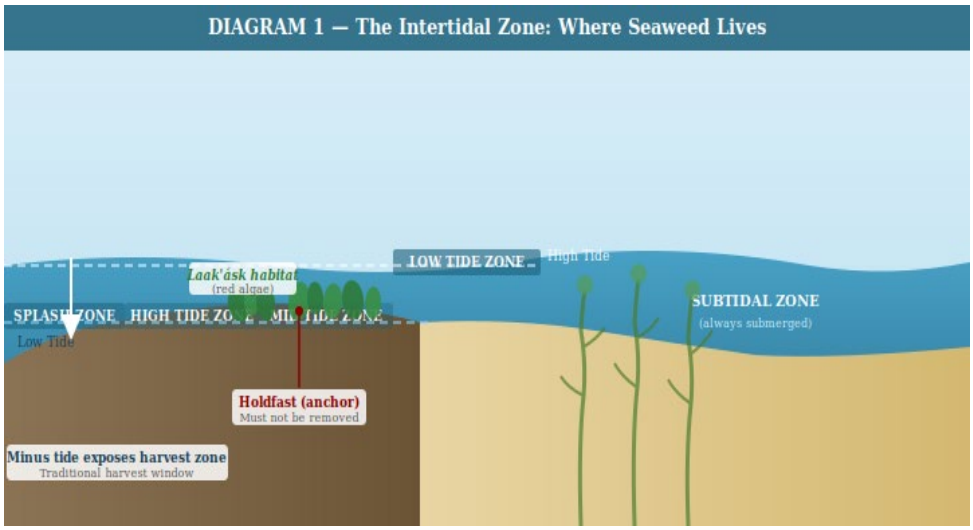
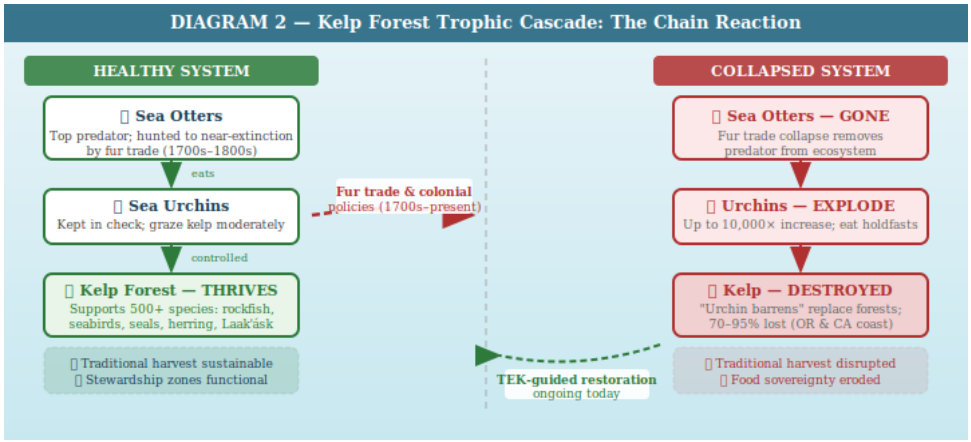
Name: _____ Date: _____

Activity 2: Reading the Coastal System, Intertidal Ecology, Trophic Cascades, and Stewardship Zones

The intertidal zone is the shoreline band exposed at low tide and submerged at high tide. It is not a uniform surface, it is a precisely layered habitat, with different species communities in each zone. Laak'ásk (black seaweed, Pyropia abbottiae) grows in the mid-to-low intertidal zone, accessible only during minus tides when the ocean recedes further than its normal low point. The holdfast, which is the root-like anchor attaching the plant to rock, must be left intact during harvest so the plant can regenerate. If the holdfast is removed, the habitat is gone.



A trophic cascade is a chain reaction through a food web triggered when a predator population changes. Sea otters control sea urchin populations. Sea urchins, left unchecked, eat kelp holdfasts and destroy entire forests. The commercial fur trade of the 1700s and 1800s hunted sea otters to near-extinction across the Pacific Coast, triggering exactly this collapse, turning biodiverse kelp forests into what marine biologists now call 'urchin barrens.' Between 70 and 95 percent of Oregon's and California's kelp forests have been lost. This collapse directly disrupted the Indigenous food systems and the hereditary stewardship systems built around those forests.



Hereditary stewardship zones are family or clan territories along the coast with defined harvest rights and responsibilities, passed down across generations. These are not simply property claims. They function as a distributed resource management system:

by defining who harvests where, they prevent any single beach from being over-harvested, enforce rotation, and maintain community-wide accountability for ecosystem health. Understanding that the zones were ecologically designed, not just culturally designated is essential for analyzing the food sovereignty arguments in the unit narrative.

Answer the following questions. Write in complete sentences.

1. The traditional harvest rule 'always leave the holdfast attached' appears in both the Tlingit oral tradition and in published research by the Heiltsuk Nation and Simon Fraser University. What would happen to the mid-tide zone habitat if this rule were consistently violated?

_____

_____

_____

2. Follow the trophic cascade in Diagram 2 from the fur trade to the loss of Laak'ásk harvest access. Name at least three links in the chain and explain why this collapse is an example of colonial disruption with ecological consequences and not simply a 'natural' environmental change.

_____

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3. Melissa Poe of Washington Sea Grant says that Indigenous seaweed projects aim at 'looking to the past to prepare for the future.' Explain what that phrase means in ecological and practical terms. What knowledge from the past, specifically, is relevant to present-day kelp restoration efforts?

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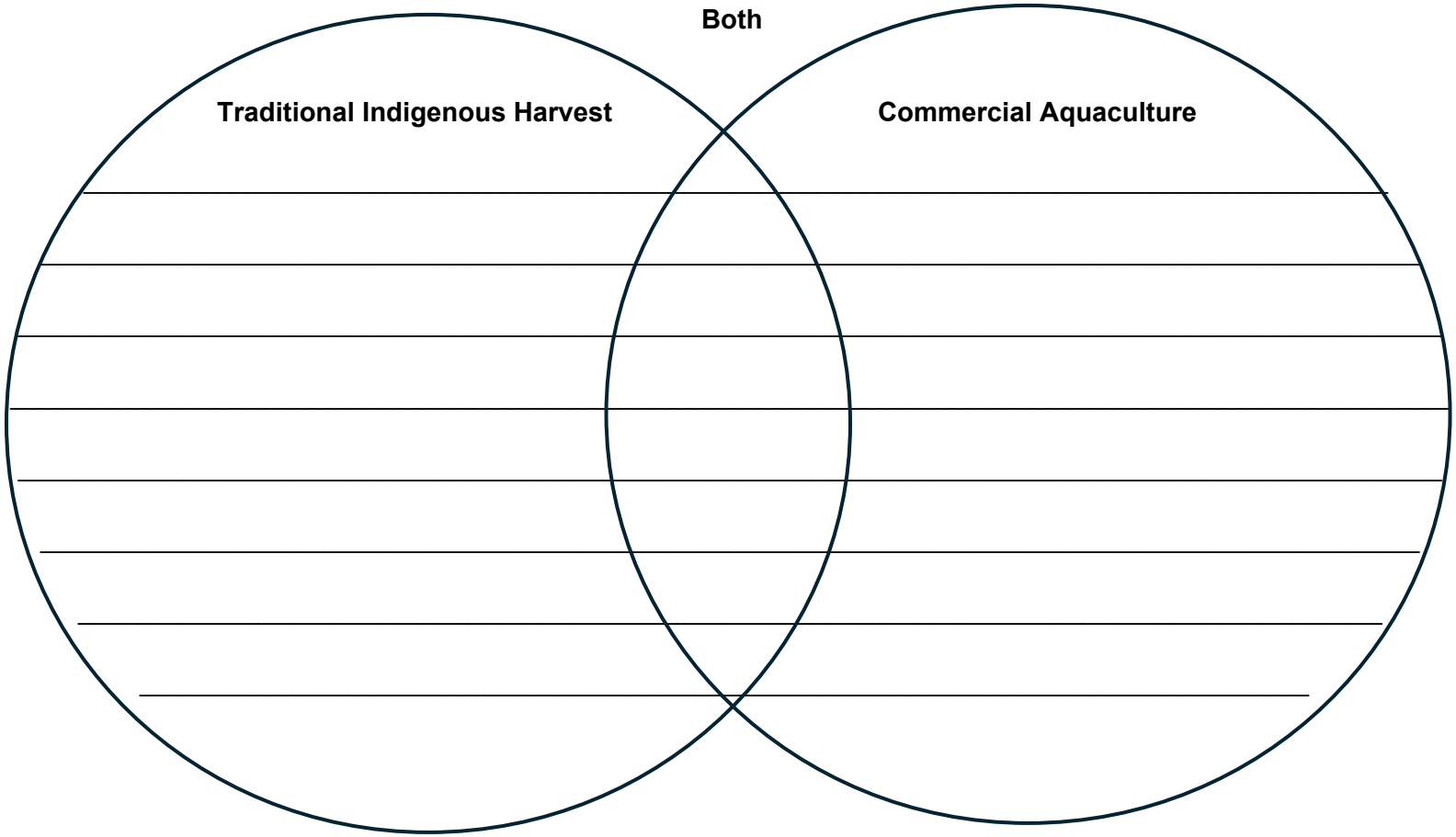
Name: _____ Date: _____

Activity 3: Traditional vs. Contemporary Seaweed Harvesting Venn Diagram

Directions: Compare traditional Indigenous seaweed harvesting (as documented by ethnobotanists and oral histories) with modern commercial seaweed farming (aquaculture). Consider the following: Water use and ecosystem impact, Knowledge system, Scale of harvest, Relationship to community, Species diversity, Seasonal/phenological awareness, Land/sea stewardship responsibility.



Name: _____ Date: _____

Activity 4: Seaweed Nutrition Deep Dive

Iodine, the Thyroid, and Indigenous Coastal Health

Iodine is essential for the production of thyroid hormones (T3 and T4), which regulate metabolism, growth, brain development, and thermoregulation. Iodine deficiency is the leading preventable cause of intellectual disability worldwide. The primary dietary sources are seafood, dairy, and iodized salt. Seaweed can contain 16 to 2,984 micrograms of iodine per gram, providing an extraordinary range of nutrients depending on species and water conditions.

1. Why might inland communities that did not have access to seafood or seaweed historically have had higher rates of goiter and iodine deficiency?

2. How does the coastal Indigenous practice of regular seaweed consumption represent a sophisticated nutritional strategy, even without awareness of the biochemistry?

You have likely seen your peers eating packs of crispy seaweed snacks or miso soup. Seaweed is a nutrient-dense "superfood." How much nutrition are you getting in a normal serving size? See the table below to see how three major types of seaweed provide, nutritionally.

Seaweed Nutrition Comparison

Nutrient	Nori (Red Algae) *1 Pack of Crispy Snacks*	Wakame (Brown Algae) *Amount in 1 Bowl of Miso Soup*	Kelp/Kombu (Brown Algae) *~2 Tsps of Food Flakes*
Protein (g)	2.0 g	0.7 g	0.4 g
Fiber (g)	1.8 g	1.9 g	1.8 g
Calcium (mg)	17.0 mg	38.5 mg	47.5 mg
Iron (mg)	1.0 mg	0.4 mg	0.7 mg
Iodine (mcg)	137.5 mcg	500.0 mcg	15,000.0 mcg
Vitamin B12 (mcg)	3.2 mcg	Trace (<0.05)	Trace (<0.05)
Omega-3 (mg)	75.0 mg	14.5 mg	20.0 mg

Nutrient Profiles (Per 5g Serving)

3. The Recommended Dietary Allowance (RDA) of Iodine for teenagers is exactly 150 mcg per day to maintain healthy thyroid function. Calculate what percentage (%) of your daily Iodine requirement you get from eating just one 5g package of Nori snacks. (Show your work)

4. Look closely at the Kelp/Kombu flakes. If a student shakes 5 grams of kelp flakes onto their noodles, what percentage of their daily Iodine limit are they consuming? (Show your work)

5. Based on these numbers, why do you think kelp is usually sold as a "condiment flake" to shake sparingly rather than eaten in large sheets like Nori?

6. Vitamin B12 is essential for brain health and red blood cell production, and its RDA for teens is 2.4 mcg per day. B12 is normally found only in animal products (meat, dairy, eggs), making it a major challenge for vegans and vegetarians.

7. Which seaweed on the chart could act as a legitimate, functional source of Vitamin B12 for someone on a strict plant-based diet?

8. If a student eats one package of crispy Nori snacks, have they met their daily requirement for B12? Use mathematical evidence from the table to support your answer.

Name: _____ Date: _____

Activity 5: Carrying Capacity and Sustainable Seaweed Harvest

History references hereditary stewardship zones and managed harvesting. Now let's apply ecological carrying capacity to seaweed harvesting. A family's traditional stewardship zone includes 200 linear meters of intertidal bull kelp habitat.

Scientific surveys suggest the following:

- Average kelp density: 3 plants per square meter
- Harvestable frond weight per plant per season: 0.8 kg
- Sustainable harvest rate: no more than 40% of harvestable fronds (leaving 60% for ecosystem function)
- Habitat width (intertidal band): 4 meters average

1. Calculate total area of the family's stewardship zone: _____ m²
   (Hint: length x width = total area)

2. Calculate total plant count: _____ plants

3. Calculate total harvestable frond weight: _____ kg harvestable fronds per season

4. Calculate maximum sustainable harvest: _____ kg per season

5. If a family of 6 needs 500g of dried seaweed per person per month for 8 months, how many kg do they need? Show your work.

6. Does the stewardship zone support the family's needs?

Writing Reflection: What does this calculation tell you about the relationship between traditional stewardship zone size and community nutrition? Why would hereditary stewardship rights be ecologically, not just culturally, important?

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Name: _____ Date: _____

Activity 6: TEK, Colonialism, and Food Sovereignty Analysis

The story documents specific colonial policies that disrupted Indigenous seaweed knowledge and harvesting: the residential school system, the potlatch ban (Canada's Indian Act, 1885-1951), and the Fisheries Act. Research each policy and complete the following analysis:

Policy/Event	How It Disrupted Seaweed / TEK	Long-Term Nutritional / Ecological Impact
Residential School System Year/s: _____ What it was: _____ _____	_____ _____ _____	_____ _____ _____
Potlatch Ban (Indian Act) Year/s: _____ What it was: _____ _____	_____ _____ _____	_____ _____ _____
Commercial Fisheries Act (licensing barriers) Year/s: _____ What it was: _____ _____	_____ _____ _____	_____ _____ _____
Sea Otter Fur Trade (species collapse) Year/s: _____ What it was: _____ _____	_____ _____ _____	_____ _____ _____
Contemporary Restoration Efforts Year/s: _____ What it is: _____ _____ _____	_____ _____ _____	_____ _____ _____

Name: _____ Date: _____

Activity 7: Critical Analysis Essay (1-2 pages)

Essay Prompt: "Traditional Indigenous seaweed harvesting practices represent a sophisticated convergence of nutritional science, ecological management, and cultural knowledge systems. Analyze how the biological properties of seaweed, traditional stewardship practices, and the historical disruption of those practices illustrate the concept of food sovereignty and its relationship to ecological health."

Your essay must include:

- A clear thesis connecting nutritional science, ecological science, and Indigenous knowledge systems
- Evidence-based analysis referencing at least THREE of the following: iodine and thyroid health, carrying capacity and stewardship zones, kelp forest ecology, phenology and harvest timing, colonial disruption of TEK, food sovereignty
- Discussion of at least one historical colonial policy and its documented nutritional or ecological impact
- A conclusion connecting traditional knowledge to a contemporary challenge (climate change, food insecurity, biodiversity loss, or Indigenous rights)
- Correct use of at least five vocabulary terms from this unit

Use at least three references to course materials or credible external sources.