OREGON MARINE SCIENTIST AND EDUCATOR ALLIANCE

ORSEA Capstone 2021

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Sea Grant Oregon

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RCRV Regional Class Research Vessels

2021 Cohort Members

- Bandon School District
- Lincoln County School District
- North Bend School District
- Port Orford School District
- Siuslaw School District
- Siuslaw Watershed Council
- Oregon Dept of Fish & Wildlife
- Oregon State University
- South Slough Reserve

Sea Grant Oregon

Image: Deploying/retrieving a video lander.
ODFW Information Reports 2019-20, p. 41

OREGON MARINE SCIENTIST AND EDUCATOR ALLIANCE

ORSEA brings together educators and marine researchers around ocean issues, career-connected learning, and effective science communication practices.

Funded by Oregon Sea Grant, the Oregon Coast STEM Hub and the National Science Foundation through OSU's Regional Class Research Vessel Project.

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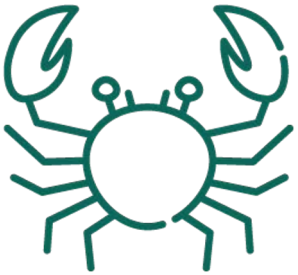
RCRV Regional Class Research Vessels



AGENDA

Welcome & Overview

RCRV Presentation

Project Presentations (7 Teams)

Upcoming Opportunities

Sea Grant
Oregon

How We Got Here

- Application
- Pilot Existing Lessons
- Kickoff Event
- Teams Meet & Plan
- Pilot New Lessons
- Capstone Event
- Lessons Published Online

You Are Here

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RCRV Regional Class Research Vessels

Regional Class Research Vessel Project

Datapresence: Technology that enables remote data interactions

CORIOLIX

Cruise **O**bservations **R**eal-time
Interface & **O**pen **L**ive **I**nformation **E**xchange

RCRV Outreach & Education Goals

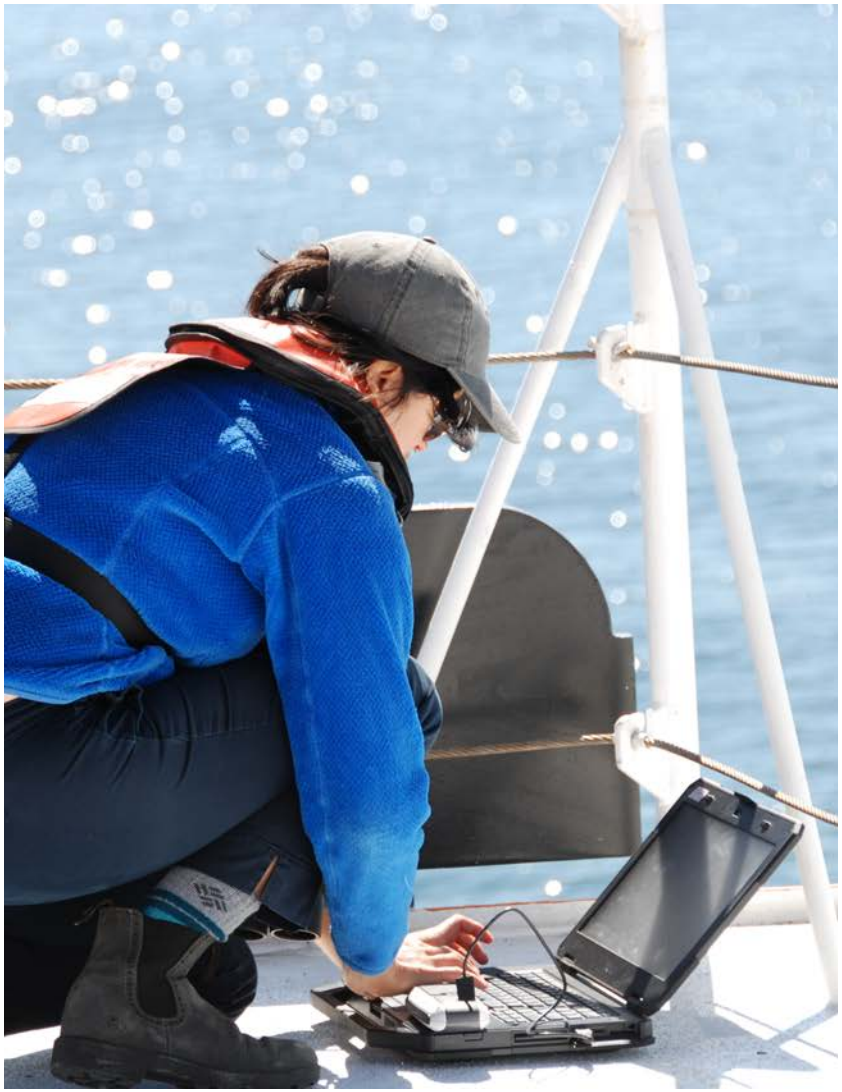
Design and build interactive exhibits for public audiences of all ages at Oregon State University's Hatfield Marine Science Center.

Provide trainings on effective outreach and engagement for researchers including datapresence and outreach tools, as well as best practices for effectively communicating science to a variety of audiences.

Develop curricula, videos and other resources for educators and students that show how scientific observations made at sea are the crux of understanding, discovering, tracking and predicting natural and human-impacted processes.

Need: Increase Data Literacy through scaffolded learning across grade levels

Strategy: Provide professional development for **teachers** that increases their efficacy around data literacy and allows them to develop lessons and curriculum which teach *students* about data and the data process



Need: Make data relatable, relevant and contextualized for students

Strategy: Create “data biographies” to address who, what, where, why, and how

ORSEA Project Goals

- ❑ Co-create integrated math and science curriculum anchoring phenomena that builds scientific and data literacy, and provides career-connected learning.
- ❑ Provide opportunities for researchers to improve their science communication skills.
- ❑ Establish a sustainable network of Oregon educators and marine science researchers.

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ORSEA 2020-21 Cohort

INTRODUCING:

Team Cetacean

Team Hypoxia

Team Plastic Fantastic

Team Rockfish

Team Sea Lion

Team Sharkbait

Team Wetlands

Seven scientists and **14** middle and high school teachers participated in this year's ORSEA Cohort.

←They formed seven teams.

Members of each team worked together to create a 5E lesson focused on an anchoring phenomenon related to the researcher team member's science. Teachers tested activities in the classroom, lessons were adjusted as needed, and then finalized.

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TEAMS PRESENT

Posters on ORSEA Website:
https://oregoncoaststem.oregonstate.edu/orsea/orsea-2020-2021-cohort

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RCRV Regional Class Research Vessels

Teeming with Fish

Sustainable Fisheries

RESEARCHER BIO: Greg Krutzikowsky

I've worked as an educator, scientist, and fishery manager. I earned a Bachelor's degree in Marine Biology at Occidental College. I worked at the Catalina Island Marine Institute, the Oceanic Society, and the Pacific Whale Foundation before returning to school to pursue a Masters Degree at Oregon State University. My Masters work on bowhead whales in the arctic used satellite monitored radio tags to track their movements and dive behavior. Since graduating I have worked as a marine mammal observer, a fisheries research biologist, the director of a Large Whale Entanglement Response Program. I currently work at the Oregon Dept. of Fish and Wildlife Marine Resources Program. In my current position I work in marine science, fishery management, ocean policy, and public outreach.

TEACHER BIO:

Jessica Bailey:

This is my 12th year as an elementary teacher in Oregon. I have degrees in teaching & learning, and political science. I currently teach 6th grade (multiple subjects) in Lincoln City. I LOVE to teach science and math!

TEACHER BIO:

Heidi Wacker:

I've taught middle school math and science for 5 years and recently started teaching a self- contained 6th grade class. 5 years teaching biology at the community college level, and 5 years teaching environmental education for nature centers and non-profits.

Classrooms:

Heidi teaches 6th grade Science and Math with a self-contained class of 15 students at Driftwood School in Port Orford, Oregon. Jessica teaches a self-contained class of 24 at an AVID elementary in Lincoln City, where she worked in fully distance learning, hybrid, and in-person models of instruction this year.

This marine research matters because …

People love to go fishing and to catch fish. People need food and jobs and the fishing industry provides both. Making sure that fisheries are managed to be sustainable is critically important. So learning about fish biology, where they live, and how to figure out how many are out there is what is needed. This lesson gets students thinking about those things.

Anchoring Phenomenon

This middle school unit combines a study of Oregon's amazing rockfish population with an introduction to statistics, and is guided by the essential question: *How many rockfish can we catch and continue to be able to fish for them over the long haul to have a sustainable fishery?* Many of our students have experienced the anchoring phenomenon of going fishing, possibly even to a rocky reef or ocean fishing such as a jetty or on a boat. We invite them to dig deeper, learning about the life cycles and habitats of rockfish, and analyzing sets of data gathered by fisheries scientists to determine if the populations are healthy. As mathematicians, students learn about measures of center and ways to organize, plot, and graph data. As scientists, students are tasked with developing (engineering) a system to monitor the human impacts on this rocky reef ecosystem. Students learn about ODFW's monitoring systems, and how fisheries scientists use engineering and math to protect the fishery populations while balancing the human impact of commercial and recreational fishing

Because of ORSEA:

We were able to share a research project and the knowledge gained from it with educators to help them incorporate it into a teaching curriculum so students can gain a better understanding of how scientific research is done and how it can be utilized in real world management. Students were able to receive a presentation on the research project. The research project work can be found at:

A video lander study of a nearshore rocky reef

We created learning experiences for our students (and others in the future) that are memorable, valuable, and useful. We hope to help them love math and science and use it towards becoming stewards of their world.

Learning Plan

EQ: How many rockfish can we catch and continue to be able to fish for them over the long haul to have a sustainable fishery?

ENGAGE:

- "How do you fish?" *Bringing equity & student voice to the classroom*
- Video lander footage & quickwrite

EXPLORE: "All About Rockfish"

- Species research & jigsaw

EXPLAIN: "Statistics"

- Key vocabulary
- Rockfish study presentation (guest visit with Greg Krutzikowsky)
- Measures of Center
- Graphing Data

ELABORATE:

- Career Connections
- Town Hall

EVALUATE: "Monitor & Protect"

- Students suggest a management plan to monitor & protect a marine ecosystem

Density and Abundance Estimates

Species	mean density estimate (#/100 m²)	minimum density estimate (#/100 m²)	mean abundance estimate	minimum abundance estimate
Black Rockfish	93.61	46.87	2,825,955	1,414,959
Blue/Deacon Rockfish	34.32	17.18	1,036,043	518,748
Kelp Greenling	17.16	8.59	518,022	259,374
Canary Rockfish	11.86	5.94	357,982	179,242
Pile Perch	11.72	5.87	353,771	177,133
Lingcod	10.88	5.45	328,501	164,481
Striped Surf Perch	6.84	3.42	206,366	103,328
Yellowtail Rockfish	1.40	0.70	42,116	21,087
Copper Rockfish	0.98	0.49	29,481	14,761
Cabezon	0.84	0.42	25,269	12,652
Quillback Rockfish	0.70	0.35	21,058	10,544
China Rockfish	0.28	0.14	8,423	4,217

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Belugas Out of Balance

Are there enough individuals of reproductive age in the Cook Inlet beluga population to promote recovery without human intervention?

RESEARCHER BIO:

Kaimyn O'Neill, BS

Kaimyn discovered her passion for genetics through her previous college coursework, and is now pursuing a career in marine conservation genetics!SHe is currently developing an epigenetic clock for Hector's dolphins and Māui dolphins for her master's thesis research with OSU and is using the same methods as the beluga epigenetic research.

TEACHER BIOS:

Erica Street - BA, MA

Erica teaches Biology, Chemistry, and Yoga at North Bend High School. She received her BA in Biology from Wells College and her MA in Math and Science Education from the University of California at Berkeley. This will be her 25th year of teaching.

Carisa Ketchen-BS, MSSE

Carisa teaches Biology, Chemistry, Anatomy, Marine Science, and AVID at Toledo Jr/Sr High School. She received her BS in Natural Science and Earth and Space systems form Lewis-Clark State College and a Masters in Science Education from Montana State University. This will be her 11th year of teaching.

CLASSROOM:

This unit is designed for high school students in 9th-12th grades. Functional for in person or virtual classrooms.

Science Standards:

HS-LS2-1 (AST 1.4): Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

HS-LS2-2 (AST 1.1): Plan and conduct an investigation that uses mathematical representations to support explanations about factors affecting biodiversity and populations in ecosystems of different scales.

Science & Engineering Practices: Use mathematical representations of phenomena or design solutions to support and revise explanations.

Disciplinary Core Ideas: LS2.A: Interdependent Relationships in Ecosystems Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease.

Crosscutting Concepts: Scale, Proportion, and Quantity The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

Math Standards:

HD.MP4 Model with mathematics.

HS.MP.2 Reason abstractly and quantitatively.

Photo by Saanvi Vavilala on Unsplash

ANCHORING PHENOMENON:

Are Belugas still out of balance? Scientists from Oregon State University are researching a specific population of these whales that reside in Cook Inlet Alaska, using epigenetic techniques to find out if their current population and age structure is viable and sustainable. Students will learn about beluga ecology, how scientists analyze populations, and epigenetics, and will apply their new knowledge as they create an action plan for beluga stewardship.

THIS MARINE RESEARCH MATTERS:

Not all beluga populations are endangered. Scientists need an accurate picture of how the population structure is changing so that they can make informed decisions about management and stewardship. In the past, analyzing teeth from dead whales was the only way to assess age and approximate the age structure of the population. Epigenetic analysis is a game-changer because it allows age data to be collected before death.

OUR ORSEA PARTNERSHIP:

We all gained an appreciation for the challenges of studying vulnerable marine populations, and helping students engage with these issues in a scaffolded way. Students will gain a practical understanding of the challenges facing wildlife biologists. Together our ORSEA partnerships create meaningful, collaborative, and ongoing relationships that interconnect current research, meet education standards, and provide opportunities our students wouldn't have otherwise.

LEARNING PLAN COMPONENTS:

ENGAGE:

Introduce students to the anchoring phenomena that provides background information on the decline of the specific belugas that live in Cook Inlet Alaska.

Beluga Introductory Video

EXPLORE:

Students will complete the following three activities for interactive background information:

Beluga Virtual Tour

Power of the Pyramids

Explore the Epigenome

EXPLAIN:

Students will describe species at risk, the issues that cause them and determine/predict trends for the population at risk. An introduction of how researchers use epigenetics to determine age, gender, and genetic history to model and predict the future of this species.

Epigenetic Clocks

ELABORATE:

Students will apply their understanding of population pyramids and attempt to use it to analyze the structure of the Cook Inlet beluga population using the ages determined by the Oregon State researchers using epigenetic clock data.

Beluga Population Pyramids

EVALUATE:

Students will create an action plan that acknowledges the issues of this population, researches what practices are currently in place, how to potentially improve these practices, and what else can be done to ensure the survival and long-term success of the Cook Inlet beluga whale population.

Action Plan

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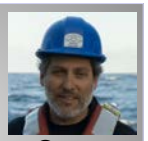
Seafloor Graveyard
What is causing episodes of dead animals on the seafloor?

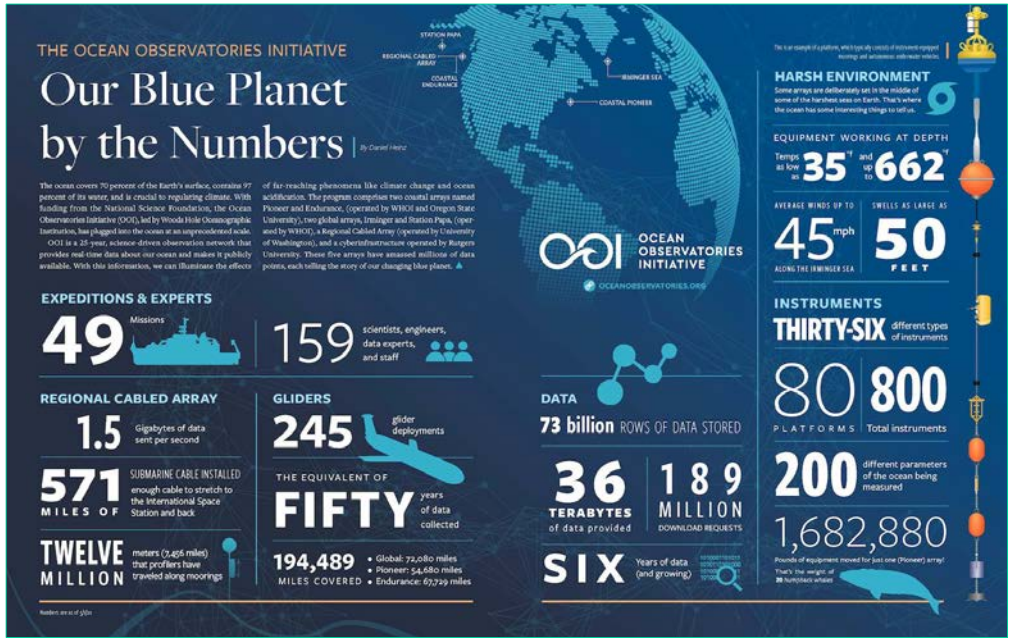


Jonathan Fram - Asso. Professor Senior Research: College of Earth, Ocean, and Atmospheric Sciences at Oregon State University. OOI Endurance Array Project Manager.

Sara Pursel - Biology teacher at Taft 7-12 in Lincoln City, OR with 14 years experience.

Mitch Lampson - Math teacher at Toledo Jr/Sr HS in Toledo, OR

When researchers in Oregon began to see mass graveyards of animals dead on the seafloor, they had a mystery on their hands. Access to data was limited and the Ocean Observatories Initiative has helped researches better understand the causes and impacts of hypoxia events.



Because of ORSEA the teachers and researcher collaborated and designed a lesson centering around the important work being done by OOI.

9th grade students gained an understanding of how the instruments and data help inform and solve mysteries and applied their knowledge to different challenges.

This marine research matters because data allows patterns to be discovered and connections to made. Information is key to understanding cause and effect of phenomena that occur on the planet.

ENGAGE:
See what happens to the animals on the seafloor when a hypoxia event occurs.

EXPLORE:
Become an expert in the type of equipment used to collect oceanic data and the OOI project.

EXPLAIN:
Dive into how the OOI data connects to ecosystems.

ELABORATE:
Work through scenarios and use Desmos to visualize the data with graphs. Extend learning by using the OOI data explorer.

EVALUATE:
Create a presentation or poster to showcase learning.

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Plastic Pollution Presents Prodigious Problems

Can we trace the plastic pathways to beaches and coastal waters to minimize the impact of these pollutants?

RESEARCHER BIO:

Samreen Siddiqui
Post doctoral Scholar, OSU

Bio: I am an aquatic ecotoxicologist with research focus on estuarine model species with pesticide and plastic exposures along the salinity gradient. I have an interdisciplinary background including big data analysis, modelling using R, and Arc GIS.

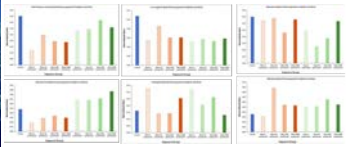
TEACHER BIOS:

Jim Grano – teacher, 33 yrs; 12 yrs post-retirement Watershed Studies Education Program Coordinator; former OCSTEM-Hub mentor teacher; currently Siuslaw Watershed Council VP & Education/Outreach chair.

Eva Ahumada- 8th grade math teacher at Taft high school 7-12 for 5 years. Major in Mathematics, Masters in Math Education and Curriculum and Instruction

Classroom:

The classes piloting these lessons are in Ahumada's 8th grade math class as an end of the year enrichment activities. Taft is a Title 1 public school, with >95% of students qualifying for free and reduced lunch.



Explanation of Anchoring Phenomenon

Plastics are everywhere in our daily lives, especially single-use plastic products, and we frequently observe them as marine debris. We must understand their pathways to our beaches and coastal waters to in order to minimize the volume of these harmful pollutants in our marine and terrestrial ecosystems.

This marine research matters because:

Plastic pollution has become an eco-crisis with the increasing use of plastic in our everyday lives, especially single-use products. Recent research demonstrates the negative impacts of plastic on aquatic organisms' growth, behavior and physiology. There is a crucial need to raise awareness and take action on this issue.

Learning Plan Components

Lesson 1:
History of Plastics

Lesson 2:
Impacts of micro and nano plastics on marine organisms

Lesson 3:
The effects of plastics on humans

Lesson 4:
The search for solutions: Community Solutions and Actions

Extensions

- Awareness Poster
- Beach Clean-Up
- Letter to local government

Because of ORSEA:

We collaborated as professionals to produce a ready-to-teach comprehensive four lesson unit on plastic pollution and it's effects on the marine environment.

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Sea Lion Feeding Frenzy

What does sea lion feeding have to do with human health?

RESEARCHER:

Samantha Rae, MS Student in Comparative Health Sciences at Oregon State University. Researching Sea Lion Health and Immune Function with a focus on Coastal Contaminants

TEACHERS:

Nicole Kraynik, MAT - Middle School Science teacher in Bandon, OR

Jason Lipe, Science Teacher at Siuslaw High School in Florence, OR

Classroom: Middle/High School

Because of ORSEA:

We were able to collaborate and work as a team to create a unit based entirely on local scientific research. We were able to bring different perspectives to the table to formulate a beneficial scientific lesson. Students will gain a better understanding of the connections between living things and the impacts humans have on their environment.

https://www.dfw.state.or.us/fish/sealion/photos.asp
https://www.dfw.state.or.us/news/2018/11_november/111518.asp

Explanation of Anchoring Phenomenon

Sea lions have adapted the behavior of migrating miles upriver to feed on salmon at hydropower dams in the Columbia River Basin. What do these sea lions feeding have to do with human health?

Sea lions are prime sentinel species because they have long life spans, are long-term coastal residents, feed at high trophic levels, and have unique fat stores that can store contaminants. They can alert us to environmental and public health dangers when we are able to study them.

This marine research matters because:

Coastal and tribal communities rely heavily on fish runs for subsistence, economic, and cultural purposes. These communities are especially tied to fish health and susceptible to marine contaminants. Since sea lions are a sentinel species, scientists use the One Health paradigm to analyze the connection between contaminants, fish, sea lions, and people to make informed decisions regarding public health, environmental protection, and wildlife conservation.

Learning Plan Components

ENGAGE:

- Anchoring Phenomenon: Sea lions eating salmon at Bonneville dam
- Driving question: "What do sea lions feeding have to do with human health?"

EXPLORE:

- Bioaccumulation activity - modeling bioaccumulation and biomagnification
- Data analysis activity - analyzing sea lion diet data

EXPLAIN:

- Bioaccumulation and Biomagnification presentation - key vocabulary, factors, and case studies
- Sentinel species presentation - key vocabulary and examples

ELABORATE:

- Bioaccumulation extension activities
- Sea lions and the One Health Paradigm - independent reading comprehension or whole-class discussion
- ORSEA Career Connections activity - STEM career exploration and researcher bio

EVALUATE:

- Food chains and Biomagnification - modeling biomagnification
- Sentinel species research project - research and present how organisms can be used to alert us to to dangerous conditions

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Swimming on an Empty Shark Tank:

What can cause white shark activity levels to vary between individuals within the species?

RESEARCHER BIO:

Taylor Chapple
Assistant Professor at OSU.
Taylor studies the movements, behaviors and population dynamics of sharks and other large marine predators

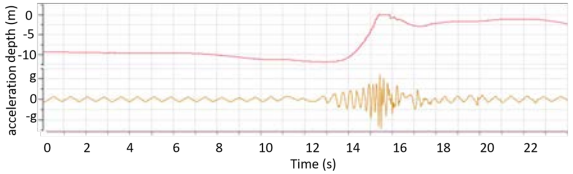
TEACHER BIOS:

Jazmin Garcia
WHS Science and Math Teacher
Began teaching January 2020
BS Biology, MS Marine Biology

Kelsey Hart
Taft 7-12 MS Math Teacher
Began teaching 2014
BA in Teleproduction,
MA Teaching,
MS Curriculum & Instruction

Because of ORSEA:

We were able to dig deep and find creative ways to present a lesson to students. Through collaboration we gained a better understanding of our individual teaching and learning techniques and we were able to combine them to create an interactive lesson. Students gain a better understanding of math and scientific research skills and get to work together to complete a fun task!



Explanation of Anchoring Phenomenon

Activity levels between individuals in a population vary due to differences in age, sex, enviroment and location. Within these subgroups, individuals have different needs and will perform varying degrees of activity each with their own energy costs. Therefore, the caloric needs of individuals will also vary.

This marine research matters because:

Predators help maintain the health of ecosystems. Part of understanding how White sharks help keep our coastal marine ecosystems healthy is understanding how much they need to eat. In order for a White shark to survive it needs to balance the energy it expends with the energy it takes in. Here wee explore how energy demands change between groups of individuals.

Learning Plan Components

ENGAGE:

Lesson 1 - Intro Video/Shark Frequency Matching + Project Intro
- Students match frequency graphs with recorded shark movements.
- Students learn important terms for the unit.

EXPLORE:

Lesson 2 - White Shark/Energy Exploration Webquest
- Students learn about calories, energy, and sharks.

Lesson 3 - Calculations Jigsaw + Calculations Worksheet
- Students work in groups to calculate tailbeat frequencies of 32 sharks.

EXPLAIN:

Lesson 4 - Energy Cost Worksheet
- Students use the tailbeat frequencies to calculate the average energy cost for each shark subgroup, and analyze the results.

ELABORATE:

Lesson 5/6 - Shark Restaurant Project
- Students work to create restaurants that serve human-sized and shark-sized portions of food. Students will compare the energy cost requirements of shark subgroups and humans.

EVALUATE:

Lesson 7 - Restaurant Presentation and Gallery Walk
- Students will share their restaurant projects with the rest of the class. Students will make observations and comparisons between restaurants, subgroups, etc.

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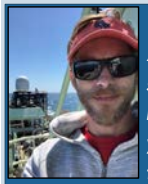
Marsh Magic
Understanding the importance of coastal wetlands

Researcher Bio – Jenni Schmitt, MS

Jenni is the Watershed Monitoring Coordinator at the South Slough National Estuarine Research Reserve. Her research interests include understanding wetland ecosystems. Much of her current work is focused on how climate change influences habitats and species distributions.

Teacher Bio – Kristina Webster, BS, MA

Kristina teaches math, science, and computer science at Toledo Jr/Sr High School. She received her BS from OSU in Fisheries and Wildlife Sciences and her MA in Teaching from Western Oregon University. This is her third year as an educator.



Teacher Bio – Andy Bedingfield, MS

Andy creates Ph.D. like experiences for HS students, mainly in chemistry. Prior to becoming a teacher, he worked for 10 years as an industrial chemist, and then four years as Director of Education, Outreach and Diversity at the Center for Sustainable Materials Chemistry. He has an M.S in chemistry and teaching.

Classroom:

This unit is designed for science (biology, ecology) and math students, grades 7-12. Functional for in-person or virtual learning environments.

Science Standards:

- HS-LS2-6 Ecosystems: Interactions, Energy, and Dynamics

Math Standards:

- HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling
- HSS.IC.B.6 Evaluate reports based on data
- HSN.Q.A.1 Use units to understand problems/guide solutions
- HSS.IC.B.5 Use data from randomized experiments to compare two treatments

Anchoring Phenomenon

Land use affects wetland ecosystem health. For example, some wetlands are no longer regularly flooded and become filled with invasive plant species, leading to low biodiversity. Others have natural flood regimes, higher biodiversity and are dominated by native species.

Research importance:

Wetlands are highly diverse systems, useful for humans by slowing flooding, filtering water, trapping carbon and reducing erosion. In the early 1900's when humans changed wetlands to farm or build on them (usually by filling, diking and draining them), they lost much of their highly productive capacity.

Our ORSEA partnership:

We created strong, collaborative connections and have imparted the importance of wetlands to students by creating a useful and engaging curriculum.

Learning Plan Components:

Engage:

- Students learn why wetlands are important via video presentation and teacher-led discussion
- Teacher shares video clips of a least-disturbed wetland, restored wetland, and impacted wetland.; students note differences observed.

Explore:

- Students explore the three wetlands in an online explorer (see below), using graphs/charts to identify patterns in the data.
- Students answer questions in their Field Notebook as they explore

Explain:

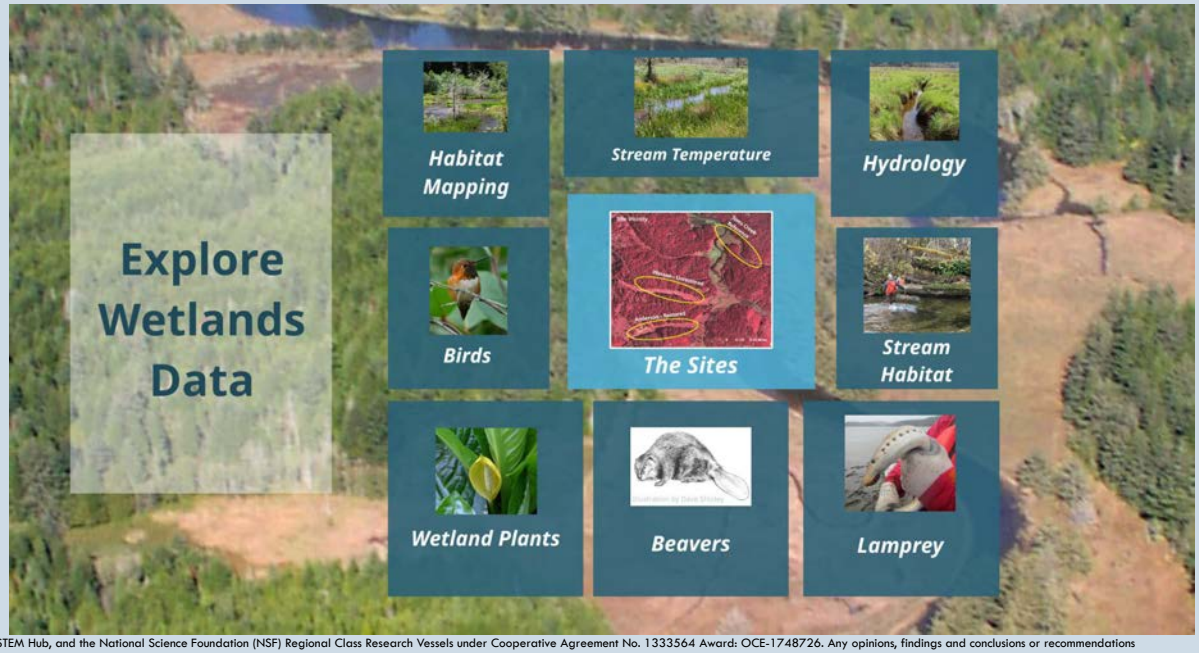
- Teacher led-discussion to wrap up each topic area

Elaborate:

- Students use a Summative Assessment Tool to create hypotheses
- Students analyze another student's claim

Evaluate:

- Formative assessments through Field Notebook, class discussions, online quiz game
- Summative Standard Achievement Assessment via Summative Assessment Tool and final online quiz



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Final Lesson Units Coming Soon!

Oregon Marine Scientist and Educator Alliance

Swimming on an Empty Shark Tank

What can cause white shark activity levels to vary between individuals within the species?

Authors
Kelsey Hart

Oregon Marine Scientist and Educator Alliance

Prodigious Plastic Pollution

By identifying plastics in our daily lives and tracing their pathways to beaches, coastal waters, can we minimize the volume of these harmful pollutants?

Overview
There are many different sources of marine debris. From intentional littering on land and in waterways, to improperly covered trash bins, items often travel by wind and currents long distances before settling on beaches or on the ocean floor. Marine debris can come from anywhere in a watershed, and be carried by rivers, streams, and other waterways into the ocean. Marine debris can also be generated in the ocean through lost cargo and fishing gear, and even dispersed by

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Belugas out of Balance

Are there enough individuals of reproductive age in the Cook Inlet beluga whale population to promote recovery without human intervention?

Overview
Are beluga populations out of balance? Scientists from Oregon State University are studying these whales using genetic techniques to find out if their current structure is viable and sustainable. In about beluga ecology, how epigenetics, and will action plan

Authors
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Grade Level
10-12

Time
class periods

Oregon Marine Scientist and Educator Alliance

Teeming with Fish

How many rockfish can we catch and still

Overview
People love to go fishing in the ocean and catch fish
want to catch "bottom fish" or "groundfish" many
reefs because these areas are **teeming** with life. To
over the long haul and still have fish to catch, rese
managers **team up** to provide sustainable fisheries
students look at data and video footage collected
rocky habitats off the Oregon Coast, and investiga
could be used to inform fishery management dec

Essential Questions
- How many fish are allowed to be caught each
- What is the life history of rockfish?
- How do scientists use math to answer these q
- How can scientists estimate how many rockfi
live on rocky reefs off
Oregon?
- What should people do to
take care of these fish?
- Why are rockfish
important? Why is
biodiversity important?

Learning Goals
Students will learn the following:
- Scientists need to understand the habita
rockfish to predict their populations.
- Scientists use statistics and plot data to
- Video lander technology can be used to
rocky habitats.

Learning Objectives
Students will be able to:
1. Use statistics to understand and an
2. Draw or describe the rockfish life c
3. Advocate for the importance of bi

Updated 08.04.2021

Oregon Marine Scientist and Educator Alliance

Sea Lion Feeding Frenzy

What does sea lion feeding have to do with human health?

Authors
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Overview
Sea lions migrate miles upriver to feed on salmon at hydro
dams in the Columbia River Basin. Salmon are a crucial par
ecosystem and are a vital food source for many tribal
communities. Contaminants in the water can accumulate i
bodies of fish and those who eat them, and concentration
contaminants can magnify higher up on the food chain. As
"sentinel species", sea lions can provide valuable informat
about potential risks to human health. In this lesson, stude
learn about the "one health paradigm" by exploring the
connection between contaminants, fish, sea lions, and pe

Essential Questions
- How do contaminants bioaccumulate and biomagnify in
ecosystem?
- How can we monitor and analyze levels of contaminati
species?
- Why are sentinel species important indicators in an eco
- What is the "one health paradigm"?

Learning Goals
Students will learn the following:
- Feeding relationships among species can lead to
bioaccumulation and biomagnification of contaminant
chain.
- Scientists gather quantitative contaminant data and a
data by converting it into percentages and creating gr
- Humans impact the ecosystem by producing and relea
harmful contaminants.
- Non-human species can be important indicators of eco
and human health.

Learning Objectives
Students will be able to:
- Develop a model for how contaminants bioaccumulat
chain.
- Analyze data by converting values into percentages a
stacked column and bar graphs.
- Identify the characterisitics and importance of sentin
- Connect the health of non-human species to human
through the "one health paradigm".

Updated 08.24.2021

Oregon Sea Grant * Oregon Coast

Oregon Marine Scientist and Educator Alliance

Marsh Magic

How has human agriculture had an effect on coastal wetlands? What are the differences between undisturbed, restored, and impacted wetlands?

Overview
South Slough National Estuarine Research Reserve on the southern Oregon coast has three wetland sites: one least-disturbed, one impacted (diked, drained and converted to agricultural lands in the early 1900's) and in need of restoration, and one impacted but then restored (2002). For the past few years, Reserve staff have been collecting data at the three sites including: beaver, lamprey, vegetation, historical imagery, hydrology, birds, and stream data.

Students will understand the importance of natural wetland ecosystems by exploring data in an online format. They will fill out digital field notebooks with guided inquiry within and explore hypothesis creation and critical analysis of other students' hypotheses (HS-LS2-6).

Essential Questions Based on HS-LS2-6
- What is a wetland ecosystem?
- Why are wetland ecosystems important?
- What factors affect the health of a wetland ecosystem?
- How do changes to land us affect the health of a wetland ecosystem?

Learning Goals
Students will learn the following:
- Wetlands provide important ecosystem services.
- Many wetlands in Oregon have been lost since the early 1900s.
- Wetlands that have been impaired have a much reduced function compared to natural wetlands or even restored wetlands.

Learning Objectives
Students will be able to:
- Make and evaluate a claim using evidence to explain differences across wetland ecosystems.
- Analyze data and charts to identify patterns.
- Articulate explanations that other scientists have developed.

Authors
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Grade Level
7-12

Time
1-2 weeks

Anchoring Phenomenon
Marsh Magic

Driving Question
How has human agriculture had an effect on coastal wetlands? What are the differences between undisturbed, restored, and impacted wetlands?

Standards
Next Generation Science Standards
LS2.C – Ecosystem Dynamics, Functioning, and Resilience

Common Core Math Standards
HSN.Q.A.1
HSN.Q.A.2
HSS.IC.B.5
HSS.IC.B.6

Updated 08.20.2021

Oregon Sea Grant * Oregon Coast STEM Hub

Oregon Marine Scientist and Educator Alliance

Seafloor Graveyard

What is causing episodes of dead animals on the seafloor?

Overview
When researchers in Oregon began to see mass graveyards of animals dead on the seafloor, they had a mystery on their hands. Students will investigate the cause of these hypoxia events, how they are measured, and their connection to climate change. They will also explore the impact on the ecosystem and challenges researchers face.

Essential Questions
Why does Oregon have hypoxia events during the summer?
Were hypoxia events always occurring off the Oregon coast?
Why are they happening now more than before?
What role do hypoxia events play in an ecosystem?
What connection can be made between climate change and hypoxia events?
Are hypoxia events measured?

Learning Goals
Students will learn the following:
- Ocean and climate change can contribute to low oxygen
- Ocean environment (hypoxia) impacts ecosystems
- Students with the Ocean Observing Initiative (OOI) monitor conditions and use data to make predictions.

Learning Objectives
Students will be able to:
- Understand effects of hypoxia events to environmental
- Understand how changes to the environment, both natural and human generated (climate change) may
- Identify of research equipment used to monitor
- Identify the engineering considerations associated

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Grade Level
9-10

Time
1-2 weeks

Anchoring Phenomenon
Seafloor Graveyard

Driving Question
What is causing episodes of dead animals on the seafloor?

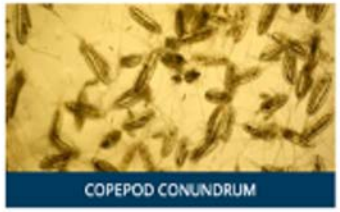
Standards
Next Generation Science Standards
LS2.A – Interdependent Relationships in Ecosystems
LS2.B – Cycles of Matter and Energy Transfer in Ecosystems
LS2.C – Ecosystem Dynamics, Functioning, and Resilience

Common Core Math Standards
HS.ID.A.1 – HS.ID.A.4
HS.ID.B.5 – HS.ID.B.6
HS.ID.C.7 – HS.ID.C.9

Oregon Sea Grant * Oregon Coast STEM Hub

OREGON MARINE SCIENTIST AND EDUCATOR ALLIANCE

https://oregoncoaststem.oregonstate.edu/orsea



ORSEA

Total Participants
25 teachers
14 researchers

Lessons
8 units completed
7 units in progress

Sea Grant Oregon

OREGON MARINE SCIENTIST AND EDUCATOR ALLIANCE

NSF

RCRV Regional Class Research Vessels

Upcoming Opportunity

TEACHERS * SCIENTISTS

Apply to participate in ORSEA 2021-22

See the ORSEA website for flyers and links to apply.
Teacher participants receive $1500 stipend.
Apply by October 15, 2021

https://oregoncoaststem.oregonstate.edu/orsea

Sea Grant Oregon

OREGON MARINE SCIENTIST AND EDUCATOR ALLIANCE

NSF

RCRV Regional Class Research Vessels

Thank you!

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https://oregoncoaststem.oregonstate.edu/orsea