Saving the Southern Resident Killer Whales
A Project-Based Learning Unit for Middle School
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Disclaimer
This resource is intended for use in middle school classrooms. Information within this curriculum should not be cited in scientific journals or other publications.

About NOAA Fisheries
NOAA Fisheries is responsible for the stewardship of the nation’s ocean resources and their habitat. We provide vital services for the nation: productive and sustainable fisheries, safe sources of seafood, the recovery and conservation of protected resources, and healthy ecosystems—all backed by sound science and an ecosystem-based approach to management.

To learn more, visit: www.fisheries.noaa.gov.
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Dedication

“If compassion were fish, the orcas would not be starving. If compassion were clean water, our orcas would not be suffering the effects of toxic contamination. If compassion were quiet waters, our orcas would once again be able to find their prey and communicate with each other.”

- Southern Resident Orca Task Force co-chairs
  Les Purce and Stephanie Solien

This resource is dedicated to you, our partners in Southern Resident recovery.

If you enjoy watching the J, K, and L pods breach in the Salish Sea, if you partake in Southern Resident ceremonies with your tribal elders, if you cherish memories of hearing the whales on a hydrophone for the first time, if you follow the news after the birth of a new calf, if you grieve the loss of an orca elder—you have been touched by this unforgettable species. You understand its link to the culture, economy, and environment of the Pacific Northwest. Because of this you play an indispensable role conserving Southern Residents for future generations.

Thank you for joining us on the road to Southern Resident recovery, doing your part to raise awareness, and helping restore and protect healthy ecosystems in which Southern Residents and all marine species can thrive. We could not make this journey without your steadfast contributions, commitment, and support.
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About this Unit

In August 2018, footage of a grieving mother killer whale, Tahlequah (J35), put a global spotlight on the plight of Southern Resident killer whales (Southern Residents). Tahlequah carried her deceased newborn for 17 days and over 1,000 miles as the world watched her every move.

This heartbreaking display served as a rallying cry for the critically-endangered Southern Residents, whose numbers stand at 75 as of July 28, 2021. Their population has decreased by about a quarter in the past 20 years, largely due to decreased prey availability, disturbance from vessels and noise, and contaminants in the environment.

This unit will engage your middle schoolers in authentic Southern Resident science and stewardship while building key success skills and meeting targeted NGSS and state sustainability standards. Through interdisciplinary research, discussions, and projects, students will understand:

• How Southern Residents are inextricably linked to the cultures, economies, and ecosystems of the Pacific Northwest.
• The major threats facing the Southern Residents.
• What individuals and collective groups can do to save this critically-endangered species.
• When we protect the Southern Residents, people and the wider ecosystem benefit.

By employing the principles of project-based learning, this unit empowers students to steer their own learning, to investigate the issues that are most important to them, and to design a meaningful public product that inspires their greater community in conservation and recovery.

Project-Based Learning

Project-based learning (PBL) shifts classrooms from teacher-centered instruction toward student-directed learning. Rather than passively learning, students are given the opportunity to try their hand at coaching, facilitating, and co-learning. Southern Resident conservation and recovery are natural topics for PBL.

Throughout the entire unit, students will consider the driving question: How can we make a meaningful difference for the critically-endangered Southern Resident killer whales? This question is addressed throughout each of the 9 activities. From self-led research and simulations to participating in a mock Southern Resident Orca Task Force and designing their own action project, students are put in the shoes of researchers, policy makers, and conservationists. As students address this driving question, they synthesize their learning and share it with a public audience.

For additional support on PBL, see: Edutopia, The National Education Association, and PBLWorks. These organizations provide curated lists of PBL basics, best practices, research, and project examples. From Inquiry to Action by Steven
Zemelman provides a foundation for implementing civic action and PBL in the classroom.

**Letter to Parents and Guardians**

If your school or class is new to PBL, consider **sending a letter to parents and guardians** to describe the project and let them know how they can support the process.

**Resources for Peer Critique**

Peer critique can be a powerful way to help students practice giving and receiving feedback. This unit presents multiple opportunities for students to practice their critique and revision skills.

For example protocols, see:

- **Critique Protocol** - Deeper Learning Competencies
- **Charrette Protocol** - School Reform Initiative
- **Peer Review Strategy Guide** - Read, Write, Think
- **Praise, Question, Suggest Critique Protocol** - EL Education

**Interdisciplinary Connections**

When students apply connections between different subject areas, the material becomes more relevant and meaningful. Throughout this unit, students will be steeped in the cultural, environmental, and economic importance of Southern Residents and will discover how their own actions can support the conservation and recovery of these critically-endangered whales.

**Cultural Connections**

Southern Residents are culturally and spiritually important to the Salish Sea and beyond. They are featured prominently in the stories, songs, dances, art, and ceremonies of the Coast Salish people. Some tribes believe the Southern Residents to be their ancestors. For example, the Lummi name for killer whale, Qwe ‘lhol mechen, roughly means “our relatives that live under the water.”

> “THEY REMIND US OF OURSELVES, AND WE SEE OURSELVES IN THEM.”
> - ADAM OLSEN, MEMBER OF THE TSARTLIP FIRST NATION

**Adaptations for Online Learning**

To enhance online and blended learning, consider having students create their own website or blog to record their research and share their learning with the public. The following digital tools can help enhance this unit. For additional tools, visit **Edutopia** or **Common Sense Media**.

- **Equity Maps**
  See data on talk time, the number of times a student talks, and patterns of who converses with each other

- **Flipgrid**
  Post discussion prompts and students can respond with short videos

- **Google Classroom**
  Streamline assignments, boost collaboration, and foster communication. To access the Google Classroom companion for this unit, email wcr.education@noaa.gov.

- **Nearpod**
  Make lessons interactive and use formative and summative assessment tools to assess progress

- **Screencastify**
  Record, edit, and share videos
In recent years, tribes from the region have hosted rallies and prayer ceremonies honoring Southern Residents who have died. Some tribes, such as the Samish, hold naming ceremonies when new calves are born. Native American Tribes and Nations are very much involved in Governor Inslee’s Southern Resident Orca Task Force and in other areas such as Lummi Nation working with the National Oceanic and Atmospheric Administration and Washington Department of Fish and Wildlife to get medicines to the ailing Scarlet in 2018.

“LUMMI NATION IS JUST STEPPING UP TO DO THE RIGHT THING AND DO WHAT WE CAN TO HELP. WE ARE ANSWERING THE CALL OF XA XALH XECHNGING, OUR SACRED OBLIGATION.”
- JAY JULIUS, LUMMI CHAIRMAN

Through cultural ceremonies, participation in the Southern Resident Orca Task Force, sustainability managing fisheries, and outreach campaigns, tribes in the Pacific Northwest are rallying to protect and recover their relatives from under the water.

Environmental Connections

From the smallest microorganisms to the fiercest predator—every species plays a role in its ecosystem. In a healthy ecosystem, there is a subtle dance between predators and prey. This balancing act helps maintain healthy populations of plants and animals throughout the ecosystem.

Apex predators, such as killer whales, play an important role in structuring their ecosystem. Southern Residents seek out the oldest, largest Chinook. These Chinook provide more calories than smaller fish. If Southern Residents consume only large adult Chinook, adult female killer whales would consume up to approximately 13 Chinook per day and adult male killer whales would consume up to approximately 16 Chinook per day. Depending on the population size, the J, K, and L pods must catch around 300,000 Chinook salmon a year. But these numbers depend a lot on the ages of the killer whales, as well as the species, size, and calorie content of their salmon prey. If fewer large, adult Chinook are available, the killer whales will have to eat more of the smaller fish to meet their caloric requirements.
Chinook populations in the Salish Sea are facing many pressures including historical overfishing, passage barriers such as dams, and changing ocean conditions due to climate change and ocean acidification. As populations of seals, seal lions, and Northern Residents rebound, they place additional pressures on fragile salmon populations.

With all of these stresses, large and old Chinook are becoming more rare. The reductions in size could have a long-term effect on the number of Chinook salmon. Smaller females carry fewer eggs. Over time the number of fish that hatch and survive to adulthood may decrease. Smaller and fewer fish means the Southern Residents will have to work extra hard to get enough to eat.

As indicator species, Southern Residents can tell us a lot about the health of their environment. Pollutants from the Southern Resident’s prey and environment become concentrated in their blubber. Some of these pollutants can cause disease or reproductive disorders. Pollutants are also passed from mothers to their calves. Since the Southern Residents are in trouble, it likely means the Salish Sea is in trouble, too.

Southern Residents are also considered to be an umbrella species. When we protect an umbrella species, we indirectly protect many other species that share the same habitat. Since many species are threatened or endangered, identifying umbrella species can make conservation decisions easier. It can also help species that are not as well known or popular—such as sea snails and eelgrass—gain much-needed protection.

**Economic Connections**

Southern Residents are a very important economic driver for Washington State. In San Juan County alone, whale watching participants support over $216 million worth of economic activity. In turn, this activity generates more than $12 million in state and local tax revenue and supports over 1,800 jobs. Whale watching is a big business!

A 2019 study revealed that if the Southern Residents become extinct, 33% of non-local, boat-based whale watching participants would no longer choose to visit the Puget Sound region. However, the commercial whale watching industry has grown in recent years despite the decreasing presence of Southern Residents in inland waters, likely due to the opportunity to view transient orcas and other whales. In another review of the whale watching industry, rules to limit viewing of Southern...
Residents were not expected to pose a risk to the viability of the industry.  

Throughout the unit, students will grapple with the need to balance the recovery of the Southern Residents with economic considerations such as the cost of conservation and competing interests from industries. For example, a decrease in whale watching could help the whales find more salmon. However, the local economy greatly benefits from whale watching. When weighing pros and cons, students will have to balance social, economic, and environmental issues—just like the real scientists and policy makers.

STEAM Connections

Through authentic explorations of Southern Resident science, conservation, and recovery, students will grapple with real-world science, technology, engineering, and math (STEM) challenges. At NOAA Fisheries, we recognize that the arts can both complement and advance our mission. Throughout the unit, students are encouraged to use their own talents—from drawing and creating social media campaigns to mapmaking and storytelling—to support their own learning and to rally their communities around sustainability and conservation issues.

Complementary Programs

The NOAA Ocean Guardian School program supports hands-on stewardship projects that are focused on current issues affecting the health of local watersheds and/or the ocean while promoting best environmental practices.

NOAA Planet Stewards supports educators’ efforts to implement hands-on action-based projects that conserve, restore, and protect human communities and natural resources from environmental challenges monitored by NOAA.

Teacher At Sea program provides K-16 teachers hands-on, real-world research experience working at sea with world-renowned NOAA scientists.

Complementary Resources

An Incredible Journey vividly details the perilous journey salmon make from their home stream to the ocean, sometimes navigating thousands of miles. The curriculum, children’s book, board game, and animation help students understand the importance of salmon to our culture, our economy, and many different ecosystems.

The Sea Stewards Handbook (English, Spanish) describes nine of the most serious issues facing our ocean today, such as runoff and marine debris. Each short summary describes how our daily actions can affect these issues and what individuals can do to make a meaningful difference. The handbook includes short profiles of ocean heroes from around the world and programs to engage schools in stewardship initiatives.

Fund Your Projects

NOAA’s Office of Education supports formal, informal, and non-formal education projects and programs through competitively awarded grants and cooperative
agreements. Student projects and comprehensive teacher professional development may be funded through these opportunities.

Evolve This Unit
We strive to make our products and programming accessible and relevant to as many classrooms as possible. If you have suggestions for how to improve this unit, please let us know.

Supporting Resources
Download the supporting slide decks and audio files at: http://go.usa.gov/x6HBh. For access to the Google Classroom companion, email wcr.education@noaa.gov.

Additional Support
We want you to feel comfortable integrating this unit into your classroom. If you need additional support, please do not hesitate to contact wcr.education@noaa.gov. We can answer questions, provide links to additional resources, and connect you with local partners and opportunities.

A student shares his final project for the school’s Celebration of Learning showcase. Credit: Allison Shelley/EDUimages

Inspire Others
Help inspire Southern Resident conservation around the globe by sharing your experience with this unit. Tag photos, student work, and student quotes.

@NOAAFisheriesWestCoast
Facebook

@NOAAFish_WCRO
Twitter

@NOAAFisheries
Instagram
Key National Standards

This unit will help middle school classrooms address the following national educational standards:

Next Generation Science Standards - Disciplinary Core Ideas

The Disciplinary Core Ideas all have broad importance within or across science or engineering disciplines, provide a key tool for understanding or investigating complex ideas and solving problems, relate to societal or personal concerns, and can be taught over multiple grade levels at progressive levels of depth and complexity.

- LS2.A. Interdependent Relationships in Ecosystems
- LS2.C. Ecosystem Dynamics, Functioning, and Resilience
- LS4.D. Biodiversity and Humans
- ESS3.C. Human Impacts on Earth Systems
- ETS1.B. Developing Possible Solutions

Common Core State Standards (CCSS)

CCSS help students develop key success skills—the cognitive and socioemotional skills that students will need for success in college and throughout their careers. Through student-led research, analysis, and public projects, this unit advances the following success skills:

Comprehension and Collaboration

Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others’ ideas and expressing their own clearly and persuasively. (CCSS.ELA-LITERACY.CCRA.SL.1; CCSS.ELA-LITERACY.SL.6.1, 7.1, 8.1)

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. (CCSS.ELA-LITERACY.CCRA.SL.2; CCSS.ELA-LITERACY.SL.6.2, 7.2)

Integration of Knowledge and Ideas

Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue. (CCSS.ELA-LITERACY.RI.6.7)

Presentation of Knowledge and Ideas

Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. (CCSS.ELA-LITERACY.CCRA.SL.4; CCSS.ELA-LITERACY.SL.6.4, 7.4, 8.4)

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. (CCSS.ELA-LITERACY.CCRA.SL.5; CCSS.ELA-LITERACY.SL.6.5, 7.5, 8.5)
Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (CCSS.ELA-LITERACY.CCRA.SL.6; CCSS.ELA-LITERACY.SL.6.6, 7.6, 8.6)

Research to Build and Present Knowledge

Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation. (CCSS.ELA-LITERACY.CCRA.W.7; CCSS.ELA-LITERACY.W.6.7, 7.7, 8.7)

Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (CCSS.ELA-LITERACY.WHST.6-8.7)

Science and Technical Subjects

Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (CCSS.ELA-LITERACY.RST.6-8.2)

Writing

Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources. (CCSS.ELA-LITERACY.WHST.6-8.1.B)

Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples. (CCSS.ELA-LITERACY.W.6.2.B; CCSS.ELA-LITERACY.W.6.2.B, 7.2B, 8.2B)

College, Career, and Civic Life (C3) Framework

The C3 Framework aims to: enhance the rigor of the social studies disciplines; build critical thinking, problem solving, and participatory skills to become engaged citizens; and align academic programs to the Common Core State Standards for English Language Arts and Literacy in History/Social Studies.

Civics

• D2.Civ.1.6-8.
• D2.Civ.10.6-8.

Communicating and Critiquing Conclusions

• D4.3.6-8.

Economics

• D2.Eco.1.6-8.
• D2.Geo.3.6-8.

Sociology

• D2.Soc.3.9-12.
• D2.Soc.13.9-12.

Taking Informed Action

• D4.6.6-8.
• D4.7.6-8.
• D4.8.6-8.
Key State Standards

California’s Environmental Principles and Concepts

Principle 2. People Influence Natural Systems

• Concept A. Direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.

• Concept B. Methods used to extract, harvest, transport, and consume natural resources influence the geographic extent, composition, biological diversity, and viability of natural systems.

• Concept D. The legal, economic, and political systems that govern the use and management of natural systems directly influence the geographic extent, composition, biological diversity, and viability of natural systems.

Principle 3. Natural Systems Change in Ways that People Benefit From and Can Influence

• Concept C. Human practices can alter the cycles and processes that operate within natural systems.

Principle 4. There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing Between Systems

• Concept B. The byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect.

• Concept C. The capacity of natural systems to adjust to human-caused alterations depends on the nature of the system as well as the scope, scale, and duration of the activity and the nature of its byproducts.

Principle 5: Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors

• Concept A. There is a spectrum of what is considered in making decisions about resources and natural systems and how those factors influence decisions.

Oregon Environmental Literacy Plan

• 1a. System structure
• 1b. Habits of systems thinking
• 2b. Structure, function, interaction and change in living systems
• 2c. Structure, function and interconnectedness of human systems
• 3a. Sense of place, region, nation and global community
• 3b. Interrelationships between the environment and human activities
• 4a. Rights and responsibilities of citizens
• 4b. Sense of personal responsibility
• 5a. Work with flexibility, creativity, openness and perseverance
• 5b. Assess the accuracy and reliability of information sources
• 5c. Identify and analyze strategies that address challenges and create desired futures.
• 5d. Demonstrate effective decision-making and citizen action.

WA State K-12 Integrated Environmental & Sustainability Education (ESE) Learning Standards

• ESE Standard 2. The Natural and Built Environment
• ESE Standard 3. Sustainability and Civic Responsibility
Introduction to the Southern Residents

Humans have a storied history with killer whales. Before they were revered as cultural icons of the Pacific Northwest, Southern Resident killer whales (Southern Residents) were perceived as a threat to lucrative salmon fisheries and were killed.\(^{16}\) In the 1960s and 1970s, they were captured for display in zoos and aquariums.\(^{17}\) Today, we appreciate these apex predators for their cultural and spiritual importance, complex social structure, and what may be demonstrations of animal grief (epimeletic behavior).\(^{18}\)

What’s in the news?

- “Despite recent births, ‘a long way to go’ to save Southern Resident orcas” King5
- “A mother orca’s dead calf and the grief felt around the world” Seattle Times
- “Pandemic gives Pacific Northwest whales a respite from din of underwater noise” KUOW
- “Orcas of the Pacific Northwest Are Starving and Disappearing” New York Times

This unit aims to balance the overwhelming negative news by empowering individual students to support Southern Resident conservation and recovery efforts. Throughout this unit, students will have the opportunity to dive deeply into local issues, create products that educate their families and communities, and design a project that will make a meaningful difference for the Southern Residents.

Who are the Southern Residents?\(^{19}\)

Killer whales (Orcinus orca) are toothed whales related to pilot whales. They occur in all the world’s oceans.

There are three main ecotypes of killer whales in the North Pacific Ocean:

1. Residents (salmon eaters)
2. Offshores (shark and other fish eaters)
3. Transients (marine mammal eaters)

While most other killer whale populations are doing well, the Southern Residents are among the world’s most endangered marine mammals.

Killer whales are highly social. Most live in social groups called pods. Southern Residents travel in three distinct groups: J, K, and L pods. Within each pod there are several family units, each descended from a single female ancestor. These units, called matrilines, are each typically composed

Southern Residents in front of the Seattle, WA skyline. Credit: NOAA Fisheries
of an adult female, the matriarch, and her female and male offspring. Pods typically consist of a few to about 20 whales. Larger groups sometimes form a temporary “superpod” for social interaction, mating, or seasonal concentration of prey.

**Where do they live?**

Southern Residents are found mostly off the coasts of British Columbia, Washington, and Oregon. Occasionally, they travel as far north as Southeast Alaska or as far south as California. They spend much of the summer in coastal waters of the Pacific Northwest and around the San Juan Islands following their main food source, Chinook salmon.

**What do they eat?**

The whales prey almost exclusively on Chinook salmon when they are available in the summer. However, they diversify their diet the rest of the year to include species such as skates, halibut, and lingcod, as well as steelhead, chum, and coho salmon. Most of the salmon the whales consume in winter and spring come from three large river systems: the Columbia, Sacramento, and rivers entering Puget Sound.

Southern Residents seek out the largest, oldest Chinook. How does a Southern Resident find and hunt down these Chinook while ranging across more than 15,000 square miles? This vast expanse is occupied by hundreds of other fish species, including five other species of salmon whose populations are often far more abundant than Chinook salmon.

The whales hunt with echolocation, which is the use of sound waves and echoes to locate objects. When hunting, a killer whale sends out a series of clicks, called a click train. These clicks spread through the water like a flashlight beam of sound. If the sound waves hit an object, echoes bounce back to the whale. Echolocation allows killer whales to detect fish at distances of up to 500 feet, much farther than they could see in the dark water.

**How do they communicate?**

Killer whales rely on underwater sound to feed, communicate, and navigate. Pod members use clicks, known as echolocation, to find prey and communicate with each other through whistles and pulsed calls. Each pod possesses a unique set of calls that are learned and culturally transmitted among individuals. These calls maintain group cohesion and serve as family badges. They also use these calls to coordinate hunting
strategies and work as a team to catch prey.

DIVE DEEPER: ORCA COMMUNICATION

Why are the whales at risk?
The Southern Resident population is closely tied to the overall health of the ecosystem. These whales are among the most at-risk marine mammals in the world. Historically, the populations have suffered from capture for aquariums. Presently, scarcity of their preferred food—Chinook salmon—chemical contaminants, and noise and crowding by boat traffic pose serious threats to this endangered population. Evidence of inbreeding, which poses additional risk, has recently been discovered in the population.

DIVE DEEPER: HOSTILE WATERS: ORCAS IN PERIL

Historical Capture
From 1962-1977, approximately 300 whales of several species were captured in Washington and British Columbia primarily for aquariums all over the world. The Southern Residents were the most heavily affected population with 36 whales captured and at least 11 dying in the process—nearly half of the population.

DIVE DEEPER: HOW A GENERATION OF KILLER WHALES WAS TAKEN FROM PUGET SOUND

Limited Prey
Southern Residents, it turns out, are picky eaters. While they will eat a variety of prey—including a variety of salmon species, sole, cod, herring, and squid—their preferred diet is Chinook salmon. They even appear to select the oldest, largest Chinook, when they are available. Unfortunately, this preference may be hurting them in the long run.

A young resident killer whale chases a Chinook salmon near San Juan Island, WA. Credit: Holly Fearnbach (SR3: SeaLife Response, Rehabilitation and Research) and Lance Barrett-Lennard (Vancouver Aquarium’s Coastal Ocean Research Institute).

On the West Coast, some Chinook populations in places such as the Columbia River are growing. Other populations like Puget Sound Chinook and Sacramento River winter run Chinook are struggling due to issues such as climate change, passage barriers, habitat loss, and water pollution. As of 2019, two populations of Chinook salmon on the West Coast are listed as endangered and seven are listed as threatened under the Endangered Species Act.21

Ocean-type Chinook prefer coastal waters, meaning they spend most of their lives relatively close to shore, or in protected inland marine waters like Puget Sound. This can expose them to industrial discharge, urban drainage, wastewater from treatment plants, and agricultural runoff—all sources of harmful chemical contaminants.

Southern Residents were herded into Penn Cove off Whidbey Island, WA. Credit: Wallie Funk/Associated Press
This is one reason why Southern Residents are more polluted than other killer whale subgroups: they eat prey that are highly polluted themselves.

DIVE DEEPER: WASHINGTON’S ORCAS ARE HUNGRY

Pollution

Southern Residents accumulate pollutants from the fish they eat in their blubber, making the whales among the most contaminated marine mammals in the world. Pollutants include pesticides, industrial coolants and lubricants, flame retardants, motor oil, and chemicals from other household products that enter Puget Sound and the Pacific Ocean when it rains.

Motor oil and other oil-based chemicals can be recognized by a characteristic rainbow-colored sheen. Credit: National Ocean Service

In a process known as biomagnification, pollutants become more concentrated as they move up the food chain. Killer whales, being top-level predators, accumulate more of these harmful chemicals than other animals in the ocean. Scientists are still learning the full extent of what this is doing to the Southern Residents’ health.

Studies suggest that when the whales do not get enough to eat their bodies break down and expose them to pollutants stored in their blubber. This can compromise their immunity and reproductive success, leaving them more vulnerable to disease and making it tougher for them to rebuild their numbers.

Pollutants can affect fetuses and nursing calves too. A killer whale mother’s milk is partially produced from her blubber.22 When nursing, she transfers a percentage of her load of pollutants to her offspring, potentially causing changes in their metabolism, growth rates, and future fertility. Pollutants can even slow learning and impair memory, challenging a young whale’s ability to forage for food and interact with others in its pod.

DIVE DEEPER: TOXIC KILLER WHALES

Boat Traffic and Noise

Hunting salmon is hard work for the Southern Residents. Underwater noise from nearby boats makes it more difficult for the whales to detect the echoes from their hunting clicks. This ultimately reduces the distance from which they can detect fish.

Boat traffic within 400 yards of Southern Residents interrupts their foraging.23 Female whales often stop feeding altogether. This can have cascading effects on her ability to meet the energy requirements to support reproduction.

Boat traffic can also disrupt prey sharing. Since lactating mothers have higher energy requirements, prey sharing is especially important for them and their offspring.

DIVE DEEPER: UNDERWATER NOISE AND MARINE LIFE

Inbreeding

Many wild species maintain diversity by leaving their family groups to mate. Many animals often join or form new family groups. Southern Residents do not follow this strategy. Instead, the whales stay with their mothers and their families throughout their lives. While we do not know the exact reason, scientists hypothesize that the whales may stick with their families because their mothers continue to help them hunt salmon. The drawback is that
it puts the population at greater risk of inbreeding.

A 2018 study found that four of the whales are already highly inbred. That includes offspring of a father-daughter and mother-son pair. Many additional whales may be inbred to a lesser degree. More than half of Southern Resident calves die before or shortly after birth; a genetic analysis from 2018 suggested that inbreeding could be a factor.

DIVE DEEPER: KILLER WHALE GENETICS RAISE INBREEDING QUESTIONS

Population Over Time

From 1973 to 2016, the Southern Resident population showed periods of both growth and decline. When the first census was conducted in 1973, 66 whales were sighted. Their population increased by 48% to a high of 98 in 1995, then dropped 16% to 82 individuals between 1995 and 2003, prompting NOAA Fisheries to list them as an endangered species. As of July 2021, there are 75 individuals.

DIVER DEEPER: SOUTHERN RESIDENT ORCA POPULATION

All Hands on Deck

Every single day we make choices that affect the Southern Residents, their prey, and their habitat. NOAA Fisheries alone cannot save the Southern Residents. The recovery of these iconic whales depends on government, industry, and community partnerships and active, informed individuals. It will take all of us working together to save the Southern Residents.

While students are not responsible for the state of the Southern Residents, they can be a real force for change—especially when they work together. It is important for us to help students understand the limitations of individual action and the benefits of collective action, governmental regulations, and social norms. When we deploy these approaches together, we can make lasting systemic changes that benefit the Southern Residents, the greater marine environment, and human health.

DIVE DEEPER: INDIVIDUAL VS. COLLECTIVE ACTION, COLLECTIVE ACTION PROBLEMS, SOLVING COLLECTIVE ACTION PROBLEMS, SOCIAL CHANGE ECOSYSTEM MAP

Are you and your students ready to take action for the Southern Residents?

Then let’s dive in!
Scope and Sequence

Each of the activities in this unit can stand alone. When using multiple activities or the complete unit, we recommend following the sequence below.

1. **Making Connections**
   After watching a media-rich slideshow featuring sounds, images, and video clips related to the Southern Residents and their environment, students draw connections to discover what they will be learning about throughout this unit. Students then brainstorm what they need to know in order to answer the unit’s driving question: How can we make a difference for the critically endangered Southern Resident killer whales?

2. **Click, Whistle, Call**
   Students describe the various sounds in their neighborhood and how noise pollution affects them personally. After learning how Southern Residents communicate, students participate in a simulation to experience how Southern Residents are being disturbed by human activities.

3. **Ripple Effects**
   During a graphics-heavy slide show, students learn about the ripple effects of various plant and animal extinctions around the world. Afterward, a jigsaw activity guides students through the potential cultural, economic, and environmental effects of Southern Resident decline and extinction.

4. **Threats and Solutions**
   The activity opens with a quick brainstorm about what animals need to survive. Students then conduct scaffolded research to dive deeper into the major threats facing the Southern Residents: starvation, contamination, and vessel noise and then research potential solutions to these threats. During a reflection, students identify the potential barriers and side benefits of implementing these solutions.
Community Mapping
After making observations about different community characteristics, students brainstorm a list of community features that might benefit or harm the Southern Residents. In small groups, students create a neighborhood map and identify local issues that might affect the Southern Residents. The class then identifies ways that the schoolyard and/or community can be improved to benefit the Southern Residents, their prey, and their habitat.

Who is Responsible?
This activity opens with a general poll about responsibility for socio-political issues. Afterward, students discuss who should be responsible (i.e., governments, industries, communities, individuals) for the threats facing the Southern Residents. The activity helps students understand that a single entity alone cannot solve these issues—it will take all of us working together to save them. The activity wraps up with a discussion around the limitations and benefits to different types of action (i.e., individual, collective, governmental).

Orca Task Force
Students take on the perspectives of various groups (e.g., commercial fishers, tribes, taxpayers, etc.) to evaluate measures designed to save the Southern Residents. During a mock meeting, groups weigh the pros and cons of each measure and decide whether or not their group would support it. Groups are then faced with a budget crisis and must decide how they would reprioritize each measure.

Yes, We Can!
A series of short case studies highlight how human passion and ingenuity can overcome seemingly insurmountable problems. Students then complete a skills and interests assessment to determine how they can use their talents and interests to help the Southern Residents.

Taking Action
Students work in small groups to design an action project for the Southern Residents that demonstrates their learning and supports their personal interests and talents. Projects can be scaled to your timeline and students’ interests.