Lesson Guide: Seaweed

Vocabulary:

- Seaweed
- Intertidal Zone
- Iodine
- Traditional Ecological Knowledge
- Sustainability
- Carrageenan
- Aquaculture

Engage:

- Read the story 'Gardeners of the Sea,' a passage on how coastal Indigenous people have managed seaweed for thousands of years, as a class. This story is inspired by the documented traditions of the Tlingit, Haida, Tsimshian, Heiltsuk, and Kwakwaka'wakw, for whom seaweed was a vital First Food.

  Before reading, have students journal or ask some or one of the questions below for class discussion (5 minutes):
  - What do you already know about seaweed or kelp?
  - Where have you seen it before, and how do you think people might use it?
  - How do you think people who live near the ocean learn when and where to gather food from the shore? What signs in nature might they pay attention to?
  - What does the word "sustainability" mean to you?
  - How do you think it might connect to harvesting plants or animals from the ocean?

  After reading, have students journal or pose questions for class discussion below (5 minutes):
  - How do the harvesting practices of the Tlingit, Haida, and other coastal peoples show scientific thinking? Give at least one example from the text that shows how traditional knowledge is based on careful observation and long-term study.
  - Harvesters use signals like blooming plants, whale behavior, and herring activity to know when to gather seaweed. Why do you think observing many different signs—not just one—is important for keeping the ecosystem healthy?
  - Traditional harvesting rules (like leaving the holdfast and not stripping rocks bare) help seaweed and marine life survive. What is one lesson from these practices that you think could help modern scientists or communities care for ecosystems today?

  For a more in-depth understanding of seaweed, show students these videos:
  - Kelp: Hidden Treasure of the Salish Sea | Changing Seas
  - Grow with the Flow! Indigenous Knowledge and Seaweed Farming
  - Kelp Forest, National Geographic
  - Harvesting Seaweed 101

Explore and Explain:

- **Activity 1: Indigenous Language Vocabulary**

- Students use a worksheet to define seven key vocabulary terms, by connecting them to their definitions, and add translations from their own language or research Tlingit terms to find the term/s that describe the word/s.
- This activity builds academic vocabulary, strengthens language connections, and helps students understand how cultural knowledge and meaning are embedded in words.

- **Activity 2: Seaweed Species Identification and Comparison**
  - Students research and complete a comparison chart for three edible seaweed species used by Indigenous peoples: Bull Kelp, Dulse, and Nori. Students will utilize the activity sheet to record each species' color and description, intertidal zone, traditional uses, key nutrients, and the nations that historically and still harvest it.
  - This activity builds scientific identification skills and helps students understand that various coastal Indigenous people developed specific relationships with specific seaweed species, reflecting precise, place-based ecological knowledge passed down across generations.

Elaborate:

- **Activity 3: Bull Kelp Power Point Learning Activity**
  - Show students the Bull Kelp presentation covering kelp anatomy, the kelp forest ecosystem and its 500+ dependent species, ecological superpowers (oxygen production, carbon capture, wave reduction), Traditional Ecological Knowledge of Pacific Northwest tribes, Indigenous food and tool uses, nutritional profile, and current threats and restoration efforts. Provide students the Activity 3 worksheet to complete during or after the presentation.
  - This activity builds knowledge of bull kelp as a keystone species, develops understanding of how Pacific Northwest tribes, including the Makah, Quileute, Quinault, and Coast Salish, engineered sophisticated tools and foods from kelp long before modern materials science. This presentation helps students apply cause-and-effect reasoning to understand how climate-driven trophic cascades collapsed kelp forest ecosystems.

- **Activity 4: The Science of the Intertidal Zone**
  - Using the story "Gardeners of the Sea" and classroom research materials, students answer four guided questions: defining the intertidal zone and its ecological importance, explaining how the twice-daily tidal cycle creates distinct zones with different communities of organisms, describing the ecological reasoning behind the traditional practice of always leaving the holdfast intact, and identifying at least two species that depend on the kelp forest as a nursery.
  - This activity develops systems thinking about coastal marine ecosystems, connects Indigenous harvesting protocols directly to modern marine science on seaweed regeneration and habitat protection, and helps students understand that the intertidal zone is a structured, biologically diverse environment, and not a uniform shoreline.

Evaluate

- **Activity 5: Nutrition Analysis — Seaweed as a Superfood**
  - Students compare three seaweed species (Nori, Wakame, and Dulse) using a nutrient data table, then answer discussion questions about nutrient differences and health impacts, including why iodine would be especially critical for coastal versus inland communities,

and why a traditional seaweed-and-fat paste made during winter would be a nutritionally strategic food.
    - This activity builds quantitative nutrition literacy through data interpretation and helps students recognize that Indigenous food systems were scientifically informed coastal communities understood and relied on seaweed's nutritional value long before laboratory analysis confirmed it.

- **Activity 6: Activity 6: Design a Traditional Seaweed Harvest Plan**
    - In small groups, students create a sustainable seaweed harvest plan for an imaginary coastal community that includes: a seasonal calendar for which species to harvest and when, a carrying-capacity calculation for how much can be sustainably taken, a harvesting technique that allows full regrowth, one specific traditional ecological practice from the story with an explanation of why it protects the ecosystem, and a preservation and use plan for storing and using the harvest across seasons.
    - This activity asks students to synthesize science, traditional knowledge, math, and food systems thinking into a coherent resource management plan — demonstrating that sustainable harvesting is a principle coastal Indigenous peoples encoded in cultural protocols thousands of years before it became a modern conservation concept.

- **Activity 7: Exit Ticket on Seaweed**
    - Students individually complete a four-part written exit ticket: one scientific fact about seaweed, one piece of Traditional Ecological Knowledge from the story, one personal reflection or connection to their own experience or community, and one question they still have about seaweed, the ocean, or Indigenous food systems.
    - This activity consolidates factual content, cultural understanding, and personal meaning-making in a single structured response and gives teachers formative assessment data across all three dimensions of the unit simultaneously.

Suggested Lesson Activities:

- Indigenous Vocabulary
- Seaweed Species Identification and Comparison
- Bull Kelp Presentation Comprehension Worksheet
- The Science of the Intertidal Zone
- Seaweed as a Superfood
- Traditional Seaweed Harvest Plan
- Exit Ticket

Additional Educator Resources:

- Farming Kelp the Heiltsuk Way
- Advancing regenerative kelp practices for coastal communities present and future
- Tribal access to the ocean can help save the kelp
- 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
- Alaska Harvesters and Scientists Share Concern Over Black Seaweed
- Indigenous knowledge of key ecological processes confers resilience to a small-scale kelp fishery
- Students connect with tradition and language at Hoonah culture camp

Gardeners of the Sea

A Note Before Reading: *Everything in this story is based on documented research, ethnographic records, and the words of real Indigenous community members, scientists, and knowledge holders. The peoples described — the Tlingit, Haida, Tsimshian, Heiltsuk, and Kwakwaka'wakw — have lived on the Pacific Northwest coast and in Southeast Alaska since time immemorial. Their knowledge of the ocean, the tides, and the seaweed that grows along their shores is not mythology. It is science--sophisticated, tested, and proven over thousands of years of careful observation.*

Researchers at the Sealaska Heritage Institute describe black seaweed as a "cultural keystone species", meaning it is so central to the culture, diet, and identity of these communities, and that losing it would affect far more than just the food supply. Underwater anthropologist Dr. Kelly Monteleone, who works with Tlingit and Tsimshian researchers at Sealaska Heritage Institute on a National Science Foundation-funded documentation project, describes it plainly: "It's mentioned everywhere. So, it’s a really important resource, but nobody spent the time to actually document it." Her team is working to change that, holding community meetings and shadowing field harvests in seven communities across Southeast Alaska.

The Most Prized Seaweed on the Northwest Coast

Of the dozens of seaweed species found along the Pacific Coast from California to Alaska, one species stands above the rest in terms of cultural, nutritional, and economic importance to Indigenous peoples of the region. It is a thin, ribbon-like red algae. Its scientific name is Pyropia abbottiae, but it is known by different names in Indigenous languages:

Nation	Name for Black Seaweed	Pronunciation Guide
Tlingit (Lingít)	Laak'ásk	laak-ask
Haida	Sgi'w	sgyoo
Tsimshian (Sm'algyax)	La'axsk	lah-ask
Heiltsuk	Known by local name	varies by dialect
Kwakwaka'wakw	Known by local name	varies by dialect

Source: KCAW Radio / KNBA: "It's one of the cornerstones of our diet" (March 2026)

Reading the Tides and the Signs--Traditional Ecological Knowledge in Action

One of the most important things that coastal Indigenous peoples know is how to read the natural world to know when to harvest. This is a form of Traditional Ecological Knowledge, often called TEK, and it has been passed down through families by direct teaching and practice over generations--this kind of knowledge is not found in books.

Tlingit and Haida harvesters do not simply go to the beach whenever they feel like it to harvest seaweed. They know that black seaweed must be harvested during a minus tide, which is a tide so low that the ocean pulls back far enough to expose the rocks where the seaweed lives. They know that the seaweed grows in three seasonal windows (winter, spring, and summer), and that the best harvest comes in April and May.

Signs from the living world signal time to harvest.

- The blooming of stinging nettles, skunk cabbage, and alder trees signal that black seaweed is entering its harvest window.
- Increased herring activity in coastal waters, including the beginning of the herring spawn, is another signal. Herring deposit their eggs on kelp and seaweed, and this timing is deeply connected to the seasonal cycle.
- The behavior of humpback whales moving into coastal waters is also observed as a sign.
- Seaweed ribbons should feel elastic and stretchy when pulled. If they are too short, it is too early. If they are brown and contain snails, harvest has come too late.

This sophisticated, multi-signal awareness of the ecosystem is not guesswork. It has been tested and refined over thousands of years of practice and observation. Modern ecologists call this type of knowledge "long-term ecological observation", and they are increasingly recognizing that it often surpasses what short-term scientific studies can detect.

Traditional ecological knowledge shows that Indigenous people were aware of phenological phenomenon *(phenology is the study of cyclical and seasonal events in nature, often called "nature's calendar"*.)

How Seaweed Is Harvested and Processed

Traditional harvest protocols among Tlingit, Haida, and other coastal peoples share core principles that are now being studied by marine scientists for ecological wisdom. The harvesting rules, taught to children and young people in every generation, are precise:

What Harvesters Do

- Harvest during minus tides only
- Clip or pull fronds from the upper portion of the plant
- Always leave the holdfast — the root-like anchor — attached to the rock
- Rinse larger varieties in the ocean to release small animals living inside
- Leave significant portions on each rock untouched
- Never strip a rock completely bare
- Take only what can be processed and used
- Share with elders who cannot come to the shore

Why These Rules Work (The Science)

- Leaving the holdfast (the root), which allows the plant to regenerate fully
- Research by Heiltsuk Nation and Simon Fraser University confirmed: partial harvesting following traditional protocols caused kelp to grow back "more enthusiastically than if left alone"
- Leaving seaweed on rocks protects the intertidal habitat of crabs, snails, and juvenile fish
- Rotating harvest areas allows recovery time between visits

Dr. Hannah Kobluk, PhD researcher, Simon Fraser University, on the Heiltsuk Nation and SFU research partnership studying traditional seaweed harvest protocols, was quoted as saying:

"People were really excited about these results, that if we're careful about following these partial harvesting rules, it really is and can be sustainable, just as Heiltsuk knowledge suggests. It underlined the richness that comes from drawing from multiple forms of knowledge, whether it be Indigenous, local, fishermen themselves."

After harvest, fresh seaweed is spread out on sheets and cloths under the sun. Some families dry it immediately; others let it soak overnight to soften first. Once fully dried, the green seaweed turns jet-black and becomes crunchy. It is then stored, ground, or prepared in dozens of traditional ways. It can be used as a snack, mixed into soups, combined with fish eggs and clam juice, or prepared as ceremonial food for potlatch gatherings, where it is served in elaborately carved wooden dishes as a mark of respect and abundance.

Seaweed farmers harvest sugar kelp from a farm site in coastal British Columbia. Photo courtesy of Cascadia Seaweed

The Kelp Forest and the Web of Life

Black seaweed and bull kelp are not isolated resources. They are part of an intricate coastal ecosystem that Indigenous peoples have understood — and managed — for thousands of years.

Bull kelp (Nereocystis luetkeana, called Geesh in Tlingit, K'áay in Haida) forms towering underwater forests that shelter young rockfish, provide oxygen, slow water currents, and support the entire intertidal food web. Tlingit and Haida communities have long used giant kelp fronds as platforms to harvest herring roe: during herring spawning season, stalks of kelp are set out in the water, the herring deposit

their eggs on the fronds, and the kelp is then gathered and dried. The herring eggs, called Gáax'w in Tlingit and K'áaw in Haida, is a prized traditional food.

Sea otters, which were hunted nearly to extinction during the fur trade era (by the early 1800s, their populations had collapsed), are the primary predators of sea urchins. When sea otters disappeared, urchin populations exploded. Urchins eat kelp holdfasts and devastate coastal marine environments, turning vibrant, biodiverse kelp forests into barren underwater deserts. Entire kelp forests collapsed into what marine biologists now call "urchin barrens." This is precisely the kind of interconnection that Indigenous coastal peoples had long observed and managed around. Their hereditary stewardship zones, which were family territories with specific harvest rights and responsibilities, functioned as a management system that protected the balance of the whole coastal ecosystem.

A Living Tradition — and a Warning

The black seaweed tradition is alive and active today. Every spring, Tlingit and Haida families across Southeast Alaska, head to the shore with baskets and sheets. Youth participate in culture camps like the Haa Toó Yeéi Yatee camp on Chichagof Island, where they learn to identify, harvest, and process Laak'ásk alongside elders.

Tlingit harvester Irene Dundas noticed something alarming in 2021: some of the black seaweed she harvested near Ketchikan was oddly shaped, discolored, and tasted different. She brought her concerns to the Sealaska Heritage Institute. Scientists and Indigenous researchers are now working together to investigate whether ocean warming, and other climate-related changes are affecting the seaweed. Changes were experienced by harvesters before any scientific study detected them.

(Pictured: Students gather beach asparagus at the Haa Tóo Yéi Yatee culture camp near Hoonah (Photo by David Purdy/KTOO)

This is Traditional Ecological Knowledge in real time: the community members who spend the most time on the shore, who have the longest generational memory of what the seaweed looks and tastes like, are often the first and most reliable monitors of environmental change.

Source: Turner, N.J. & Grevstad (2021); ResearchGate ethnobotany review; Southeast Alaska Traditional Foods Guide (SEARHC) Pic: raventrust.com Heiltsuk Nations, Patagonia: Shared Stewardship (2022); SEARHC Traditional Foods Guide; The Cordova Times (2023), Heiltsuk/SFU research cited in Mongabay: "By Cultivating Seaweed" (2022), Pic: Hakai Magazine, Puget Sound Kelp Conservation and Recovery Plan, Appendix B: Cultural Importance of Kelp for Pacific Northwest Tribes (NW Straits Commission); Patagonia: Shared Stewardship (2022) Sealaska Heritage Institute (2022); KCAW/KNBA coverage of the NSF-funded documentation project (2026)

Teacher's Note: Invite local or regional Indigenous community members and culture bearers to participate in discussions about seaweed harvesting and traditional food practices where possible. Center Indigenous voices and expertise throughout the unit. Handle discussions about resource extraction and colonization's impact on traditional food systems with care and appropriate cultural sensitivity.

Name: _____ Date: _____

Activity 1: Indigenous Language Vocabulary

Directions: In the space below each vocabular word, write the word in your own Native or Tribal language, a peer's language, or look one up. Practice saying it aloud. Pair the definition with the correct vocabulary word by drawing a line from the word, on the left, to it's definition on the right.

Vocabulary Word Indigenous Language Rewrite	English Rewrite / Definition
Seaweed _____	The farming of aquatic organisms including seaweed, fish, and shellfish in controlled environments
Intertidal Zone _____	A natural thickening agent extracted from red seaweed, used widely in processed foods
Iodine _____	Macroalgae — plant-like marine organisms that photosynthesize in ocean water.
Traditional Ecological Knowledge (TEK) _____	The area of shoreline between high and low tide lines, exposed and submerged daily
Sustainability _____	A mineral found abundantly in seaweed, essential for thyroid function and metabolism
Carrageenan _____	Using natural resources in a way that allows them to renew and continue providing for future generations
Aquaculture _____	Accumulated knowledge about the environment developed by Indigenous peoples over generations

Why does it matter that seaweed has names in Indigenous languages?

_____

What does language tell us about a culture's relationship with something?

_____

Name: _____ Date: _____

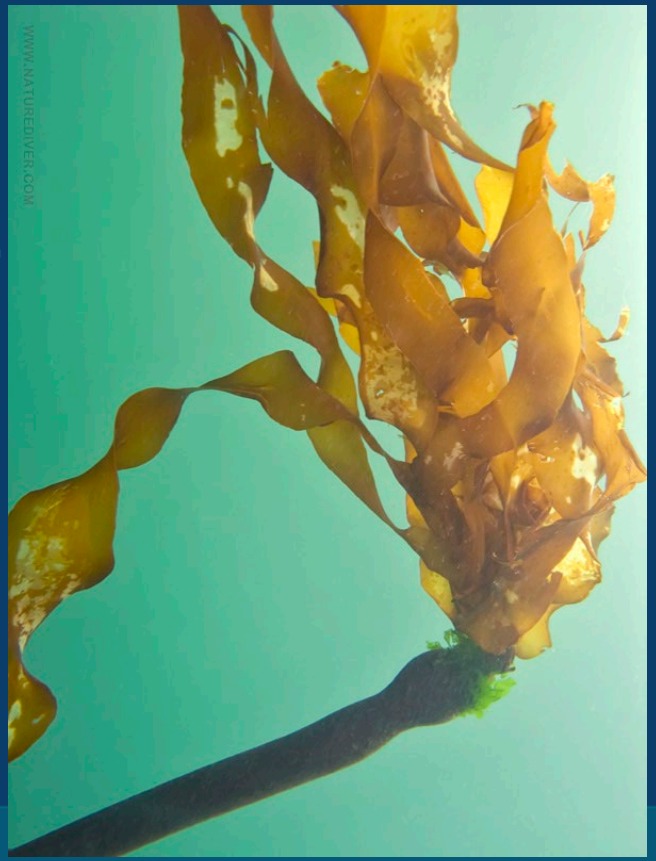
Activity 2: Seaweed Species Identification and Comparison

Students research and compare three common edible seaweed species used by Indigenous peoples.

Characteristic	Bull Kelp	Dulse (Red Seaweed)	Nori (Purple Laver)
Color and Description			
Zone (where it grows)			
Traditional use			
Nutrients			
Nations that harvested it			

BULL KELP

Science • Indigenous Knowledge • Food & Nutrition



Nereocystis luetkeana

What IS Bull Kelp?

Bull Kelp is Not a Plant!

Bull kelp is a MACRO ALGAE, because you can see it with your eyes. It's scientific name is *Nereocystis luetkeana*.

Bull Kelp lives in cool nutrient-rich water

Found along the Pacific Coast from Alaska to central California

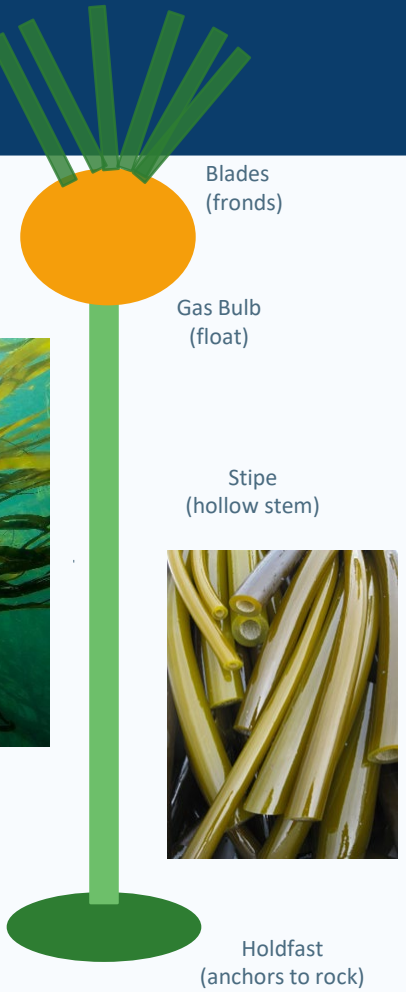
Bull Kelp can grow up to 100 feet tall!

Can grow up to the height of a 10-story building! And it grows fast! Up to 1–10 inches PER DAY. It can reach full size in just a few months and is one of the fastest-growing things on Earth.

Bull Kelp has a one year lifespan

Annually it reproduces and dies. Every year a whole new forest regrows!

Anatomy of Bull Kelp:



Parts of a Bull Kelp

Each part has a special job!

🎈 GAS BULB

A single gas-filled float that holds kelp upright. Also contains reproductive spores. This is what you hear 'pop' on the beach!

⚓ HOLDFAST

Grips onto a rock on the seafloor — like roots, but it doesn't absorb nutrients! Just an anchor.

BLADES

Up to 60 long, ribbon-like fronds grow from the bulb. They can each grow up to 9-13 feet long. This is where photosynthesis happens. absorbing sunlight and CO_2.

STIPE

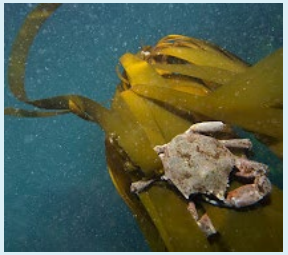
The long hollow stem — can be 30 meters (100 ft) long. Indigenous peoples used it as rope and for steaming wood.

The Kelp Forest: An Underwater City

Bull kelp forests are some of the most biodiverse places on Earth — like a rainforest, but underwater.

Rockfish live their whole lives inside kelp forests hiding from predators in the canopy.

Harbor Seals
Rest and hunt in kelp beds — the dense canopy protects pups from sharks.



Squid & Crab use kelp as nurseries for eggs and juveniles. Blue rockfish eat herring that eat krill.

Gray Whales
feed near kelp forests along the Oregon coast during migration.

Seabirds dive through kelp to catch fish — using it like a hunting blind.

500+ Species

Kelp forests support more species per area than almost any other ocean habitat!

Kelp's Superpowers 

Bull kelp helps fight climate change!

- **Oxygen Factory**

Kelp produces MORE oxygen than a tropical rainforest of the same size through photosynthesis.
It's basically the lungs of the Pacific!

- **Carbon Capture**

Kelp absorbs CO2 from seawater, helping to slow ocean acidification.
As it grows, it locks away carbon.

- **Water Purifier**

By taking up nutrients and CO2, kelp makes the surrounding water healthier, creating a better environment for fish, crabs, and shellfish.

- **Wave Reducer**

Dense kelp forests absorb wave energy, reducing erosion of coastlines, almost like a natural sea wall.

Traditional Ecological Knowledge

For thousands of years, Pacific Northwest tribes have lived with and protected bull kelp forests.

Makah & Quileute

Used dried bull kelp stipes as strong fishing lines, anchor lines, and harpoon ropes for whale hunting.

Coast Salish (Samish, Squaxin, Lummi)

The story of Ko-kwahl-alwoot: a woman who married a sea spirit. Her hair, the blades of bull kelp, still waves near Rosario Beach — a reminder that she provides for her people.

Siletz, Tillamook & Oregon Tribes

Kelp connected trade routes up and down the coast. Tribes followed kelp migration patterns and used forests as navigation markers at sea.

Quinault

Used the hollow stipe as a steam-bending tool; filling it with water to soften cedar wood for canoes and bows.

Indigenous peoples engineered incredible tools from bull kelp long before plastic was invented:

- **Fish Lines & Nets-** The long, tough stipe was dried and twisted into strong rope, used for fishing lines, anchor lines, and nets. The nets were stronger than many ropes of the time.
- **Basketry & Rope-** Makah and Quileute tribes steamed cedar bark inside kelp stipes to soften it for weaving rope and baskets.
- **Food Storage Containers**- The hollow stipe and gas bulb made natural waterproof containers. Tribes stored fish oil, fresh water, and preserved foods inside sealed kelp bulbs.
- **Wood-Bending Steam Tool**- Branches placed inside a water-filled stipe, then buried in hot coals overnight — the steam softened hardwood so it could be bent into hooks, bows, and canoe parts.
- **Ceremony & Play-** Dried kelp bulbs filled with pebbles became rattles. Children across many tribes made toy blowguns and played beach games with kelp stipes — some even pretended to harpoon whales!
- **Navigation Aid-** Dense kelp beds marked safe passages and rocky reefs. Canoe paddlers used kelp forests as natural maps along the coast.

(Pictured: kelp fishing line and water vessel with kelp braided handle.)

A Samish Story: Ko-kwahl-alwoot

The Maiden of Deception Pass

Long ago, a young Samish woman named Ko-kwahl-alwoot was chosen to marry a spirit of the sea. Her marriage to the ocean spirit brought her people great bounty — fish, shellfish, and calm waters for canoe travel.

Over time, Ko-kwahl-alwoot began to transform, becoming part of the sea herself. Though she could no longer visit her family on shore, she did not abandon them.

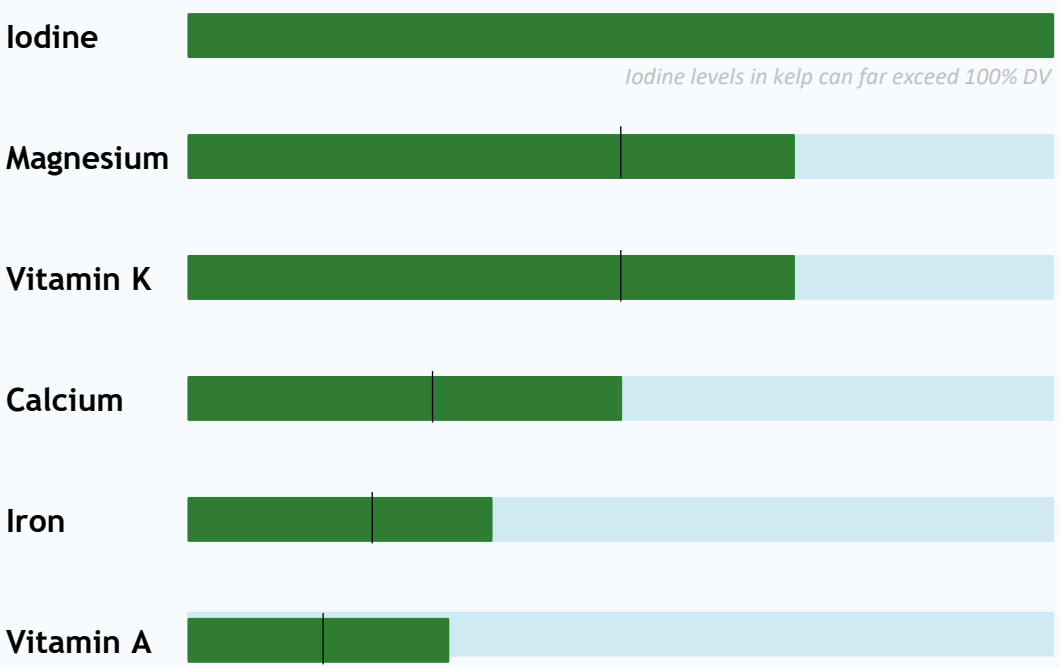
Today, when Samish people see the long, swaying blades of bull kelp near Rosario Beach — her hair — they know she is still there, still watching, still providing for her people.

This story reminds us that kelp is not just an organism — it is family, a provider, and a living connection between humans and the sea. This is why protecting kelp forests is so deeply important to Pacific Northwest tribes.

Source: Samish Indian Nation Elders / Northwest Straits Commission Kelp Recovery Plan

Bull Kelp: Nature's Multivitamin

HUGE in nutrients!



Iodine	100–10,000%+ DV (highly variable)	Critical for thyroid & brain health. Kelp has more iodine than almost any food!
Magnesium	50–70% DV	Supports muscles, nerves, and energy
Vitamin K	50–70% DV	Helps bones stay strong and helps with blood clotting
Calcium	30–50% DV	Keeps bones and teeth strong
Iron	20–35% DV	Helps carry oxygen in your blood
Vitamin A	20–35% DV	Good for eyes and immune system

Nutrient content in bull kelp varies significantly by season, location, and preparation method. Iodine content is especially variable and can be much higher than shown. Values shown represent a moderate estimate for dried bull kelp.

How Humans Eat Bull Kelp 🍽️

People have been eating kelp for thousands of years, and it's still delicious today!

🍜 Kelp Noodles & Soup *Modern*

Fresh kelp stipes are cut into noodle-like strips and added to soups.
Bull kelp soup has been made by Alaska Native communities for centuries.

🫁 Medicine *Traditional (Native Village of Eyak)*

Before iodized salt existed, eating kelp prevented goiters (thyroid disease). Kelp was also used for headaches and bleeding disorders.

🐟 Herring Roe on Kelp *Traditional (Northwest Tribes)*

Each spring, herring lay eggs on kelp fronds. Tribes harvested these roe-covered blades — a prized seasonal delicacy still collected today.

🥒 Kelp Pickles *Traditional & Modern*

The hollow stipe is sliced into rings and pickled with vinegar, garlic, and dill — just like cucumber pickles! Crunchy and tangy. Alaska Native communities have made these for generations.

How Humans Eat Bull Kelp, continued 🍽️

🍣 Kelp-Wrapped Food *Traditional & Modern*

Bull kelp blades can wrap fish or rice for cooking over coals — like a natural aluminum foil! Coast Salish people wrapped salmon in kelp for steaming.

🧂 Dried & Powdered *Traditional*

Dried kelp was ground into powder and used as a salty seasoning — like seaweed salt. It adds umami flavor to soups, stews, and meat dishes.

⚠️ Kelp is in Trouble

70-95%

of Oregon's and California's kelp forests lost to urchin barrens

NOAA received a petition to list bull kelp as endangered under the Endangered Species Act.
Purple urchins can go dormant for years, making recovery extremely difficult.

Video Resource:
Sunflower Star Project—Purple Urchin Eating Machine

Marine Heat Waves In 2014-2016, ocean temps spiked. Kelp needs cold water. The warm water stresses and kills kelp.

Sea Star Wasting Disease A disease caused by a bacteria that was introduced by warm water has wiped out sunflower sea stars, which were the main predator that kept urchin numbers in check

Urchin Barrens Without sea stars, purple urchins exploded 10,000x on some reefs, eating all the kelp.

Ocean Acidification More CO_2 makes ocean water more acidic, making it harder for young kelp spores to survive.

OPB / Center for Biological Diversity (Sept. 2022); OR Kelp Alliance (Dec. 2024); The Nature Conservancy (2023)

🌱 Hope & Restoration

Scientists, tribes, agencies, and volunteers are ALL working together to bring kelp back:

🤿 NOAA

Scientific divers manually remove sea urchins from urchin barrens so kelp can regrow. NOAA invested $4.9 million in kelp restoration projects.

🌊 Kelp Alliance Groups

Test different restoration techniques along the coast. The kelp economy is worth $23–50 million/year to Oregon, alone.

🏘️ Community Science

Volunteers survey kelp from paddleboards and boats. Students and community members collect urchins on weekends on the northern California and Oregon coasts.

🌿 Tribes & First Nations

Indigenous communities bring traditional ecological knowledge to restoration planning. Tribal partners consulted with NOAA and the Northwest Straits Commission on kelp recovery plans.

🔬 University Science

Research how feeding red seaweed to cattle may cut methane emissions, and studying how to make kelp forests climate-resilient.

🐟 Good News!

Sunflower sea star restoration efforts are underway. Aquariums are raising them for reintroduction, which could naturally rebalance the urchin population.

What Can YOU Do?

You don't have to be a scientist to help save kelp forests!

1. Learn about local Indigenous tribes (like the Siletz, Tillamook, or Quinault) and their relationship with the ocean. Respect their knowledge and leadership in conservation.

2. Reduce your carbon footprint — ride a bike, eat less meat, turn off lights. Less CO_2 = less ocean acidification = healthier kelp.

3. Try eating kelp! Bull kelp pickles are available at markets. Every food dollar you spend on sustainable seaweed supports the industry.

4. Join a beach cleanup or volunteer with a Kelp Alliance Group. Community scientists make a real difference in tracking kelp recovery.

5. Share what you've learned! Tell your family and friends. Kelp forests need more people who care about them.

Sources Credits

Scientific Sources

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- NOAA National Marine Sanctuaries – Climate Investments: sanctuaries.noaa.gov
- Scientific Reports (2019) – Marine heat wave & urchin barrens: doi.org/10.1038/s41598-019-51114-y
- Lenfest Ocean Program – Ecology & Management of Bull Kelp: lenfestocean.org
- OPB – Oregon Kelp Alliance Report (Dec. 2024): opb.org/article/2024/12/08/oregon-kelp-forests-coast-ocean-report-urchin
- Frontiers in Marine Science (2023) – Bull Kelp Genetics: frontiersin.org/journals/marine-science

Indigenous & Cultural Sources

- Northwest Straits Commission – Cultural Importance of Kelp for Pacific NW Tribes (Appendix B, 2020): nwstraits.org
- Native Village of Eyak – Mariculture & Traditional Food: eyak-nsn.gov/mariculture
- Pew Charitable Trusts – Puget Sound Kelp Decline: pew.org (Oct. 2021)
- NOAA – Olympic Coast National Marine Sanctuary – Original Peoples: olympiccoast.noaa.gov
- BullKelp.info – The Mysterious World of Bull Kelp: bullkelp.info/characters/humans

🧠 Quick Quiz — Test Yourself!

Q: How fast can bull kelp grow?

A: Up to 10 inches per day!

Q: Is bull kelp a plant?

A: No! It's a macro algae — not a plant.

Q: What did Makah tribes use the stipe for?

A: Fishing lines, harpoon ropes, and steam-bending wood.

Q: What is an 'urchin barren'?

A: An area where urchins ate all the kelp, leaving the seafloor empty.

Q: Name one nutrient found in bull kelp.

A: Iodine, calcium, magnesium, vitamins A, C, E, or K!

Q: How much of Oregon's and California's kelp forest has been lost?

A: About 70-95%.

Name: _____ Date: _____

Activity 3: Bull Kelp Power Point Activity Sheet

Directions: Complete each section during or after the Bull Kelp presentation. Use complete sentences for written responses.

Anatomy of Bull Kelp

Bull kelp has four main parts — each with a specific job. Fill in the table below with the function of each part and one additional fact you learned from the presentation.

Part	Job / Function	Fun Fact or Indigenous Use
Holdfast		
Stipe		
Gas Bulb		
Blades (Fronds)		

Circle the correct answer for questions below:

1. The holdfast functions most like a plant's _____.
   a) leaf b) root c) flower d) seed

2. Where does photosynthesis happen in bull kelp?
   a) Holdfast b) Stipe c) Gas bulb d) Blades

3. What is inside the gas bulb?
   a) Water b) Nutrients and minerals c) Gas and reproductive spores d) Fish eggs

4. The presentation described the kelp forest as an "underwater city" that supports 500+ species. Name THREE animals that depend on kelp forests and explain HOW each one uses the kelp forest.

Animal	How it uses the kelp forest

5. The presentation compared kelp forests to tropical rainforests. Give TWO ways they are similar:

Similar in that:

Similar in that:

Kelp's Ecological Superpowers

6. Match each "superpower" to its correct description by drawing a line:

Superpower		What It Does
Oxygen Factory		Absorbs CO_2 from seawater, slowing ocean acidification
Carbon Capture		Absorbs wave energy, protecting coastlines from erosion
Water Purifier		Produces more oxygen per area than a tropical rainforest
Wave Reducer		Takes up excess nutrients and CO_2, improving water quality for fish and shellfish

7. Explain in your own words: how does reducing CO_2 in seawater help young kelp spores survive?

Name: _____ Date: _____

Activity 4: The Science of the Intertidal Zone

Using the story and research, students map the intertidal zone and answer the following:

1. What is the intertidal zone and why is it important for seaweed harvesting?

2. How does the twice-daily tide cycle affect which organisms can live in each zone?

3. What is the ecological reason for leaving the holdfast? How does this demonstrate sustainable harvesting?

4. How does the kelp forest function as a "nursery"? Name at least two species that depend on it.

Name: _____ Date: _____

Activity 5: Nutrition Analysis — Seaweed as a Superfood

Seaweed has been called a nutritional powerhouse. Let's look at the data:

Nutrient	Nori (per 10g)	Wakame (per 10g)	Dulse (per 10g)	% Daily Value Significance
Iodine	~232% DV	~128% DV	~66% DV	Critical for thyroid; rare in most plant foods
Iron	1.2 mg	0.6 mg	1.1 mg	Supports blood oxygen transport
Calcium	35 mg	15 mg	29 mg	Bone health; comparable to dairy per serving
Fiber	0.4 g	0.5 g	0.7 g	Digestive health, blood sugar regulation
Vitamin K	High	Very High	Moderate	Blood clotting, bone metabolism
Omega-3 fatty acids	Present	Present	Present	Heart and brain health; rare in plant foods

Questions:

1. Note two observations about the seaweed nutrition facts, shown in the table above.

2. Compare seaweed's nutritional profile to a vegetable you eat regularly.
   What is similar? What is different?
   Vegetable:
   Similar:
   Different:

3. Traditionally, Indigenous people mixed seaweed with animal fat to make a winter food. Using the nutrition table, explain why combining seaweed's minerals and vitamins with a high-energy fat would help people stay healthy during long, cold winters. *Hint: Think about what nutrients seaweed gives the body, and what fat gives the body.*

Name: _____ Date: _____

Activity 6: Design a Traditional Seaweed Harvest Plan

In small groups, students design a sustainable seaweed harvest plan for an imaginary coastal community, then present the plan to “the community” in 5 minutes by group or spokesperson.

The plan must include:

- Which species to harvest and when (seasonal calendar)
- How much to harvest (using a simple carrying-capacity calculation)
- Harvesting technique that allows regrowth (describe the method)
- One traditional ecological practice or protocol to include
- How the seaweed will be preserved and used

Group Notes and Strategies:

Name: _____ Date: _____

Activity 7: Exit Ticket

Three Things I Learned (Exit Ticket)

Write three things you learned in this unit:

1. One scientific fact about seaweed:

_____

_____

2. One piece of traditional ecological knowledge:

_____

_____

3. One personal reflection or connection:

_____

_____

4. What is one question you still have?

_____

_____