


# BOEM OCEAN SCIENCE

THE SCIENCE & TECHNOLOGY JOURNAL OF THE BUREAU OF OCEAN ENERGY MANAGEMENT

VOLUME 14 ISSUE 1 • APRIL/MAY/JUNE 2017

A close-up photograph of a person's hand holding a collection of seashells and a small red crab. The shells are of various sizes and colors, including white, yellow, and brown. The crab is bright red and is positioned near the top of the shell collection. The background is a solid, light brown color.

## Science Education and STEM through BOEM's Environmental Studies Program

**Recruiting the Next Generation of  
Ocean Scientists**

**Spotlight on a Scientist: Cathy Coon**

**Alaska Native Exploration,  
Education, and Outreach**

**STEM Activities from the Top: BOEM  
Headquarters Leading by Example**

**Engaging Stakeholders and the Next  
Generation of Scientists in the Gulf  
of Mexico Region**

**Citizen Science and Education in the  
Pacific Region**

**New Waves: Late-Breaking News &  
Information**

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*BOEM OCEAN SCIENCE* is published quarterly by the Bureau of Ocean Energy Management to communicate recent ocean science, technological information, and issues of interest related to offshore energy recovery, marine minerals, and ocean stewardship.

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## ON THE COVER

Seashells in the hands of a child.  
Photo by Allexandar/Shutterstock.com

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## FREQUENTLY USED ABBREVIATIONS

ESP	Environmental Studies Program
GoMMAPPS	Gulf of Mexico Marine Assessment Program for Protected Species
GOMR	Gulf of Mexico Region
GOM-SCHEMA	Gulf of Mexico Shipwreck Corrosion, Hydrocarbon Exposure, Microbiology and Archaeology
MARINe	Multi-Agency Rocky Intertidal Network
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NGO	non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
NOSB	National Ocean Sciences Bowl
OCS	Outer Continental Shelf
OREP	Office of Renewable Energy Programs
ROV	Remotely Operated Vehicle
STEM	science, technology, engineering, and math

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To receive *BOEM OCEAN SCIENCE*, visit [www.boem.gov](http://www.boem.gov), click on the *BOEM Ocean Science* magazine cover, then select "Sign up for Ocean Science" at the bottom of the page, or email [Melanie.Damour@boem.gov](mailto:Melanie.Damour@boem.gov).

## FOR MORE INFORMATION

Check out the Bureau of Ocean Energy Management website at [www.boem.gov](http://www.boem.gov).



## THE ACTING DIRECTOR'S MESSAGE

The Bureau of Ocean Energy Management (BOEM) depends on a highly-educated, science-focused workforce to carry out its mission—overseeing the responsible development of Outer Continental Shelf energy and non-energy mineral resources for the Nation. Science is at the heart of all we do and to successfully accomplish our mission, BOEM employs a diverse field of experts from the fields of science, technology, engineering, and math (STEM) applied to coastal, marine, and human environments.

This edition of *BOEM Ocean Science* focuses on the work we do to share scientific knowledge and to educate and engage with citizens, organizations, students, and other scientists to further that knowledge and challenge our own understanding.

In addition to petroleum and civil engineers, physical and biological oceanographers, and biologists, we also rely on meteorologists, social anthropologists, economists, marine archaeologists, information technology experts, geologists, geographers, cartographers, geophysicists, and experts in other fields. Our employees come from many different backgrounds including the military, academia, industry, and non-governmental organizations (NGOs).

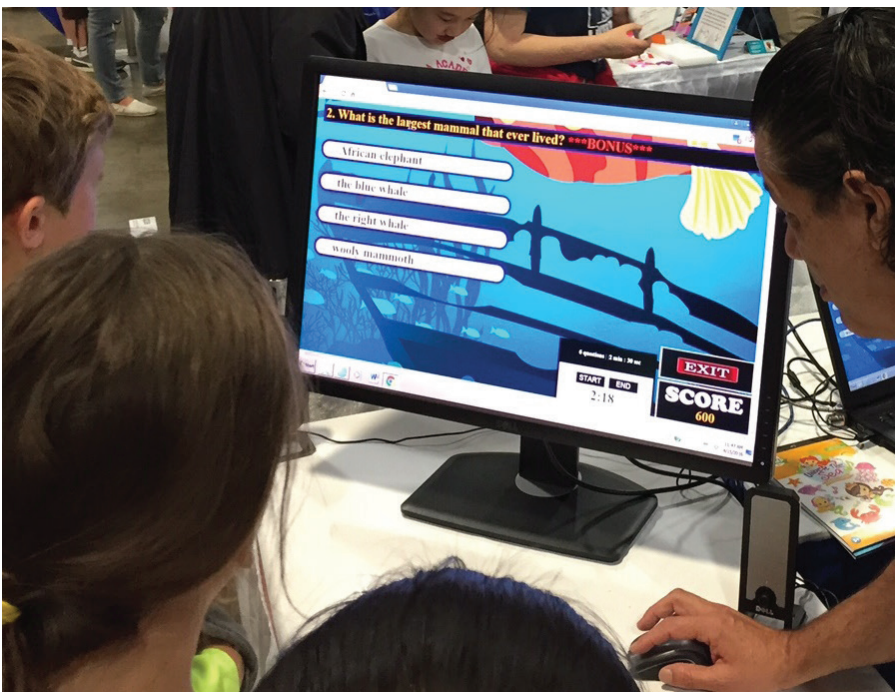
They must understand the Earth's ecosystems to advise policymakers on critical decisions regarding the efficient, effective, and responsible management of our Nation's offshore energy and non-energy resources. Maintaining this multi-disciplinary, high-caliber workforce is essential to BOEM's success.

Our country depends on a STEM-educated workforce to innovate and meet the demands of a 21st century economy. Our employees have dedicated years—decades in some cases—to developing their expertise to help the Nation responsibly meet its energy needs, and they willingly share their knowledge with the public. The Nation benefits from a science-literate public that is prepared to participate in civic affairs.

BOEM holds a public trust as a government agency. Directly and indirectly, science education and outreach contribute to national ocean science literacy and are key to broadening awareness and increasing public confidence and trust in BOEM's decisions.

I hope you enjoy learning about the bureau's ocean science education outreach and communication efforts.

– Walter D. Cruickshank



### FOR MORE INFORMATION

BOEM's Environmental Studies Program

<http://www.boem.gov/Studies/>

BOEM oceanographer Guillermo Avad demonstrates the "Energize Your Mind with Ocean Science" game to kids attending the 2016 USA Science and Engineering Festival in Washington, DC. Photo by Marjorie Weisskohl, BOEM.

# Recruiting the Next Generation of Ocean Scientists

Meeting our Nation's energy needs while protecting the environment requires a science, technology, engineering, and math (STEM)-educated workforce. Maintaining this multi-disciplinary, high caliber workforce is essential to BOEM's mission and the Nation. Our employees must understand the Earth's ecosystems to help policymakers make decisions on managing energy and non-energy resources.

## OUR SCIENCE EDUCATION GOALS

BOEM has defined four goals to integrate ocean science education into its activities. These goals include educating students in grades K–12, engaging colleges and graduate schools, encouraging citizen science, and reaching out to Tribal youth and generally interested adult communities.

The goals are focused on four principal outcomes: (1) creating enthusiasm for science in general and ocean sciences in particular by involving young people, including Tribal youth, in fun, interesting, relevant activities; (2) fostering appreciation for the role that science plays in environmental stewardship and the Earth's well-being; (3) raising awareness of career fields related to ocean science and stewardship; and (4) helping BOEM communicate its science mission to students of all ages, from elementary school to older adults, through lifelong learning.



Students from Santa Monica High School in CA won the championship round at the 2017 National Ocean Sciences Bowl, co-sponsored by BOEM. Photo by Pat Kight.

## NATIONAL OCEAN SCIENCES BOWL

One of our longest-running activities has been co-sponsoring the National Ocean Sciences Bowl (NOSB) annually since 2001. The NOSB is an academic competition and program that addresses a national gap in environmental and earth sciences in public education by introducing high school students to and engaging them in ocean science, preparing them for

ocean science-related and other STEM careers. Managed by the Consortium for Ocean Leadership, the NOSB helps students become knowledgeable citizens and environmental stewards. The NOSB reaches out to students and communities to increase participation by minorities, women, and disadvantaged students, which supports BOEM's goal of a diverse workforce. In addition, BOEM is profiled in the NOSB career booklet, "An Ocean of Possibilities! Careers Related to the Ocean and Aquatic Sciences."

This year's event—the 20th—took place at Oregon State University in Corvallis, Oregon. The competition brought together 25 regional high school championship teams, 125 students from coastal and inland states who were challenged to demonstrate their knowledge of the oceans. Ocean energy and coastal management figured prominently, including questions about offshore renewable energy—wave, wind, and current technology—and the chance to observe a wave tank in action. When the competition began in the fall of 2016, there were more than 1,800 high school students from 272 schools across the country, and 1,500 volunteers from the ocean science community. One take-away message was that the sheer experience of participating at NOSB will enable students to be lifelong advocates for science and science communication.

## WORKING WITH SCHOOLS AND TEACHERS

In addition to working with the NOSB, BOEM works with organizations such as the National Marine Educators Association (NMEA) and the National Science Teachers Association (NSTA) to support their science education efforts by providing educational materials and hearing about what works best in their classrooms. BOEM regions have adopted local schools



BOEM geophysicist Jennifer Miller and oceanographer Guillermo Auaud engage students at the 2016 USA Science and Engineering Festival in Washington, DC. Photo by Marjorie Weisskohl, BOEM.

and participated in hands-on events such as Earth Day and science festivals.

BOEM (then) Deputy Director Walter Cruickshank signed a Memorandum of Understanding (MOU) in 2016 with Sterling Elementary School Principal Jennifer Meres Short for future STEM activities. In addition, scientists from BOEM have run hands-on activities for students at three Sterling-area elementary schools. Others have participated at science-day and career-day school events in Falls Church, VA; Annapolis, MD; and Thomas Jefferson High School for Science and Technology in Fairfax, VA.



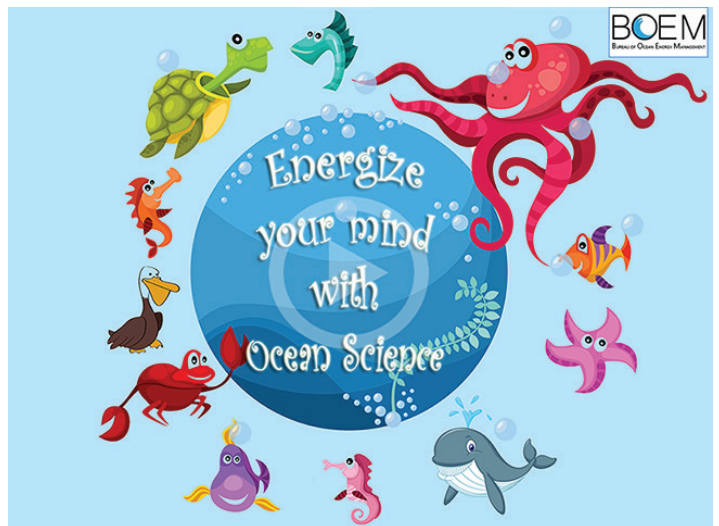
Sterling Elementary School Principal Jennifer Meres Short (left) and BOEM Deputy Director Walter Cruickshank (right) sign a Memorandum of Understanding in 2016 to support STEM activities.



At Rosa Lee Carter Elementary School in Ashburn, VA, BOEM's Jake Levenson leads students practicing echo-location by trying to find each other using only sound and while wearing blindfolds.

## EXPANDING OUR REACH

To reach more students through a networked approach, BOEM has developed materials for teachers and students, including ocean science posters and curriculum materials for lectures. In 2016, at the USA Science and Engineering Festival in Washington, DC, BOEM introduced the animated game "Energize Your Mind With Ocean Science" to test students' knowledge of ocean sciences and energy. It includes terms and concepts in physical and biological oceanography, marine biology, archaeology and social sciences, ecology, geology, energy, mapping, and related topics. It is designed for students in grades 3 through 12, and is based on the oceanography and science programs of school systems across the country.



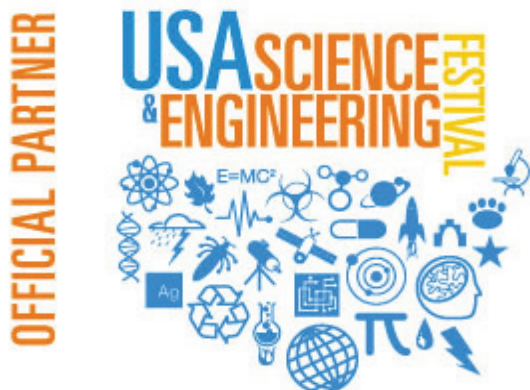
BOEM's "Energize Your Mind With Ocean Science" game allows students to earn points for every correct answer.

## OUTREACH AND EDUCATION THROUGH BOEM STUDIES

Increasingly, BOEM's Environmental Studies Program is requiring our studies to include education materials and outreach activities based on the research. Some environmental studies include the production of videos that may be used in conjunction with teacher lesson plans. Examples include the video, "Arctic Currents: A Year in the Life of the Bowhead Whale," discussed in more detail in the article on page 8, and "Atlantic Canyons: Pathways to the Abyss" discussed in the article on page 10. Other videos capture student activities, such as one from our Pacific region, where students from Ventura and Los Angeles Counties shared their knowledge and creativity in making and operating mini-Remotely Operated Vehicles at a BOEM exhibit.

## OUTREACH IN BOEM'S REGIONS

Each of our regions conducts outreach to students. BOEM's Pacific Region has a long-standing commitment to sharing its



science with the education community. Working with education partners like the Ventura County Office of Education, the Aquarium of the Pacific, Santa Barbara Zoo, the Marine Advanced Technology Education Program, the National Energy Education Development (NEED) Project, and regional colleges and universities, BOEM's Pacific office continually strives to position itself as a science resource to educators and students.

The Gulf of Mexico Region (GOMR) regularly conducts educational outreach. From teacher conferences to STEM events, GOMR employees support students' desire to learn by engaging them in the classroom and at science fairs. The region also produces posters that highlight various natural and cultural resources in the Gulf of Mexico.

GOMR educational outreach activities include contributions from BOEM's marine archaeology studies to the Museum of the Coastal Bend in Victoria, TX, for its upcoming exhibit "Sunken History: Shipwrecks of the Gulf Coast" in the fall of 2017. Photographs and 3D laser scans of the German U-boat *U-166*, discovered in 5,000 feet of water in 2001 and the subject of several BOEM studies, were provided for the exhibit, as well as Historic Shipwrecks of the Gulf of Mexico posters for distribution. As part of the region's outreach initiative, BOEM participated at Core Element Hands-On STEM DAY held in New Orleans on May 17, 2017. More than 10,000 students from grades 2 to 6 attended, and BOEM employees engaged students in ocean-science-related games and provided handouts and posters. More information about GOMR outreach and education can be found in the article on page 12.

BOEM's Alaska Region conducts education outreach in a number of ways, varying by community, and dependent upon the desires of the school and faculty. Scientists from the regional office participate with their own version of BOEM Scientists in the Classroom. The region's outreach officer has served on the Advisory Board for the Alaska Science Teachers Association and has given several presentations to colleagues to describe the range of expertise available.

The annual Alaska Marine Science Symposium in Anchorage includes poster sessions that feature a student competition allowing scientists to provide constructive comments.

One big success has been with the University of Alaska Anchorage and the Alaska Native Science and Engineering Program (ANSEP). Since 2010, BOEM directors have appeared in front of approximately 200 students on three separate occasions. In February 2017, BOEM gave a presentation to nearly 150 students and faculty at the university.

## THE FUTURE OF OCEAN SCIENCE

While BOEM engagement with students is fun and energizing, it serves a greater purpose—helping to light a spark in the next generation of ocean energy and environmental leaders.

In order to stay competitive economically, we need a trained workforce. According to the U.S. Department of Education, the school-age population (K–12) was projected to be about 56

million in the 2016–2017 academic year. In addition, more than 20 million students are expected to receive post-secondary degrees in the fall of 2017. In 2014–2015, the Nation conferred 636,000 degrees in the sciences. Through BOEM's science education outreach, hopefully some of those people with the passion, curiosity, education, and talent will enter into the exciting field of offshore energy and marine minerals management.

— William Y. Brown, Ph.D.,  
BOEM Chief Environmental Officer



BOEM hosts science open-houses in Nuiqsut and Barrow, Alaska for the public. Photo by BOEM.

## FOR MORE INFORMATION

### National Ocean Sciences Bowl

NOSB photos: <https://www.flickr.com/photos/kightp/albums/72157679815536903>

NOSB video: <https://youtu.be/J7J9l-s3P44>

### BOEM outreach materials

<https://www.boem.gov/Environmental-Studies-Program-Teacher-Resources/>

<https://www.boem.gov/oceanscience/oceanscience.html>

<https://www.boem.gov/BOEM-Posters>

<https://www.boem.gov/BOEM-Videos/>

<https://www.boem.gov/Working-with-Students-to-Promote-Ocean-Science/>

<https://www.facebook.com/Core4KidsNOLA/>

### U.S. Department of Education information:

[https://nces.ed.gov/programs/digest/current\\_tables.asp](https://nces.ed.gov/programs/digest/current_tables.asp)

[https://nces.ed.gov/programs/digest/d16/tables/dt16\\_318.45.asp?current=yes](https://nces.ed.gov/programs/digest/d16/tables/dt16_318.45.asp?current=yes)

# Spotlight on A Scientist: Cathy Coon

**What is your job at BOEM? What role do you play in BOEM's Environmental Studies Program?**

In the fall of 2016 I was promoted to Chief of the Environmental Sciences Management Section, Office of the Environment, in BOEM's Alaska OCS Region. We are a team of seven scientists that develop and manage scientific studies to better understand the effects of potential oil and gas exploration and development in the environment. Our scientific design is facilitated by our close partnership with the Environmental Assessment sections in our office as well as input from a vast network of stakeholders.

**Why did you decide to work for BOEM?**

I began working for BOEM (then MMS) in 2008. I was intrigued by working for a federal agency whose mandate under regulation supports the collection of meaningful environmental information to be applied to resource management decisions. The concept of applied science resonates strongly with me and the linkage between science and policy is a key passion.

**How has your educational background and experience prepared you for the work you do?**

In hindsight, all of my schooling and work experience aligns perfectly with my role in BOEM. I studied Biology at the University of Arizona and leveraged most of that time with summer programs in Marine Biology in the U.S. Virgin Islands and Oregon. After college, I worked as a National Marine Fisheries Service fishery observer in Kodiak, Alaska and collected biological data from commercial fishing vessels. I also worked seasonally for the Alaska Department of Fish and Game collecting sport fish data (creel surveys) in Kodiak, Alaska. After several years of collecting data, I completed a graduate degree at the University of Alaska Fairbanks, College of Fisheries and Ocean Science. My research examined commercial fishery data and related it to the effects of bottom trawl gear on benthic communities in the Gulf of Alaska and Aleutian Islands. I spent a large portion of that time "crunching data" and learning the art of geographic information systems (GIS) to display biological data in relation to commercial fisheries locations.

After graduate school I took a position as a fishery analyst/GIS specialist supporting the North Pacific Fishery Management Council (NPFMC), one of eight regional councils established by the Magnuson-Stevens Fishery Conservation and Management Act, which manages fisheries in U.S. federal waters. I served as an expert in Alaskan marine fisheries biology and management, advising Council members on the status of habitats in Alaskan waters with respect to existing and proposed fisheries regulations. My work focused on applied technical problem-solving skills to lead the research



Cathy Coon, Chief of the Environmental Sciences Management Section, Office of the Environment, BOEM Alaska OCS Region.

and resolution of significant issues ranging from marine habitats to protected species in the Exclusive Economic Zone offshore Alaska. During my ten years at the NPFMC I also worked on Environmental Impact Statements and Environmental Assessments to ensure compliance with the National Environmental Policy Act (NEPA).

**What do you find most rewarding about your work?**

The accomplishment I'm most proud of in the 27 years I've been a marine scientist in Alaska is collaboration. With experience at both the Federal and State level I've learned that relationships are key if you want to build good communication networks with a broad range of stakeholders. Through collaboration we are able to establish and maintain resource management partnerships with Federal, State, and local government agencies, non-governmental organizations (NGOs), and private industry partners; communicate and negotiate research needs and priorities; improve coordination and cooperative understanding on issues of shared responsibilities; negotiate controversial and sensitive issues; and build cooperative endeavors to further the environmental protection and energy independence goals of the Nation.

# Alaska Native Exploration, Education, and Outreach

## KAKTOVIK K–12 OCEANOGRAPHY PROGRAM: START THEM EARLY AND PIQUE THEIR INTEREST!

For the third year in a row, BOEM sponsored a Summer Oceanography Program based in the remote Beaufort Sea village of Kaktovik, Alaska. The program is a 5-day adventure conducted by the University of Texas Marine Science Institute, and coordinated with the U.S. Fish and Wildlife Service and many volunteers. The program exposes local students, ages 4–17, to the diverse techniques and technologies used by scientists for ocean exploration and to help them understand the unique coastal zone of the Beaufort Sea. Students were immersed in a combination of field, laboratory, and classroom activities to stimulate their interest in science and discovery.

They experienced how ocean exploration takes place by learning field work skills and lab techniques from expert biologists, chemists, and geologists. Kaktovik Lagoon served as a natural classroom where students were able to extract live species for laboratory observation.

The Summer 2016 course included 19 students, representing one-third of all K–12 students in Kaktovik. They developed new skills for exploring their local environments and investigating marine biology and chemistry. The program included hands-on science activities that focused on several important principles in marine environmental science.



Students and Cliff Strain measure the size of a “kook” during the erosion survey. Photo courtesy of UT Marine Science Institute.

## AN EVENING OF SCIENCE IN THE BEAUFORT

A small consortium of BOEM’s Environmental Studies Program (ESP) representatives from the Alaska OCS Region visited both the Kisik Community Center in Nuiqsut and the Tuzzy Consortium Library in Utqiagvik (Barrow) to discuss recent Beaufort Sea studies. Both gatherings provided informal opportunities for community members to learn how BOEM applies the local and traditional knowledge that is shared, and how their contributions benefit their communities.

BOEM presenters shared information with attendees about

## Educational Experiences

- Seining for capturing fish and invertebrates for classroom observation.
- Piloting a Remotely Operated Vehicle for observing the underwater lagoon environment.
- Experiments to observe foraging behavior of different organisms.
- Microscopic observation of plankton, water samples, and sediment.
- Tracking eiders (large seaducks) using radio transmitters.
- Dissection of a shark.

## Educational Topics of Discussion

- Ecosystems
- Energy transfer from the sun through producers, consumers, and predators.
- Careers in marine science
- Taxonomy
- Beach erosion
- Practical importance of sciences and math in our lives.

the ongoing research to understand fish and marine mammal behaviors; to identify ice hazards, improve spill modeling, and detect contaminants near OCS oil facilities; and to monitor food security in Beaufort Sea communities.

Over the last few decades, BOEM has supported numerous efforts to study the Beaufort Sea’s unique environment. Since the creation of the ESP in 1973, BOEM and its predecessor agencies have invested more than \$500 million in coastal Alaska research—much of it in the Beaufort Sea. Currently, the bureau is managing more than 65 ongoing study projects in the Alaska OCS Region.

## UNDERNEATH THE DEEP BLUE SEA – THE BOWHEAD WHALE

Although 71% of the earth’s surface is water, there is no easy way to study the creatures that live beneath the surface of the sea. With an average water depth of 12,000 feet, there are plenty of places in the ocean to hide—even for a creature as large as the bowhead whale, a marine mammal that can measure up to 66 feet long, weigh up to 100 tons, and live to be 200 years old.



A joint effort between the University of Alaska Museum of the North, BOEM, and other partners created a scientific film following the epic journey of bowhead whales as they make their annual migration across the Bering, Chukchi, and Beaufort Seas. Through "Arctic Currents: A Year in the Life of the Bowhead Whale," BOEM and its partners hope to improve public understanding of the iconic bowhead whales and their role in the Pacific Arctic marine ecosystem, their importance to the Iñupiat way of life, and to inform public policy on managing OCS energy resources.

Through traditional knowledge and science, the film explores whale taxonomy, physiology, diet, behaviors, and their widespread movement through Subarctic and Arctic waters. Other topics include the study of the whales through:

**Tagging.** This has allowed tracking of the whales' migration patterns in their search for food throughout the various seasons. Short-term tagging is used to obtain ocean water samples to measure temperature, salinity, and the amount of food available to the bowhead whale.

**Satellite telemetry and aerial observation.** Aerial photography (survey) is used to locate the bowhead whales, determine their numbers and how long they stay in a given area, and estimate body length. The observation also documents feeding, socializing, and traveling tendencies or patterns.

**Traditional knowledge.** The film looks at the ways information is gathered and sustained by the indigenous whalers.

Another important aspect of the research is to ensure the protection of subsistence harvesting. To maintain population estimates, whales are counted in the spring as they pass by Utqiagvik (Barrow). The Iñupiaq, Yup'ik, and Siberian Yup'ik peoples of western and northern Alaska heavily depend upon the subsistence harvest of marine mammals, land mammals, fish, and migratory birds for food security, cultural tradition, and spiritual necessity.

Outreach efforts for informing the public and improving technologies for OCS energy development are important to BOEM and its partners. BOEM will continue to monitor bowhead whales, which, as the film explains, are "on the move, year after year, for perhaps hundreds of years."

– Janet Purdy

## Knowledge and Observances of the Bowhead Whale:

- Social and non-aggressive toward humans;
- Eat the smallest of species, such as krill and copepods, by the millions;
- Begin reproducing at age 25, birth a calf weighing one ton after a 13- to 14-month pregnancy;
- Total population is estimated to be 30,000 with 16,000 of these in the Bering, Chukchi, and Beaufort Seas;
- Estimated to live 200 years; and
- Are individually recognized by scientists from distinctive marks and scars.



Students and Ken Dunton pilot the ROV from the R/V Proteus. Photo courtesy of UT Marine Science Institute.



Students in chest waders pull in a seine. Photo courtesy of UT Marine Science Institute.



Students examine algae samples using microscopes. Photo courtesy of UT Marine Science Institute.

### FOR MORE INFORMATION

**Kaktovik K-12 Oceanography Program:**

<https://utmsi.utexas.edu/visit/summer-science/kaktovik-alaska>

**Bowhead Whale film:**

<https://www.boem.gov/Life-of-Bowhead-Whale/>

# STEM Activities from the Top: BOEM Headquarters Leading by Example

One of the best aspects of working at BOEM's offices in the Washington, D.C. area is the opportunity to participate in the bureau's science education outreach activities with students. From individual classrooms to special events at the Smithsonian Institution and larger science festivals and competitions held near the Nation's Capital, BOEM employees eagerly share their knowledge and passion for science with students.

## SMITHSONIAN ARCTIC SPRING FESTIVAL

At the Smithsonian's Arctic Spring Festival in 2015, BOEM scientists shared real-life experiences from the Arctic region. The exhibit celebrated Arctic peoples, cultures and science, and highlighted research information from BOEM and other agencies working in the Arctic. BOEM staff who lived and worked in Alaska shared personal stories.

## CELEBRATING WORLD OCEANS DAY

World Oceans Day is an annual celebration, and BOEM has participated in special events for young students and families at the Smithsonian's Sant Ocean Hall. In 2016, BOEM maritime archaeologist Jimmy Moore showed the compression effect of underwater pressure on Styrofoam heads and cups as part of an experiment. In addition, computer monitors were set up to show video footage of historic shipwrecks in the Gulf of Mexico.



BOEM's Jimmy Moore demonstrates the effects of underwater pressure to students. Photo by Marjorie Weisskohl, BOEM.

At another table, oceanographer Guillermo Auad described research conducted in the frigid Arctic waters and coral research in the warm Gulf of Mexico waters. Hundreds of people visited the BOEM table that day.

## EXPLORING THE SEABED, LOOKING FOR HAZARDS

BOEM geophysicist Jennifer Miller explained seafloor mapping and seabed features during her segment of "The Expert is In" program at the Smithsonian Museum of Natural History.



BOEM's Jennifer Miller interacts with attendees.

## USA SCIENCE AND ENGINEERING FESTIVAL

BOEM has been an official partner of the USA Science & Engineering Festival since 2012. Held every two years in Washington, D.C., the festival draws more than 350,000 K-12 students and parents, more than 5,000 teachers, and more than 3,000 STEM professionals. The event showcases 3,000 exhibits from the World's leading professional scientific and engineering societies, universities, government agencies, high-tech corporations, and STEM outreach and community organizations. BOEM is gearing up for the April 7-8, 2018 festival and will build upon our highly successful array of hands-on, interactive activities.

## SUPPORTING THE KIDWIND CHALLENGE

With interest in BOEM's Office Renewable Energy Programs (OREP) expanding in three OCS regions, it is no surprise that the program staff is involved in the KidWind Challenge. This annual engineering design competition for grades 4 through 12 challenges students to design and build a working small wind turbine, present their design to judges, and demonstrate their knowledge of the wind industry.

In spring 2017, two members of OREP's staff participated as judges in three competitions sponsored by James Madison University's Center for Wind Energy. The top two teams in the high school and middle school divisions at each challenge are invited to the National Challenge in California at the AWEA



BOEM's Annette Moore (front row, third from left) and the KidWind National Competition winning team from Bobby Duke Middle School in Coachella, CA. Photo by John Romero, BOEM.

Windpower conference. The Challenge gives students the opportunity to learn about wind power and engineering design as well as renewable energy careers through a competition, and promotes hands-on, team-based learning.

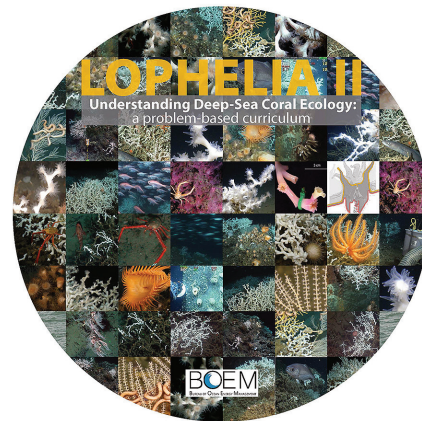
## TEACHER RESOURCES

Additional teacher resources based on the research sponsored by BOEM's Environmental Studies Program are available for classroom use. An advanced program for high school students is "Lophelia II: Understanding Deep Sea Coral Ecology." The curriculum challenges students to adopt the role of marine scientists and prioritize potential drilling sites while minimizing ecosystem impacts.

## OFFSHORE CANYONS IN THE ATLANTIC

BOEM sponsored the production of a documentary, "Pathways to the Abyss," as part of an interagency partnership with the National Oceanic and Atmospheric Administration and the U.S. Geological Survey for the mid-Atlantic canyons project. The study involved 17 organizations, including the North Carolina Museum of Natural Sciences and videographer Art Howard. A communication component was incorporated to reach the general public, such as students who visit the museum and other science organizations. It has also been featured at the Virginia Aquarium and Marine Science Center. The video reveals the beauty and uniqueness of two mid-Atlantic Canyons located 100 miles offshore Virginia and Maryland and features interviews with scientists who participated in the research.

– Marjorie Weisskohl, BOEM



Teacher resources include this curriculum based on the Lophelia II study.

## FOR MORE INFORMATION

**USA Science & Engineering Festival**

<http://www.usasciencefestival.org/>

**Center for Wind Energy at James Madison University**

<http://wind.jmu.edu/index.html>

[https://www.facebook.com/pg/CenterforWindEnergy/photos/?ref=page\\_internal](https://www.facebook.com/pg/CenterforWindEnergy/photos/?ref=page_internal)

**Lophelia II: Understanding Deep Sea Coral Ecology**

<https://www.boem.gov/Curriculum-Lophelia-II/>

**Pathways to the Abyss video**

<https://www.boem.gov/Atlantic-Canyons-Pathways-to-the-Abyss/>

# Engaging Stakeholders and the Next Generation of Scientists in the Gulf of Mexico Region

BOEM's Gulf of Mexico Region (GOMR) has been a part of several initiatives to boost interest in and supplement educational programming for science, technology, engineering, and math (STEM) careers as well as engage with various stakeholders.

## ULTIMATE ROV CHALLENGE

In 2015, two STEM competitions were developed in coordination with the PAST Foundation, C&C Technologies, and the Center of Science and Industry (COSI) in Columbus, Ohio. These programs were supported through BOEM's Gulf of Mexico Shipwreck Corrosion, Hydrocarbon Exposure, Microbiology and Archaeology project (GOM-SCHEMA). The first competition brought more than 80 high school students together to showcase the Remotely Operated Vehicles (ROV) they designed and constructed throughout the school year. The Ultimate ROV Challenge allowed the 19 teams to test their ROVs in COSI's water tank, which contains a replica wooden shipwreck. Teams in the Advanced category competed by collecting archaeological, biological, and geological "samples" with their ROV from the "shipwreck" similar to the sampling conducted at real shipwrecks as part of GOM-SCHEMA. In addition, the student teams gave a presentation to a panel of judges and answered questions about their ROV design.



Students maneuver their ROV in the COSI water tank and collect "samples" from a replica shipwreck. Photo by Melanie Damour, BOEM.

## ROV DESIGN CHALLENGE RANGER CLASS

For the second ROV challenge, student teams tested their ROVs in the water tank and, as a supplement, the Ohio State University ROV team presented four workshops to further enhance the educational experience. The workshops discussed: buoyancy, ROV construction and design, technical documentation, and career opportunities/real-world applications. This STEM program provided an opportunity for students to test

their engineering designs as well as simulate collection of scientific data—important skills for the next generation of scientists.

## GOMMAPPs

BOEM entered into an Interagency Agreement (IA) with NOAA for the study "Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPs): Marine Cadastre Planning Tool and Outreach Support." The goal is to improve information regarding marine mammals, sea turtles, and seabirds for mitigation and monitoring of impact-producing factors such as underwater noise, vessel traffic, entanglement, marine debris, discharges/produced water, and accidental spills. In addition, IAs for GoMMAPPs fieldwork were awarded to NOAA for marine mammals, the U.S. Fish and Wildlife Service for seabirds, and the U.S. Geological Survey for sea turtles.

An important component of the GoMMAPPs program is to develop planning and educational tools to facilitate stakeholder engagement. Quantum Spatial, Inc. (QSI) is in the process of developing outreach and educational tools to demonstrate the goals and intent of GoMMAPPs and the environmental information needs that the study fills. Examples of these products may include presentations, interactive web-based story maps, and web-based and printed outreach material. The educational and outreach tools will help ensure GoMMAPPs is well coordinated with other science programs, including Gulf restoration and restoration-monitoring programs. BOEM has developed a web page to make study information publicly available including recent presentations from the GoMMAPPs workshop during the 2017 Gulf of Mexico Oil Spill and Ecosystem Science conference in New Orleans, Louisiana, a soon-to-come cruise blog, and other updates. More outreach events are anticipated for this year to encourage collaboration and involvement with the GoMMAPPs program.



## Gulf of Mexico Marine Assessment Program for Protected Species

### THE GULF SERPENT PROJECT

The deep-sea has always captivated our imaginations. Its bizarre animals are so alien to us. Children are particularly

fascinated by deep-sea marine life. How can you show them its wonders and compete with the amazing footage on the Discovery Channel or Blue Planet? It turns out there is a way to bring the deep-sea into the classroom in a way that few children will forget.

Through a partnership with Shell and Oceanering, Gulf SERPENT has been using 3D high-definition video to turn elementary students into ocean explorers. With the aid of 3D glasses, students can experience being immersed in the ocean while their feet are firmly on dry land. This amazing technology allows sharks, jellyfish, and hundreds of other spectacular deep-sea animals to literally swim in front of the students.

At a recent marine science exhibition, called Ocean Commotion and sponsored by Louisiana Sea Grant, students were lining up to have a chance to enter the depths. The same technology has been shown to students at Baton Rouge's Buchanan Elementary School and was also a hit with participants at the 2016 TEDxLSU conference.

3D underwater video was developed to provide ROV pilots with better depth perception when performing subsea work. The same technology gives students a much better perception of the incredible animals that make the deep-sea their home.

– Mark Benfield, Louisiana State University



School children use 3D glasses to view ROV video footage of marine life in the deepwater environment. Photo by LSU.

### ADDITIONAL EDUCATIONAL OUTREACH

A recent outreach effort in the GOMR provided multiple programs and exhibits for the Louisiana Children's Museum. Marine educators provided hands-on interaction at the Museum to teach kids about marine science in the GOM. Other outreach materials developed in the GOMR include educational posters that focus on historic shipwrecks in the GOM, the endangered sea turtle, and the twenty-one species of whales and dolphins found in the Gulf. These posters are available free to the public. BOEM often shares the posters at conferences, workshops, school visits, and teacher or science conventions.

*Energy from the Ocean*, a five-module, historical-based curriculum for students in grades 5–8, is an available resource funded by BOEM on the history of the offshore oil and gas industry in the GOMR. The program includes information about ocean energy development careers and is intended to introduce and reinforce key social studies, science, and ocean literacy concepts.

Collectively, GOMR's outreach and education efforts, and support for STEM programs demonstrate the importance of engaging with stakeholders and with future scientists.

– Janet Purdy



Educational posters produced by BOEM's Gulf of Mexico Region.

### FOR MORE INFORMATION

#### GOM-SCHEMA Project

<https://www.boem.gov/GOM-SCHEMA/> and <https://hamdanlab.com/gom-schema/>

#### ROV Challenge

<https://pastfoundation.org/ultimate-rov-challenge-was-amazing>

#### GoMMAPPS

<https://www.boem.gov/GOMMAPPSS/>

#### Gulf SERPENT Project

<http://www.serpentproject.com/>

<https://www.youtube.com/user/serpentproject>

#### BOEM Educational Posters:

<https://www.boem.gov/BOEM-Posters/>

#### Energy from the Ocean Curriculum:

<https://www.boem.gov/Curriculum-Energy-from-the-Ocean/>

# Citizen Science and Education in the Pacific Region

BOEM's long-term monitoring of the California rocky intertidal shores brings science and math to life for professionals, students, and volunteers.

## MONITORING THE COASTAL SHORES

Ongoing BOEM studies are providing valuable information for stakeholders regarding the potential impacts of OCS activities to the coastal shoreline by differentiating between naturally caused impacts and other anthropogenic impacts, including those from OCS oil and gas production and accidental oil spills. For decades, BOEM has provided funding for multiple teams of scientists from the Multi-Agency Rocky Intertidal Network (MARINe) to continuously monitor rocky intertidal sites on the mainline shore, immediately adjacent to OCS oil and gas and potential wind and wave facilities. MARINe includes partners and funding from several National Parks, the U.S. Navy, National Marine Sanctuaries, and many universities to collect data at more than 200 sites from Mexico to Alaska.

MARINe protocols have been used to assess oil spill injury, endangered species listing, human-use impacts, chronic effects from water pollution, and community changes in response to shoreline protection. Sites are monitored to detect changes in the abundance of targeted species. The species are either photographed in fixed plots in the field or measured and counted in plots.

New in 2016, sampling the biodiversity of an entire site is conducted at BOEM sites to evaluate species changes across the site and better compare among regions of the coast. This sampling also identifies rare species and provides clues to gradual species shifts, such as movement of species in relation to elevation and temperature.

Let's take a look at a unique program initiated by BOEM and MARINe.

## CITIZEN SCIENCE AT WORK

Accurate, reliable data are necessary for documenting ecosystem health and can serve as a reference for policy-makers to make informed management decisions regarding OCS energy production. Working with MARINe, BOEM is developing citizen science programs to supplement professional monitoring by BOEM with volunteers who are environmentally-minded and interested in ocean stewardship.

In 2016, BOEM collaborated with the Bren School of Environmental Science & Management at the University of California, Santa Barbara to develop a sampling protocol for volunteers that can integrate with existing data collected by scientists. Specific protocols are initiated for the citizen science volunteers and all data collected are compared to that of professionals to ensure consistency and accuracy. The

volunteers receive a field guide for reference, which includes each protocol component and an identification key for each of the nine biological categories (chosen based on abundance, importance, and ease of identification), as well as instructions for data collection.

## Protocol Components in 2016

- Transect – measure the percent cover of biological categories over 10-meter paths.
- Species of Concern Search – 30-minute search within the site boundaries for an organism with a specified ecological significance.
- Photoplot – measure the percent cover of biological categories by using a smartphone to photograph quadrats.
- Site Survey – record qualitative characteristics of the site with photos and general site observation.

## WAS THE PROGRAM EFFECTIVE?

The quality of the citizen science photos was sufficient for MARINe professionals to score the percent cover of California mussels. In addition to professional scoring, the photos were crowdsourced for an efficient way to analyze the data. There were more than 120 respondents to the crowdsourcing of the Mussel photoplot.

Prior to the collection of data, citizen science volunteers practiced the transect protocol, including category identification. This practice may have contributed to the accuracy of collection as 80% of the citizen scientists scored within 10% of the professionals.



MARINe participant measures the size of mollusk shells. Photo by BOEM.

The data accuracy is assuring and the future of the ecological monitoring of the Pacific Coast will be complemented by the use of citizen scientists. Site surveys provide important information for creating site maps to compare non-biological characteristics of sites over time.



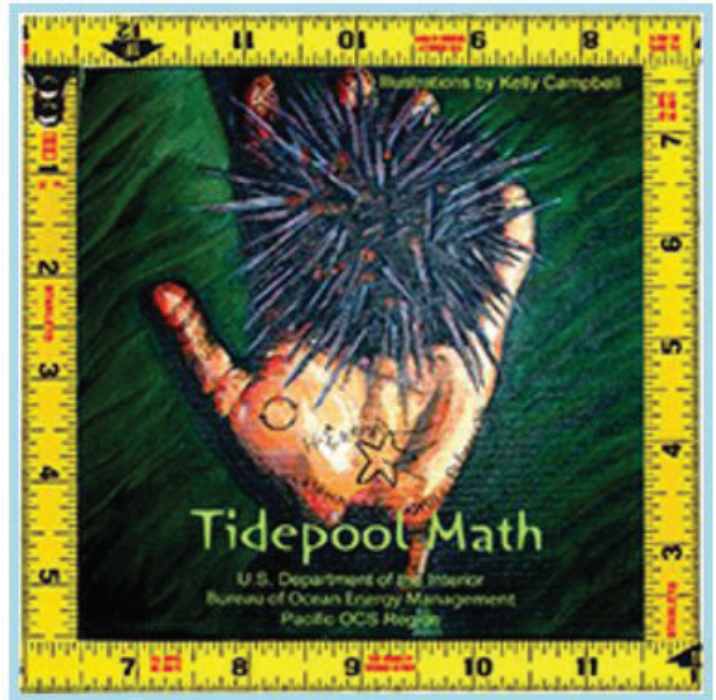
BOEM and citizen scientists work together on the MARINE project. Photo by BOEM.

## TIDEPOOL MATH

Another BOEM program to further STEM education, Tidepool Math, is a curriculum program developed by a retired BOEM intertidal biologist and teachers in Ventura County, California. The curriculum is complemented with teaching instructions and flashcards for easy implementation, and also an extensive photo library of classroom exercises and sampling methods.

Tidepool Math is designed to help students understand scientific method through the fun study of tidepools. At the K–8 level, students use a plot of a mussel bed to better understand the scientific applications of counting and estimating. They also learn that their environment is constantly changing and learn ways to “sample” and “monitor” change. At the high school level, students learn the concepts behind designing a field sampling program and learn the differences between random, systematic, and targeted sampling approaches. They are also introduced to simple statistical tools used to analyze environmental data.

– Janet Purdy



Tidepool Math is designed to help students at the K–8 level understand the scientific method through the study of tidepools.



Students practice Tidepool Math. Photo by BOEM.

## FOR MORE INFORMATION

### MARINE:

<https://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Pacific-Region/Studies/PC-15-02.aspx>

<http://www.eeb.ucsc.edu/pacificrockyintertidal/data-products/collaborative-monitoring/index.html>

### Tidepool Math:

<https://www.boem.gov/Tidepool-Math/>

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# New Waves

Late-Breaking News & Information

## BOEM Steams Ahead with Ocean Science Education Nationwide

BOEM was honored to be on hand as students from Santa Monica High School, in Santa Monica, CA, won the 20th Annual National Ocean Sciences Bowl (NOSB) in Corvallis, OR, on April 23, 2017. Marshfield High School, in Marshfield, WI, earned second place. The NOSB is an interdisciplinary ocean science education program of the Consortium for Ocean Leadership, which BOEM has supported since 2001. It tests students' knowledge of ocean-related topics, including biology, chemistry, policy, physics, and geology.

To qualify, the 25 competing teams first had to win their regional competitions. More than 390 teams (made up of 1,960 students representing 33 states) participated. More than 30,000 students have passed through the NOSB over the last 20 years.



The Marshfield High School Team receives the second place trophy from Marjorie Weisskohl, BOEM. Photo by Hannah O'Leary, Consortium for Ocean Leadership.

Besides proving their knowledge, students showed that interest in ocean science extends to states far from the ocean. Teams also hailed from Arkansas, Colorado, Michigan, and Ohio.

The NOSB consists of buzzer-style, multiple choice questions and longer, critical thinking team challenge questions. For the Scientific Expert Briefing, students present science recommendations on a piece of legislation at a mock congressional hearing, enhancing the competition's critical thinking

elements and focusing on real-world skills. Montgomery Blair High School in Silver Spring, MD, won that award.

BOEM congratulates all who participated during the year, preparing for science, technology, engineering, or math (STEM) careers, and contributing to a science-literate society.