



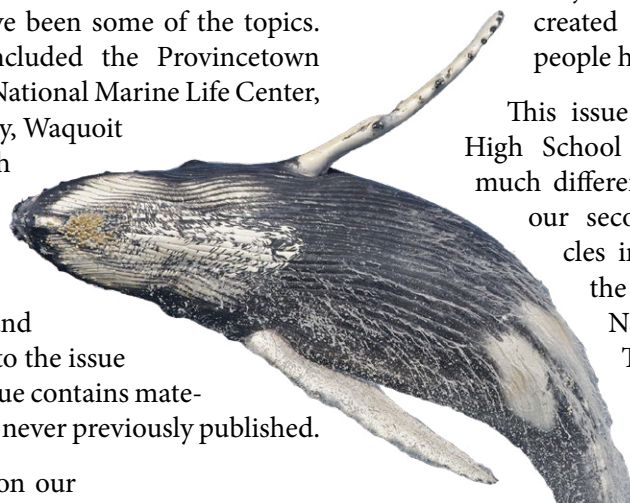
Over the past years, *Flotsam and Jetsam* issues have been devoted to individual topics, and in some cases to Marine Science Organizations. Sea Level Rise, Science of Seafood, Sharks, Seaweed, Underwater Communities and Shipwrecks, Aquaculture, Oceanic Diseases, Intertidal Zone, and Coastal Geology have been some of the topics. Some of the organizations included the Provincetown Center for Coastal Studies, The National Marine Life Center, the Marine Biological Laboratory, Waquoit Bay National Estuarine Research Reserve, and the New England Aquarium.

In many instances, there were additional articles, activities, and references which never made it to the issue due to space constraints. This issue contains materials from our archives that were never previously published.

We have also had information on our activities for members, like the Boston Harbor Educators Conference, the High School Marine Science Symposium, and our annual Woods Hole

Conference. Who would have thought that we would have a year and a half when these programs became virtual due to a pandemic? Even the annual Marine Art Contest format was changed in the last year. We have tried to add extra articles in the journal for teachers to use in their newly created methods of teaching. How many people had used ZOOM before?

This issue has the usual information on the High School Marine Science Symposium in a much different format even from last years, and our second virtual Annual Meeting. Articles include Jonathan Bird's Blue Waters, the Northeast Canyons and Seamount National Marine Monument and Shark Teeth to mention some. In addition, there are links to other locations with materials that can be used in your classrooms. 🐙



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If you have difficulty accessing this journal, contact the editor at dimmick@esteacher.org. The next issue of *F&J* will be posted on the website in the summer.



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MASSACHUSETTS MARINE EDUCATORS
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2021 MME Calendar

Check website and F&J for details.

SATURDAY, MAY 1
MME Virtual Annual Meeting and Election of Officers

WEEK OF MARCH 15
High School Marine Science Symposium
 Virtual Conference

WEDNESDAY, MAY 12
MME Board Meeting

Please check the MME website for details as we get closer to these dates.

All MME Members are invited to Board Meetings, which will be virtual meetings. Please check with an MME officer for details.

The annual meeting will also be a virtual one again this year.

Join MME Today!

If you have not already renewed your membership, it's time!

(In past years it was included in the registration fee for our annual meeting.)

New or renew, visit our website – massachusettsmarineeducators.org/join

SAVED

The Northeast Canyons and Seamounts Marine National Monument, Worthy Ocean Realm Needs You

Rob Moir, Ocean River Institute – MME Member and Contributor



President Biden has moved quickly and decisively to undo the damages done to the Northeast Canyons and Seamounts Marine National Monument. Former President Trump had opened the wildlife refuge to commercial fishing, gas and oil drilling, and high-tech metal mineral mining, despite more than 300,000 individuals and families sending messages to Washington calling to designate this place a national monument area.

Out in the Atlantic Ocean, about 130 miles southeast of Nantucket, is Oceanographers Canyon. Further East, Gilbert and Lydonia Canyons cut into the continental shelf. These canyons, one and two-thirds times as deep as the Grand Canyon (10,000 ft vs 6,000 ft), were formed when Georges Bank was dry land with mastodons, and torrential glacial melt water scrubbed and scoured its way to the sea.

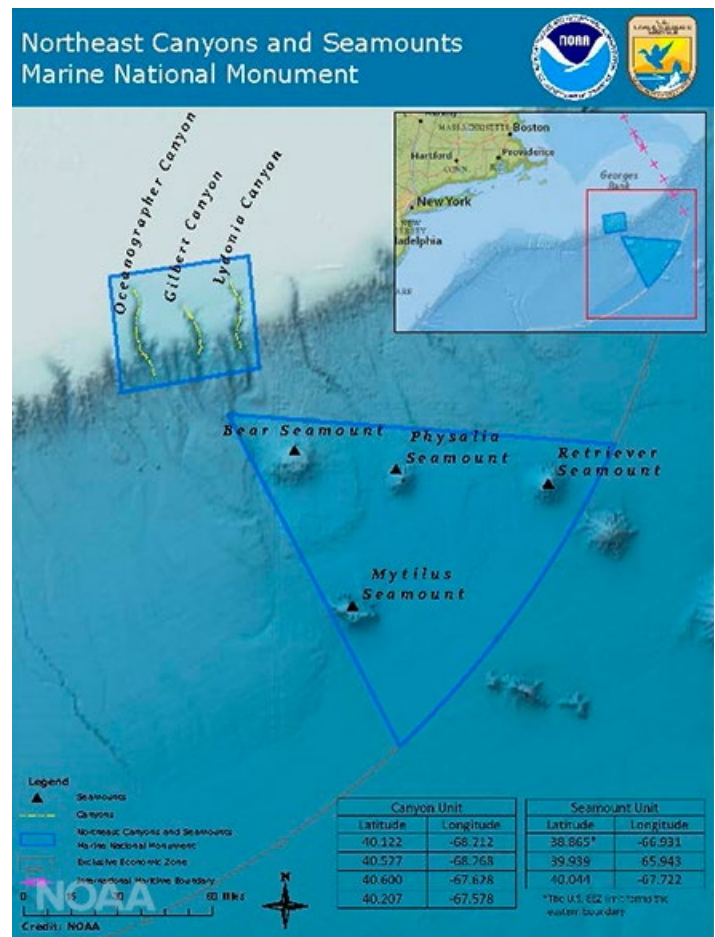
Beyond the continental shelf, out on the Sohm Abyssal Plain, underwater extinct volcanoes rise up off of the ocean floor. Some form a line Eastward to the mid-Atlantic Ridge, an underwater mountain range that divides the Atlantic Ocean into two halves. A stationary hotspot hole in the ocean plate appears to have moved Eastward as the ocean widened over the course of forty million years.

Four seamounts are within the two-hundred-mile limit that make up American waters. Perched on the last bit of continental slope, Bear Seamount is closest to our shore. Bear is the smallest at 3,615 feet above the benthic bottom. In comparison, Mt. Monadnock is 3,165 feet above sea level. Located further offshore, Physalia Seamount is 6,062 feet, nearly the

height of Mt Washington (6,288 feet). Retriever Seamount is 5,967 feet. Finally, Mytilus Seamount is a grand 7,444 feet. For all four seamounts, there is more than a thousand feet of water from summit to the sea surface, much deeper than the reach of sunlight. Here are ecosystems of complete black inky darkness.

On the chart, a rectangle has been drawn around the three canyons and a triangle around the four seamounts with the outer edge marking where American waters end and international waters begin. These ocean realms of deep sea canyons and monolithic seamounts encompass 4,913 square miles, about the size of Connecticut.

The Northeast Canyons and Seamounts Marine National Monument is today America's first fully-protected wildlife refuge park area in the Atlantic Ocean. Here is a larger diversity of pristine ocean ecosystems than in any other similar



continued on page 12



President's Message



Greetings all,

It has been quite a year, to say the least. When I wrote the spring letter last year, COVID-19 had not found its way here, at least not in any meaningful way. That said, I am sure the letter was published well into the outbreak. I remember our last day of in-person school, it was March 13, 2020. Many of us naively thought we would be back in a few weeks! None of us expected it would last this long, nor claim the lives of over 500,000 Americans. My hope is that all of you have remained healthy, or have recovered if you fell ill, or have found some peace after the loss of someone close to you.

This will be my last letter to you as President of MME. In reflecting on my time as President, I went back and looked at my first letter, written in May of 2019. I stated three goals for the organization: 1. Increase member value; 2. Increase member engagement and volunteerism; and 3. Improve our communications and social media presence. In the summer of that year, we held a Board retreat to focus on our priorities, and reaffirm our mission. At that meeting, it was felt that the third goal, around improving communications, was a prerequisite for the others.

I am proud of what we have been able to do over the last two years toward meeting this goal. We hired Elaine Brewer as a consulting media specialist and board member Jeffrey Morgan really stepped up to lead the effort. Through their combined efforts, we completely revamped our website, established regular email newsletter communications, and dramatically increased our postings on social media, including Facebook and Instagram. Elaine recently

moved on to other activities, and we were very fortunate to bring on Ronni Mak to take over and continue to build this program. The Board remains committed to our other goals and we are making great strides in meeting them.

As of this writing, we are about to go live with our first virtual High School Marine Science Symposium, March 15-19. Board member Emily Duwan has led this effort with great support from many other Board members and other volunteers. And planning is well underway for our Annual Meeting and Conference, to be held virtually on Saturday, May 1st, from 9:00-11:00 am. We have learned a lot about virtual conferencing over the year, and this one is sure to be a success. I hope to see you all there. Special thanks to Board member Grace Simpkins and President-Elect Pat Harcourt and their team for putting this together!

Finally, be sure to “like” our postings on the MME Facebook and Instagram pages. Share them with your friends! It’s a great way to spread the word about our important work. As always, if you have any questions, ideas, comments or concerns please feel free to contact me directly at dpinkerton1019@gmail.com, or call/text me at (781) 718-5770. I am on Instagram and Twitter @pinkerteach.

Warmest regards,

Don

Don Pinkerton, President

2021 HS Marine Science Symposium

Marine Science Conference for High School Students & Teachers

MONDAY, MARCH 15 - FRIDAY, MARCH 19

Join us for a series of FREE virtual workshops and asynchronous events throughout the week!

Our annual High School Marine Science Symposium will be virtual this year! We invite high school teachers and students to join us for workshops by organizations across Massachusetts who will share their work protecting the ocean and paths to a career in marine science.

Live workshops will be held each day at 10 am and 1 pm on Zoom, with activities specifically tailored for students to complete during remote learning. Registration for the event also gives you access to a suite of asynchronous marine science activities and resources to use during the week and beyond.

Workshops and asynchronous activities will be approximately 1 hour in length; teachers will be provided Zoom links and resources for each workshop in the week before the event. Students are welcome to join Zooms individually/remotely or as a class.

WORKSHOP SCHEDULE

Please [register now](#) to sign your class up for the workshops you are interested in. Zoom links will be sent out a few days prior to the workshop.

MONDAY, MARCH 15

THEME: Microscopic to Macroscopic

10am: Virtual Tidepooling, Presented by Northeastern University Marine Science Center

1pm: Can You Hear Me Now? Marine Mammal Bioacoustics, Presented by Woods Hole Sea Grant

1pm: Wicked High Tides, Presented by Museum of Science

7pm: A Conversation on Environmental Justice, Presented by Women Working for Oceans

TUESDAY, MARCH 16

THEME: Ocean Technology

10am: What Does It Take To TikTok an Octopus? Presented by OceanLab

1pm: Near Real Time Gliders in the North Atlantic, Presented by NOAA Fisheries

FRIDAY, MARCH 19

THEME: Marine Conservation

10am: Youth Artists for the Ocean, Presented by Bowseat Ocean Awareness

1pm: Design your Own Marine Protected Area, Presented by OPAK

WEDNESDAY, MARCH 17

THEME: Career Pathways in Marine Science

10am: See Yourself in STEM, A College and Career Q&A

1pm: Whale Walk to Informal Education, Presented by Center for Coastal Studies

ASYNCHRONOUS ACTIVITIES will include

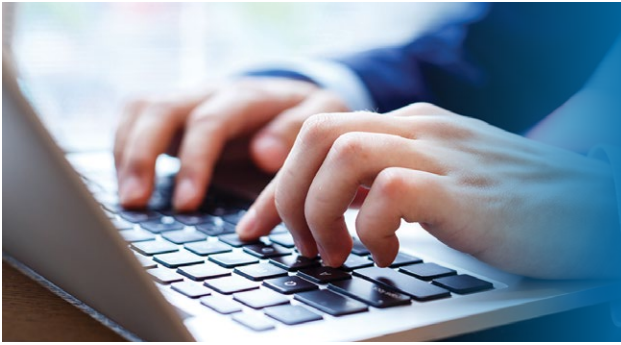
- Fish Forensics with the Ocean Genome Legacy Center
- Tiny Sea: An Online Aquaculture Experience
- Webinar: Northeast Canyons and Seamounts Marine National Monument
- Seagrass Explorer: A Virtual Aquarium

Keep checking back as this is not an exhaustive list!

THURSDAY, MARCH 18

THEME: Environmental Justice and Community Impacts

10am: Talking Trash: Marine Debris Solutions, Presented by Beach Sisters and Salem Sound Coast Watch



From the Editor's Desk

This month, I am posting links to several locations where you will find materials related to the most recent *F&J* issues and other locations where you will find related links. Some are things which can be used for in person or virtual teaching.

A Coloring Companion for Sea Walls Boston

The Sea Walls Boston team has collaborated with Bow Seat Ocean Awareness Programs to create a coloring book as a safe way for local youth to engage in Sea Walls Boston and build a sense of ownership and pride for the artworks painted during Sea Walls Boston 2020. This book contains 12 coloring pages and 12 pages which explain each picture and show it in color. As a response to the global COVID-19 pandemic and need for educational resources for students (young and old), this is one of many ways we are adapting the project to serve the community in a difficult time, when public art is more important than ever. Art helps to express ourselves when words may be hard to come by!

A Warmer World for Arctic Animals

In this lesson from *Clue into Climate*, produced by KQED PBS, students will learn about the challenges that climate change presents for four specific Arctic predators. They will explore how such changes ripple throughout ecosystems, habitats, and food webs. From the Jean-Michael Cousteau collection with materials for grades elementary through high school. Standards based with plenty of resource material from this link.

NOAA Live! webinar series from WHOI Sea Grant

This link is to a series of webinars using NOAA experts. It is geared to grades 2-8. You will find a link to 72 (and counting) different NOAA webinars with topics as varied as Diving in the Coral Reefs, Amazing Story of the Horseshoe Crab, the Wonderful World of Plankton, Alaska Sea Ice, Ice, Baby, the Ocean Acidification Blues, uncovering the Sea floor, and Hunting Hurricanes.

- Different NOAA expert and topic with each webinar
- Moderated Q&A webinars with the scientists

Each webinar is approximately 1 hour long. The recordings all contain English captions and Spanish subtitles.

NMEA BRIDGE

- Concise multimedia background information on a variety of ocean science topics
- Downloadable lesson plans that utilize authentic marine science data sets
- Information about marine careers, internships, and summer activities for students
- Professional development opportunities for both formal and informal educators

Marine Biological Laboratory SciShoots programs for high school

MBL has launched a new initiative to bring science to high school students—virtually. Students can hear directly from MBL scientists and researchers as they share their science and answer your questions. Presently the series consists of 16 SciShoots varying from 6 to 16 minutes dealing with such topics as Water Quality, Invasive Alien Species, Cape Cod Corals, and Local Species.

Estuary Education Resources

This suite of estuary education resources help educators bring [estuarine science](#) into the classroom through hands-on learning, experiments, fieldwork, and data explorations. These specially designed lessons, activities, [data explorations](#), animations and videos can be used independently or as a supplement to existing curricula and can be adapted to meet any grade level. Plans are in PDF format. Over 40 lessons are present.

Ten Years of Collecting Ocean Exploration Data from NOAA Ship Okeanos Explorer

National Oceanic and Atmospheric Administration (NOAA) commissioned NOAA Ship *Okeanos Explorer* in 2008 as America's first civilian agency ship dedicated to ocean exploration. Since its first voyage in 2009, *Okeanos*

Explorer has served as the “new technological eyes” that allow NOAA’s Office of Ocean Exploration and Research (OER) to pursue the Exploration Objectives described in the Panel’s report. This link is to 10 years of expeditions.

- **Mapping at New Scales.** Find and explore archaeological sites, expand understanding of marine resources, characterize ocean ecosystems, discover new species, and map the seafloor—all to show others what lies beyond our current understanding.
- **Exploring Ocean Dynamics and Interactions at New Scales.** Discover new oceanographic features, reveal oceanographic and atmospheric changes, and unravel the processes that connect living and non-living systems in the ocean.
- **Developing New Technologies.** Invent, build, and adapt remote and in situ tools for measuring, mapping, and exploring all aspects of the ocean, and create new ways to visualize ocean data.
- **Reaching Out in New Ways.** Deliver ocean expeditions to schools and informal science centers around the nation; develop new technologies to connect scientists and explorers with students, educators, and the public; and expand the reach of ocean exploration data to include business and industry partners.

These links represent enough material for your classes to use in nearly any Marine Science class. I hope you can use many hours of materials to enhance your classes. More links to follow in the summer edition of *F&J*.

Howard

Howard Dimmick, Editor



OCEAN LITERACY PRINCIPLE 6

The ocean and humans are inextricably interconnected.

- The ocean affects every human life. It supplies freshwater (most rain comes from the ocean) and nearly all Earth’s oxygen. The ocean moderates Earth’s climate, influences our weather, and affects human health.
- The ocean is a source of inspiration, recreation, rejuvenation and discovery. It is also an important element in the heritage of many cultures.
- Much of the world’s population lives in coastal areas. Coastal regions are susceptible to natural hazards (tsunamis, hurricanes, cyclones, sea level change, and storm surges).

2019 MARINE ART CONTEST WINNERS



1st Place

American Lobster

Hantong L., Grade 8

Luckie Art Studio, Lexington

1st Place

Red-Gilled Nudibranch

Jessica D., Grade 8

Diamond MS, Lexington



New Curriculum-based episodes from *Jonathan Bird's Blue World* Great for remote or in-person educators!

Recognizing the efforts of educators to bring new content into classes while teaching remotely, *Jonathan Bird's Blue World* has developed a new series of episodes designed to help teach concepts in marine biology. Expanding upon the sponges lesson that is widely incorporated in classrooms nationally, upcoming series episodes feature major ocean phyla such as cnidarians, arthropods, mollusks, echinoderms and concepts such as symbiosis and camouflage. These robustly educational media also have accompanying PDF study guides to help reinforce concepts and engage students.

These (and hundreds of other) episodes are available for free at BlueWorldTV.com.



[com](http://blueworldtv.com/webisodes/curriculum-based). Direct link for curriculum-based episodes: blueworldtv.com/webisodes/curriculum-based

"It is exciting to be able to bring our award-winning educational materials into classrooms to enrich students' learning," says series host Jonathan

Bird. "By combining the exciting visual aspect of the video with the science content, we have created an engaging and fun way to teach marine science."

"Terrific video on Cnidarians. Although some are not creatures in the North Atlantic, it is a great explanation of this group of animals," Andrew Martinez, Teacher, Photographer and Author of the New England field guide, *Marine Life of the North Atlantic*

Jonathan Bird's Blue World is an Emmy Award-winning underwater science adventure series. Previously broadcast on public television, it is available on YouTube channel BlueWorldTV.

What is Jonathan Bird's Blue World?

Jonathan Bird's Blue World is an Emmy Award-winning underwater science/adventure program that airs on public television in the United States. If you like **Jonathan Bird's Blue World**, don't forget to subscribe! Support us on Patreon! You can buy some **Blue World** T-shirts & Swag! <http://www.blueworldtv.com/...> You can join us on Facebook!

Who is Jonathan Bird?

Meet Jonathan Bird, one of the world's top underwater nature cinematographers. Traveling the world on assignment for all the major networks, he is an Emmy Award-winning authority on the underwater world. In fresh water or salt, reefs, wrecks or caves, Jonathan documents the world beneath the waves. Welcome to the Blue World.



About the Author

Jonathan Bird, when asked, says that he has the world's greatest, but most difficult to explain job. He travels the world filming episodes for his underwater science/adventure series *Jonathan Bird's Blue World* which airs on public television. He is both the director of photography and host, as well as one of the writers and editors. But in spite of his exciting-sounding job description, he actually spends more time in a dark room writing and editing than he does out in the field having adventures.

Jonathan received his B.S. in Electrical Engineering from Worcester Polytechnic Institute, and a M.S. in Ocean Engineering from the University of New Hampshire. Jonathan has provided materials for *F&J* in the past.

— CURRICULUM BASED WEBISODES —

Some *Jonathan Bird's Blue World* webisodes have an accompanying lesson plan, listed below by webisode number. These are aimed at Grades 6-8 but can be adapted by educators for other educational settings. We welcome feedback on our educational materials. Please email us your suggestions! This [Downloadable Lesson Plan Summary Sheet](#) lists the concepts illustrated in each lesson plan. Use "right click" to save the document to your hard drive.

Jonathan Bird's Blue World is designed

to be not only entertaining, but educational. Episodes are packed with information and presented in a way that makes marine biology fun to learn. Teachers all over the world are using *Jonathan Bird's Blue World* in the classroom.

This section of the website is designed to provide resources and assist educators in using *Jonathan Bird's Blue World* effectively. Study guides are available for download and he hopes that they will be used by educators to help get the

most out of each segment's education content and teach students about the incredible world beneath the waves.

- Study Guides
- Lesson Plans
- National Science Standards
- Ocean Literacy Principles
- Curriculum Based Videos

Webisodes Over 90 on line and more coming. The latest one – Webisode 165: [What are Cnidarians?](#) – debuted online February 21.



Cnidarians: Squishy Stingy animals!

In this biology **Blue World**, Jonathan examines the phylum Cnidaria, a group of animals containing the jellyfish, anemones, corals, hydroids and other squishy, stingy critters! Your teacher might make you watch this for biology class, but you probably will like it!

Curriculum Based Webisodes



What are Cnidarians?
Webisode 165



Cephalopods!
Webisode 103



Skates and Rays
Webisode 79



The Biology of Sponges
Webisode 66



Symbiosis in the Sea
Webisode 46



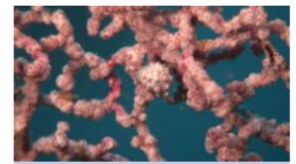
Shark Biology
Webisode 45



Defense in the Sea
Webisode 44



Cleaning Stations
Webisode 43



Color and Camouflage
Webisode 42



Climate Change on Our Ocean Planet

Online Conference, Saturday, May 1, 2021

9am – 11am



Art: Eden M. gr. 12
Bourne HS. MME Art Contest

KEYNOTE SPEAKERS

Arctic Meltdown: Why it matters to all of us

Dr. Jennifer Francis, Senior Scientist
Woodwell Climate Research Center

The Changing Ocean South of New England: Technology and community

Dr. Glen Gawarkiewicz, Senior Scientist
Woods Hole Oceanographic Institution



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SCHEDULE

- 8:50 am Join us
- 9:00 am Welcome and Opening Remarks
- 9:05 am Keynote 1
- 9:35 am Sharing Digital Teaching Tools – Lightning Round
- 9:55 am Awards
- 10:00 am Keynote 2
- 10:30 am MME Educator Awards and Annual Meeting
- 10:45 am Choice of breakout room exhibits
- 11:00 am Trivia for those who want to socialize

DURING THE WEEK (5/3-5/6)

Monday, Tuesday, and Thursday night at 7 pm, sessions will be offered on themes around:

- *Teaching tools to engage all students online*
- *Marine topics in citizen science for students*
- *Ocean activities you can do at home*

REGISTRATION

Regular and Student registrations include the 2021-2022 MME membership and all conference activities.

Regular Registration: \$40
(\$10 conference fee + \$30 MME membership)

Full Time Student: \$25
(\$10 conference fee + \$15 student membership)

Conference questions? Contact: Grace Simpkins,
gsimpkins@whoi.edu

Click here to Register or visit

<https://massmarineeducators.wufoo.com/forms/2021-mme-woods-hole-conference-online/>

Hosted by Woods Hole Sea Grant and Woods Hole Oceanographic Institution

ABOUT OUR SPEAKERS



DR. JENNIFER FRANCIS,
Senior Scientist
Woodwell Climate Research
Center in Woods Hole, MA

Arctic Meltdown: Why it matters to all of us

The Arctic seems very far away, but the momentous changes occurring there affect us all. Global warming, sea-level rise, tropical storms, and extreme weather events are all connected to the rapidly melting and warming Arctic. I'll discuss recent research into this "hot" topic.

Background: Dr. Francis got her undergraduate degree in meteorology from San Jose State University and her doctorate in atmospheric sciences from the University of Washington. Her research is focused on the rapidly changing Arctic: why it's happening, how changes are affecting the Arctic system, and how disproportionate warming there is affecting temperate regions on Earth, where billions of people live. Recently she has been researching connections between rapid Arctic warming (aka Arctic amplification, AA) and weather patterns in mid-latitudes.



DR. GLEN GAWARKIEWICZ, Senior Scientist,
Physical Oceanography Department, Woods Hole
Oceanographic Institution

The Changing Ocean South of New England: Technology and Community

The continental shelf south of New England is among the most rapidly warming regions in the world oceans. Recent changes in the Gulf Stream have contributed to this warming, and have had effects on fishing in the region. Dr. Gawarkiewicz will discuss the [Ocean Observatories Initiative Pioneer Array](#), a seven-site mooring array 75 nautical miles south of Martha's Vineyard, and how this has contributed to our understanding of ocean changes. He will also share the story of his [unique partnership with commercial fishermen](#) to gather data and contribute to this understanding.

Background: Dr. Gawarkiewicz got his undergraduate degree in Ocean Engineering from MIT and his doctorate in physical oceanography from the University of Delaware. His primary areas of research are coastal oceanography, particularly frontal dynamics and observations and modeling of shelfbreak fronts; interdisciplinary aspects of frontal exchange problems; marine heatwaves, and ocean observatories. For more information about Dr. Gawarkiewicz, watch this audio story on CFRF/WHOI Shelf Research Fleet – Data access give fishermen edge against warming sea 1/27/21 – including an interview with him. youtube.com/watch?v=FVmzHeBsCgA

SAVED

continued from page 3

sized ocean area in the world. Deep blue-water marine life has different survival strategies than do the more coastal inhabitants. Animals mature at a later age, have fewer offspring, and live extremely long lives. Cold-water corals live below the reach of light so are absent of algal symbionts, some white as new fallen snow. Coral bits brought up by fishing trawls, supposedly mid-water trawls that hit bottom a dozen times, have been found to be more than 4,000 years old.

The canyon walls of near vertical rock and shelf places are covered with marine life, anemones, barrel sponges, and at least 54 species of deep-sea corals. More active species live here as well including crab, octopus, skates, flounder and sharks.

Sperm whales dive deep in the canyons and hunt for squid in utter darkness. In their boxcar-shaped heads the whales have a melon filled with an acoustical oil, “spermaceti oil.” Until recently NASA used stockpiled spermaceti oil due its ability to withstand great temperatures. Shape of the melon may be adjusted and focused like a lens. Behind it from a windpipe that should lead to the right nostril but instead circles back, a train of click sounds are emitted. The sperm whale exhales and inhales through one nostril, blowhole, on the left side of its head. Conical teeth on the only bottom jaw are covered with bioluminescent bacteria. At a great depth, a sperm whale can be still with jaw perpendicular to head to lure in squid. The whale can remain underwater for forty-five minutes.

I had the good fortune to visit the deep sea canyon. Twice, we sailed

through the region and every time there were sperm whales. A few years later, I led a sperm whale watch voyage out of Gloucester. After traveling a day and a night, we reached the canyon waters and found a sperm whale in the morning. Approaching slowly, we were shocked to discover the whale was dead, floating high in the water. It had likely been killed by a ship strike. The captain, who was a jeweler when not at sea, wanted to dive in with a big knife to cut out some of the whale’s teeth to scrimshaw and sell for a great price – to harvest some of the resource he had come upon. I told him that the whale was swollen with gasses. With one touch, the whale would release the gasses, blow, and there would be sharks everywhere. The Captain got dressed. That day, we went on to see two live sperm whales, blow, wheel, and dive.

Fin and sei whales have been observed in these waters. Surveys have also reported significantly higher numbers of beaked whales. The diving of toothed whales, sperm and beaked whales, stir the waters likely bringing nutrients up into water lit with sunlight. Further research is warranted. In particular, to lessen the number of ship strikes, there is a need for remote monitoring by citizen-scientists of ship traffic and of the presence and activity of whales.

Industries are an even bigger threat. Clarion voices of a savvy constituency are needed to prevent the exploitation

of canyon resources and the destruction of seamounts. The basalt rock of seamounts is rather porous. It acts like a sponge over the millennia pulling rare earth minerals from sea water and laying on a ferromanganese crust of mineral deposits. One mineral, tellurium, is rarer than gold. Purified and combined with bismuth, a high-tech metal alloy is formed that is an ideal semiconductor for quantum computer chips. There is even more demand for the alloy formed by combining tellurium with cadmium. This is considered the best material for thin-film photovoltaic multi-terawatt solar-cell electricity.

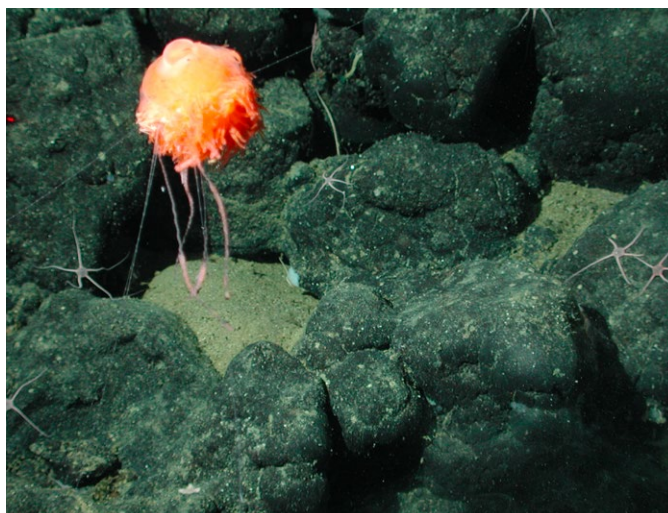
China has ancient seamounts on land where tellurium is mined. They require all manufacturing be done in China. People believe the price for the best solar cells and computer chips would go down if only US industries were permitted full mountaintop removal mining of seamounts starting with Bear Seamount, the oldest (richest), that happens to be the one closest to the fishing grounds. Each seamount has unique assemblages of marine life with many species yet described. Entire marine ecosystems depend on the Northeast Canyons and Seamounts Marine National Monument and steadfast friends, savvy? 🐦

Rob Moir, PhD, is Executive Director of the Ocean River Institute. For more information about the Deep Sea Canyon Rangers and Seamount

Guardians Protecting Atlantic Marine Life visit oceanriver.org

Photo: Fulmars by Rob Moir

Photos: Monument Map and black gnarly seamount basalt with siphonophore and seastars by NOAA



Seamount Guardians
Canyon Rangers
Protecting Atlantic Marine Life

MME Awards

Massachusetts Marine Educators has a number of awards given out annually to recognize excellence in Marine Education in Massachusetts. If you would like to nominate someone for one of the awards below, please fill out the [MME award nomination form](#) and send it to Corrine Steever at csteever@neaq.org. Due date for nomination is March 26, 2021.

MME AWARD CATEGORIES

MME Annual Award of Distinction

This very special award is given in recognition of outstanding contributions and dedication to Massachusetts Marine Educators as an organization and to the field of marine science. This award recognizes an individual who demonstrated a commitment to marine education that is evidenced by accomplishments in his/her community, school, business, or region.

MME Marine Educator Award

This award is given for outstanding effort and distinguished performance in the teaching of marine science. This award recognizes an individual's ability to foster interest, appreciation, and love of the marine environment in the classroom setting.

Nap J. Buonaparte Service Award

The Nap J. Buonaparte Award is given in appreciation for outstanding and enthusiastic contributions to the Massachusetts Marine Educators. This award recognizes an individual who has provided outstanding assistance and support to the organization.

Joseph Balsama Service Award

This award recognizes an individual who has provided assistance and support to MME with special emphasis on service for the Boston Harbor Educator's Conference.

MME Certificates of Appreciation

This certificate is presented for dedicated service and commitment to the advancement of marine science. It recognizes an individual or group's commitment to promoting the mission of the Massachusetts Marine Educators.



Explore Mars with GIS

By Philip Mielke and Arno Fiva

Used with permission of Joseph J. Kerski, Ph.D., GISP Education Manager ESRI

Geographic Information Systems (GIS) have been a tremendous part of the way that paper maps have evolved into current technology. GIS is helping governments, organizations and students think spatially, and to speak the language of mapping. We at Esri really appreciate how GIS has made the joy of exploration and understanding more accessible to a wider audience, and our users have produced and shared maps and visualizations from around the world. [Now, we can explore other worlds!](#)

We've recently developed the ability to use other planetary coordinate systems with a 3D globe, and the timing couldn't be better as we anticipate the landing of the Perseverance rover. Digital elevation models, precise imagery and spatial data representing previous rover landing sites all display accurately under the Martian coordinate system, and this 3D application enables your exploration of the Martian surface. We've included a few tools that we thought would help you better understand the shape and scale of Mars, and to quickly find information on the previous landing sites.

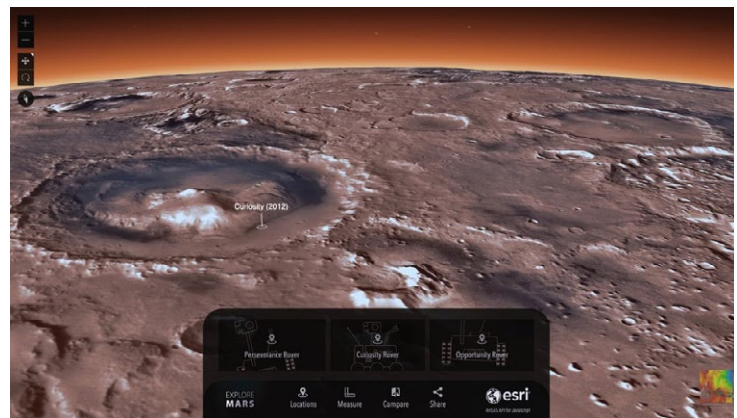
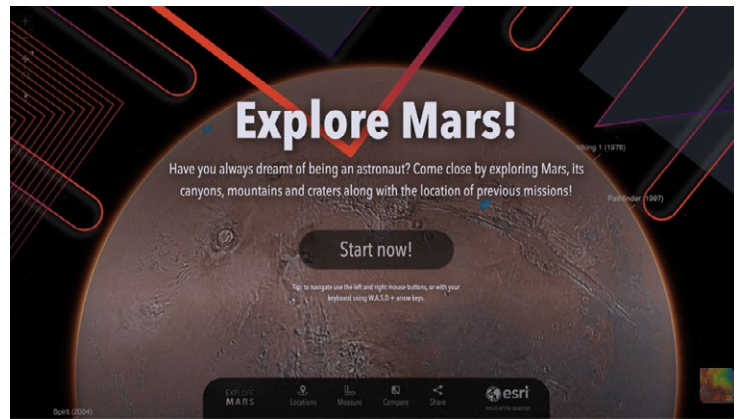
Locations

Perseverance, Curiosity and Opportunity all have landing sites and paths that you can easily explore by selecting that Rover from the Locations setting.

Measure

Measurement tools are a helpful first step to answer some basic questions: "How big is that crater?" "How tall is that mountain?" As we're utilizing the Martian coordinate system for display, the data is accurately displayed based on the real size of the planet. We offer three measurement tools for you to work with, and all of these can display results in different unit measurements:

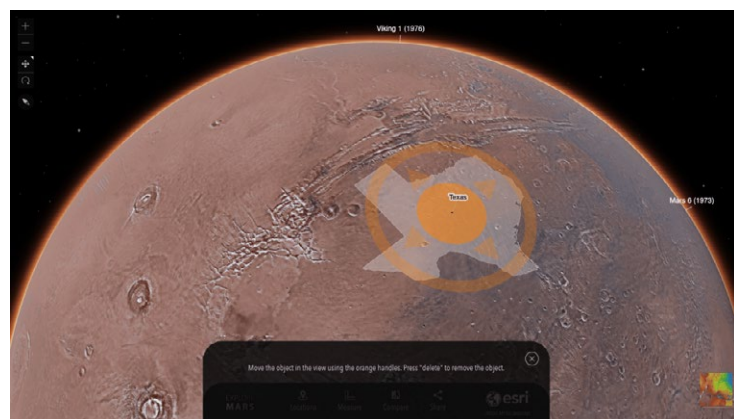
- **Line:** From a distance, you can draw a line along the surface of Mars that will curve to measure longer geodesic length. You can also zoom into a crater, for example, and measure a straight line that will also measure horizontal and vertical distances.
- **Area:** You can draw a polygon to learn surface area and perimeter. Double-click to finish the polygon and see the area and perimeter.



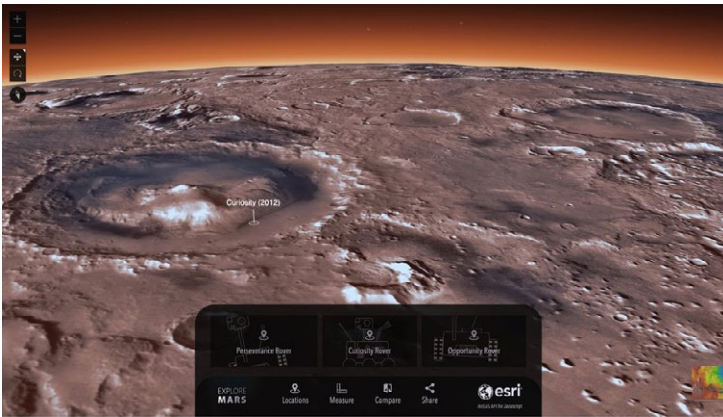
Locations



Elevation Profile for Perseverance's planned path.



Comparison tool lets you place Earth region boundaries on Mars to get a sense of scale.



The Grand Canyon is dwarfed by the Valles Marineris.

- **Elevation:** You can draw several line segments to understand the elevation with a profile graph. The graph starts to show as you're drawing the lines, and you can double-click to see the finished result. This is useful to understand what Perseverance's path will look like as it will traverse some hilly terrain.

Compare

So much of our spatial understanding is based on making comparisons with what we already know. To better understand Mars, we thought it would make sense to overlay known 2D and 3D features to give you a better sense of scale.

Regions: You can place countries and states (regions) in their true size on Mars to help you imagine size and scale. What would a road trip across Mars look like? Place and rotate your favorite region on Mars, and make sure to plan some good sightseeing! It's surprising for many to learn that Mars is smaller than Earth. You can really see that with Texas on Mars (below).

3D Objects: Ever wonder what an iconic city or geographic feature would look like on Mars? Now you can find out! Buildings and mountains are an especially valuable reference point for height, and you can now place the Grand Canyon inside the Valles Marineris to understand the tremendous depth of one of the largest canyons in the Solar System. You can also take a snapshot of New York City with a Martian background.

Share

As you're travelling vicariously along Mars, share what you're finding with a quick snapshot on Twitter. This will make it easy for your friends and followers to see your point of view and explore Mars for themselves!

Enjoy the exploration! 🐼



OCEAN LITERACY PRINCIPLE 2

The ocean and life in the ocean shape the features of Earth.

- Many earth materials and geochemical cycles originate in the ocean. Many of the sedimentary rocks now exposed on land were formed in the ocean. Ocean life laid down the vast volume of siliceous and carbonate rocks.
- Sea level changes over time have expanded and contracted continental shelves, created and destroyed inland seas, and shaped the surface of land.
- Sand consists of tiny bits of animals, plants, rocks and minerals. Most beach sand is eroded from land sources and carried to the coast by rivers, but sand is also eroded from coastal sources by surf. Sand is redistributed by waves and coastal currents seasonally.

Shark Teeth Offer Clues to Ancient Climate Change

Teeth from the long-extinct sand tiger shark provide historical information



Paleoecologist Sora Kim studies ancient shark teeth to learn about Earth's history. Credit: UC Merced

A character in a great white shark movie said that all sharks do is “swim and eat and make little sharks.”

It turns out they do much more than that. Sharks have roamed Earth's oceans for more than 400 million years, quietly recording the planet's history.

If a researcher like paleoecologist Sora Kim of the [University of California, Merced](#) wants to “read” those records to learn about major global changes that took place 50 million years ago, she must decode the information stored in what remains of ancient sharks: their teeth.

Teeth from the long-extinct sand tiger shark are providing new information about global climate change and the movement of tectonic plates, which Kim and colleagues report in the journal [Paleoceanography and Paleoclimatology](#).

For example, there's been debate about the timing and depth of the Drake Passage opening. The passage is the strait between South America and Antarctica, 620 miles wide and 11,000 feet deep, that allows ocean waters to mingle and form the Antarctic

Circumpolar Current.

The opening, it was thought, led to the climate changing from greenhouse to icehouse. But the data Kim and her colleagues analyzed show something different.

“Analyzing isotopes in shark teeth, we can track the water-mass transfers between ocean basins and see when the passage opened,” Kim said. “But we

don't see evidence of a climate shift at that time. That will make people question what we think we know about the time and the area.”

Supported by a grant from the [U.S. National Science Foundation](#), Kim and her colleagues used shark teeth collected around Seymour Island near Antarctica.

“The results of this work are exciting as they integrate shark paleontological studies, geochemical analyses for environmental reconstruction and novel global climate model simulations to look at the timing and depth of the Drake Passage opening,” said Michael Jackson, acting head of NSF's Antarctic Sciences Section.

Added Kim, “Shark teeth contain a lot of data. Their potential should be considered as part of other researchers' analyses and geologic reconstructions to study ancient climate.”

Article Courtesy NSF Public Affairs, researchnews@nsf.gov

Marine Debris



A glass bottle seen at 1,152 meters (3,780 feet) depth at Titov Seamount in the Howland and Baker Unit of the Pacific Remote Islands Marine National Monument.

Image courtesy of the NOAA Office of Ocean Exploration and Research, *Discovering the Deep: Exploring Remote Pacific MPAs*.

While deep-ocean exploration is responsible for ground-breaking discoveries, it is also unmasking the scale of our impacts in the deep ocean. Marine debris is a growing problem and a study published in May 2020 showed that even unexplored, remote, and protected areas of the central and western Pacific deep ocean are not immune from our touch.

We packed long underwear and never wore it! Arctic scientists shocked at warming



Greenpeace's Arctic Sunrise ship navigates through floating ice in the Arctic Ocean in September. Photograph: Natalie Thomas/

When the Arctic researchers Jacqueline Grebmeier and Lee Cooper made their annual scientific pilgrimage to frigid seas off Alaska last month, what they found was startling.

Areas that were previously accessible at that time of the year only with an ice-breaking ship had become open, wavy water.

“We packed our long underwear, and we never put it on,” Cooper said.

In years past, the pair could convince wary volunteers to accompany them by promising walrus sightings. But with no sea ice to perch on and fewer clams to eat, the tusked butterballs have moved to more comfortable accommodations on the beaches.

Instead, the research team saw huge fishing boats searching farther north

for Pacific cod, and a container ship traveling a newly melted route from Quebec to Korea. It snowed only once during their three weeks on the water.

While the world on average has warmed more than 1C because of human-caused climate change, the Arctic is heating much faster. The researchers found the shallow waters were up to 3C hotter than is typical throughout the water column. This year marked the second-biggest sea ice retreat toward the North Pole ever, after 2012.

Many Arctic science trips were canceled due to the pandemic. Grebmeier and Cooper agreed to strict rules to make their annual trek. They quarantined at home in Maryland and then again in Anchorage before flying by charter plane to Nome and boarding the 115ft research vessel.

The crew of the Norseman II had been at sea for eight months, due to tight restrictions on where they could dock. They extended their time out to accommodate the researchers. The couple also obtained samples and collected data for other researchers who could not make their usual journeys.

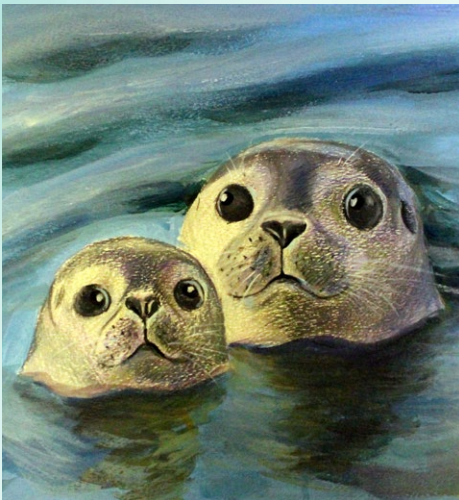
“It’s surprising that in my lifetime, particularly in the last five to eight years, how quickly things have changed,” Grebmeier said. “You can’t project like you used to.”

Grebmeier explained that the lack of sea ice was leading to higher levels of algal production – including the kind that can be deadly. Clams eat the toxic algae, and walruses, diving ducks and humans eat the clams. That’s also worrying because indigenous populations along the Alaska coast depend on clams for food.

One study published this year found that marine communities in the Pacific Arctic will see profound changes in response to warming and reductions in sea ice. Larger species that live longer are likely to move toward the pole by the end of the century, disrupting the food web.

Cooper said the changes were particularly sad for indigenous communities that have been in Alaska for thousands of years and are now coping with unstable sea ice and trying to hunt animals that are moving.

“Not in our lifetimes is it going back to the way it was when we first started out working in Alaska in the late 1980s,” Cooper said.



Harbor Seals – Donna X., gr. 5, Li Mao Art Studio, Houston, TX

2021 Marine Art Contest

THEME: Illustrating the Biodiversity of Stellwagen Bank National Marine Sanctuary

DEADLINE: May 7, 2021

Massachusetts Marine Educators, Stellwagen Bank National Marine Sanctuary, and co-sponsors invite students in grades K-12 to participate in the 2021 Marine Art Contest. The theme is *Illustrating the Marine Biodiversity of Stellwagen Bank National Marine Sanctuary*. Contest sponsors encourage students to consider composing pieces that illustrate a representative species in its sanctuary habitat, show predator-prey relationships, or depict a sanctuary habitat with a diverse array of marine species.

REQUIREMENTS

- Make sure that all artwork depicts species that are found in Stellwagen Bank National Marine Sanctuary, which is located in the Gulf of Maine, just off the Massachusetts coast.
- Entries should be submitted as high resolution digital images – jpg or tif formats preferred but pdf will also be accepted.
- White, non-glossy paper is recommended — please be careful in scanning or photographing art to avoid glare.
- Original photographs may be submitted in the computer graphics division.
- If manipulating images from outside sources in the computer graphics division, please cite the source of the image.
- Include a scan of the entry form or type the entry information in the email text area: student's name, age, grade, school, school address, school phone number, teacher's name and teacher's email address. Write the common and/or scientific name(s) of the animal(s) in

the artwork. Attach the artwork file(s) to the email.

- Please provide home address (for mailing awards, if selected), email of parent or guardian, and phone number for correspondence purposes. For all students under age 18, check the box or note that the parent approves submission of the entry.
- Students are limited to two entries. Submit each entry to stellwagen@noaa.gov

DIVISIONS

Elementary School: Grades K-4

Middle School: Grades 5-8

High School: Grades 9-12

Scientific Illustration: All Grades

Computer Graphics & Photography: All Grades

PRIZES

1st Place: \$50 cash award, certificate

2nd Place: \$30 cash award, certificate

3rd Place: \$15 cash award, certificate

4th-6th Places: certificate

Additional prizes may be available. MME is working with local museums and marine institutions to acquire passes, posters, and other rewards.

Winning artwork will be shared on the NOAA Stellwagen Bank National Marine Sanctuary and MME websites and social media (including, but not limited to, Facebook, Instagram, and Twitter). MME and co-sponsors will have unrestricted use of all submitted artwork.

Please note that by sending your artwork to the stellwagen@noaa.gov email address, you are giving the contest sponsors permission to use the image for other purposes, such as websites and publications of the sponsoring organizations. Credit to the artists will be applied whenever any of the art is used.

Credit for students in elementary and middle school will include first name, last initial, age, grade, and school. For students in high school, the full first and last names will be used. If students do not want full names posted, please tell us in the entry email

See next page for a partial species list

FOR MORE INFORMATION:

www.massachusettsmarineeducators.org • stellwagen.noaa.gov • anne.smcina@noaa.gov

781-738-2242 or 781-546-6007

2021 Marine Art Contest Partial Species List

This is only a partial list. There are many other species, particularly among phytoplankton, zooplankton, worms and other benthic invertebrates.

PHYTOPLANKTON

Diatoms
Dinoflagellates
Blue-green algae

ZOOPLANKTON

Arthropods – Copepods and other drifting crustaceans
Chaetognaths – Arrow worms
Cnidarians – Moon jelly, Lion’s mane jelly
Ctenophores – Beroe’s comb jelly, Sea gooseberry
Mollusk – Pteropod, Naked sea butterfly
Larval fish and invertebrates

INVERTEBRATES

Sponges

Finger and Branching sponges
Breadcrumb and Bulbous sponges
Chalice or cup sponge
Common palmate sponge

Cnidarians

Moon and Lion’s mane jellies
Frisled and Bolocera anemones
Northern red anemones
Northern cerianthid
Pom pom anemone
Red soft coral
Solitary hydroid
Tubularian (pink-hearted) hydroids

Bryozoans (Spiral tufted bryozoan)

Mollusks

Ocean quahog
Northern horse mussel
Sea scallop
Northern moon snail
Waved and Ten-ridged whelks
Red-gilled nudibranch
Short- and Long-finned squid
Atlantic octopus

Worms

Nemertean (ribbon worms)
Annelids (segmented worms)
Clam and Fan worms

Brachiopods (Northern lamp shell)

Arthropods

Rough barnacle
Acadian and Hairy hermit crabs
Jonah and Rock crabs
Stone crab
American lobster
Northern pink and Sand shrimp
Dichelopandalus shrimp
Mysid and Skeleton shrimp
Krill
Horseshoe crab
Isopods and amphipods

Echinoderms

Forbes’ and Northern sea stars
Spiny and Smooth sunstars
Horse and Badge stars
Blood sea star
Daisy brittle star
Northern basket star
Orange-footed cucumber
Scarlet psolus
Common sand dollar
Green sea urchin

Tunicates

Stalked sea squirt (Botenia)
Sea vase and Sea peach
Northern white crust
Sea grape

FISHES

Sharks

Thresher shark
Blue shark
Shortfin mako shark
White shark
Porbeagle
Basking shark
Spiny dogfish

Skates

Winter (big) skate
Little skate
Barndoor skate
Thorny skate

Small, Schooling

Prey Fish

Northern sand lance
Atlantic herring
Atlantic mackerel
Butterfish

Flounders

Atlantic halibut
American plaice
Four-spot flounder
Windowpane flounder
Winter flounder
Witch flounder
Yellowtail flounder

Gadids (cod family)

Atlantic cod
Cusk
Haddock
Pollock
Red and White hakes
Silver hake (Whiting)

Silvery Swimmers (pelagic)

Bluefish
Bluefin tuna
Striped bass

Demersal (seafloor)

Dwellers

Atlantic wolfish
Sea raven
Ocean pout
Acadian redfish
Longhorn, Shorthorn and Grubby sculpins
Northern sea robin
Cunner
Black sea bass
Goosefish (Monkfish)
Snakeblenny

Unusual Shape

Ocean sunfish
Pipefish
Hagfish
Lumpfish

MARINE MAMMALS

Baleen Whales

Blue whale (rarely seen)
Fin whale
North Atlantic right whale
Humpback whale
Sei whale
Minke whale

Toothed Whales

Sperm whale (rarely seen)
Orca (rarely seen)
Long-finned pilot whale
Atlantic white-sided dolphin
Common dolphin
Harbor porpoise

Seals

Harbor seal
Gray seal
Harp, Hooded and Ringed seals (rarely seen)

SEA TURTLES

Kemp’s ridley sea turtle
Leatherback sea turtle
Loggerhead sea turtle (rarely seen)
Green sea turtle (rarely seen)

SEABIRDS

Alcids

Razorbill
Dovekie
Atlantic puffin
Common murre
Thick-billed murre
Black guillemot
Great auk (extinct)

Gulls and Terns

Herring gull
Great black-backed gull
Lesser black-backed gull
Laughing gull
Bonaparte’s gull
Ring-billed gull

Iceland gull
Glaucous gull
Sabine’s gull
Black-legged kittiwake
Least tern
Roseate tern
Common tern
Arctic tern

Gannets and Cormorants

Northern gannet
Great cormorant
Double-crested cormorant

Sea Ducks and Loons

Common eider
Long-tailed duck
Black scoter
Surf scoter
White-winged scoter
Great skua
Common loon

Shearwaters, Storm

Petrels and Albatrosses

Great shearwater
Cory’s shearwater
Sooty shearwater
Manx shearwater
Wilson’s storm petrel
Yellow-nosed albatross

Fulmars, Jaegers,

Phalaropes

Northern fulmar
Parasitic jaeger
Pomarine jaeger
Long-tailed jaeger
Red-necked phalarope
Red phalarope

Art Credits: Cover –

- Naked Sea Butterflies by Grace Li, gr.10, Newton North HS (Scientific Illustration);
- Ocean Sunfish and Diver by Sophia S., gr.8, William Diamond MS, Lexington (Computer Graphics);
- Common Dolphins by Bohdan A., gr.6, Viz Art School, Northborough (Middle School);
- Atlantic Puffin with Fish by Jessica Wu, gr.11, North Quincy HS (High School);
- Sanctuary Scene by Charlotte R., gr.1, Antioch School, Fall River (Elementary School);



For more information:
<https://www.massachusettsmarineeducators.org>
 or <https://stellwagen.noaa.gov>
 email anne.smrcina@noaa.gov;
 phone: 781-738-2242 or 781-546-6007

MME Marine Art Contest
 c/o SBNMS
 175 Edward Foster Road
 Scituate, MA 02066

Send DIGITAL entries to:
stellwagen@noaa.gov

2021 ENTRY FORM MARINE ART CONTEST

Theme:
**Illustrating the Marine Biodiversity of
 Stellwagen Bank National Marine Sanctuary**

DEADLINE: May 7, 2021

Submission of this entry gives the sponsoring organizations all rights to use the artwork for non-commercial purposes, in products that serve to promote and publicize the contest, to educate the public about local marine species, and in online or traveling exhibitions of winning art. Any use of artwork will include credit to the student. Credit for high school art will include the student's full name. For grades K-8, students will be identified by school, grade, and first name/last initial only. All winning artwork and honorable mentions will be posted on the sanctuary website (selected artwork will also be posted to the MME website). Personal identifiable information on this form will be held securely and not released to any outside individual or organization.

PUBLIC SCHOOL PRIVATE SCHOOL HOMESCHOOL ART SCHOOL/AFTERSCHOOL PROGRAM
 INDIVIDUAL ENTRY Please type or print clearly and then sign at the bottom of the form.

Student Name: _____

Grade: _____ School: _____

Name(s) of animal(s) pictured in artwork: _____

Teacher's Name: _____ Phone #: _____

Teacher's Email: _____

School Address: _____

Home Mailing Address: (for mailing of prizes, if chosen, and contest correspondence)

Parent/Guardian Name: (for questions related to contest entries)
 _____ Phone #: _____

Parent/Guardian Email Address: _____

- I represent and warrant that the artwork submitted for this contest is my own or my child's original creation.
- If the submitted artwork is a photograph, and one or more individuals appear in the photograph, I warrant that I have obtained written permission from the individual/s to use their likeness/es.
- I understand that the 1st through 6th place prizes listed in the contest announcement (if applicable) will be the only compensation received for use of my/my child's artwork by the contest sponsors.
- I agree to indemnify and hold harmless NOAA, as well as its employees, agents, and contractors; MME; and other sponsors of this contest against any and all claims, actions, or damages (including attorney's reasonable fees) asserted by or paid to any party on account of a breach or alleged breach of the above warranties.
- I hereby give permission for my/my child's artwork to be entered in this contest, and I agree to the terms outlined in this form and the contest announcement. Please sign below.

Student _____ Parent (if child is under 18) _____