

# Marine Biological Laboratory

WOODS HOLE, MASSACHUSETTS

## The Marine Biological Laboratory: Where Basic Biology Leads the Way

Gina Hebert, Director of Communications, Marine Biological Laboratory, Woods Hole, MA

Most members of the Massachusetts Marine Educators (MME) are aware that Woods Hole contains numerous scientific research organizations. MME's annual conferences have been held at Woods Hole Oceanographic Institution (WHOI) for more than 30 years, and field trips have introduced us to many of the others. Situated squarely in the center of Woods Hole village is the Marine Biological Laboratory (MBL), an institution where basic biological discoveries have informed human health and the health of our planet for more than a century. The MBL, founded in 1888, is a private, nonprofit institution and an affiliate of the University of Chicago. Using aquatic organisms as models, MBL scientists have explored fundamental questions about how life works, often leading to direct impacts for human beings.

Research at the MBL focuses on a four general themes, including:

- discoveries emerging from the study of new research organisms in the areas of cell biology, regenerative biology, neuroscience, sensory physiology, and comparative evolution and genomics;
- the study of microbiomes and microbial diversity and ecology in a variety of ocean, organismal, and terrestrial habitats;

- innovation in imaging and computation, illuminating cellular function and previously unknown biology; and
- adaptation and resilience of environmental systems and organisms in the face of global change.

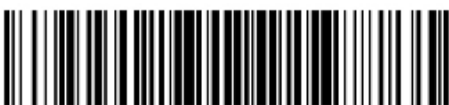
Of the MBL's 250 year-round employees, about half are scientists and scientific staff. They are joined each year by more

*continued on page 8*

### • INSIDE THIS ISSUE •

Marine Biological Lab . . . . .	1	Marine Science in the News .	12-14
MME Calendar . . . . .	2	MBL HS Program . . . . .	15-17
Developing New Research . . . . .	3	Marine Science Lessons . . . . .	18
President's Message . . . . .	4	Marine Art Contest Winners . . . . .	19
Marine Science in the News . . . . .	5		
From the Editor's Desk . . . . .	6		
MME Fall Conference . . . . .	7		
Pleasant Bay Boating . . . . .	11		

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 c/o Robert Rocha, New Bedford Whaling Museum  
 18 Johnny Cake Hill, New Bedford, MA 02740  
[massachusettsmarineeducators.org](http://massachusettsmarineeducators.org)

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## 2020 MME Calendar

Check website and F&J for details.

**SATURDAY,  
OCTOBER 3**

### Virtual Conference

Theme: Diversity in Marine Education

**WEDNESDAY,  
NOVEMBER 4**

### 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. If they are virtual meetings, please check with an MME officer for details.**



Mayflower in Plymouth Harbor

The Postal Service will issue the Mayflower Forever Stamp at Plymouth September 17, 2020. The U.S. Postal service stamp marks the 400th anniversary of the arrival of the ship MAYFLOWER in Plymouth Harbor in 1620. The Mayflower II has recently returned to Plymouth after an update in Mystic CT.

# Developing “New” Research Organisms at the MBL

Gina Hebert, Director of Communications, Marine Biological Laboratory

Asign on the wall in the MBL’s Marine Resources Center reads: *Discovery is to see what everybody has seen and think what nobody has thought.* The quote is attributed to Albert Szent-Gyorgyi, a Nobel Laureate who was an MBL scientist for most of his career.

MBL scientists study aquatic “model organisms” to understand the basic life processes that they share with humans. A “model” organism is typically described as a non-human species that is widely used to characterize certain biological processes. Studying simple “models” leads to discoveries about human health and disease and builds the foundation for medical progress.

Looking at a sea urchin or sea star might inspire only cursory interest among most people at the shore, but to marine scientists, from the very first summer of MBL’s history (1888) to the present, **echinoderms** have been the door into embryology and development. They produce abundant, transparent eggs that are easily fertilized and divide in synchrony, all of which can be observed using a standard light microscope.

The large, off-shore **surf clams** have shed light on the cell cycle. Studies have involved the chemical events controlling cell division and DNA replication. An MBL investigator won a Nobel Prize for the discovery of proteins known as cyclins, which regulate the timing of the cell cycle.



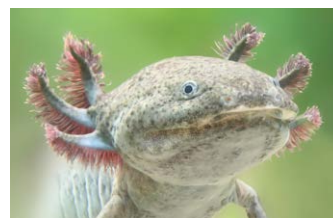
It was known by the 1930s that the Woods Hole **squid** has a “giant axon” down the middle of its mantle which can be seen with the naked eye. It is the largest nerve cell in the animal world – fifty times larger than the diameter of a human axon. The synapses, where the axon communicates with other nerve cells, are large enough to be studied easily as well. Squid have become a model for learning how nerve impulses propagate and how ionic channels in the nerve cell membrane allow information to pass in and out of cells. Squid have elucidated so much of what we know about our nervous system, and studying them has resulted in so many Nobel Prizes, that it has been suggested they might be due for their own Nobel!



The eyes and blood of the **horseshoe crab** have been subjects of study since the 1960s. An article on page 15 of the Summer 2020 issue

of *Flotsam & Jetsam*, “The Race for a Coronavirus Vaccine Runs on Horseshoe Crab Blood,” provides a nice summary of the continued use of the animal’s blood to detect endotoxins. What the article does not say is that the *Limulus* amebocyte lysate (LAL) test was discovered and developed at the MBL, and its first commercial production was via a spin-off company called Associates of Cape Cod started right in Falmouth, MA. The LAL test today is the industry standard around the world for testing medical devices and injectables for potential pathogens.

Regeneration has interested biologists for centuries. Scientists at the MBL use several model organisms for studying tissue and organ regeneration. While many invertebrates are the focus of study, such as worms and sea stars, the vertebrates are yielding a surprising number of research subjects. The goal is to apply basic knowledge to treatments for human conditions like spinal cord injury, diabetes, organ failure and Alzheimer’s disease. Research at the MBL’s Eugene Bell Center on the regenerative powers of the **African clawed frog** (*Xenopus*) has made it one of the best understood models in regenerative biological research. The lab maintains the National *Xenopus* Resource center, where the frogs are bred, genetic stocks are maintained, and training in husbandry, transgenesis, imaging, and genomics is offered. The **lamprey**, an eel-like fish, has been shown to be able to recover from severe spinal cord damage, even if the injury is repeated a second time. And then there’s



the **axolotl, or Mexican Salamander** (*Ambystoma mexicanum*). A lab at the MBL has launched a sizeable breeding and husbandry program because, according to the principal investigator, these endangered amphibians are the “superstars of regeneration.”

An axolotl can regrow its limbs, jaw, skin and even parts of its brain and spinal cord. In addition, it can regrow a severed arm dozens of times and always makes a perfect copy. Of primary interest is the fact there is no build-up of scar tissue. These are only a few examples of research in regenerative biology that may lead us closer to tissue engineering and drug therapies that can heal damaged body parts or even grow new organs in humans.

*continued on page 10*



# President's Message



Greetings all,

It seems the theme of our current time is “uncertainty”. When will the pandemic end? Will I get sick? What will happen if I do? Is school going to be remote, in person, or hybrid? When can I travel to see distant family members? Is racism finally getting addressed in our country? Will there be justice and equality for all? So many questions, so few answers.

I think the reason so many people seek solace in nature during times of uncertainty is because nature is full of relative certainties. I was privileged and fortunate to spend a week away from all the chaos at one of my favorite places on Earth: a little cottage on a thread of sand in Tisbury Great Pond, on Martha's Vineyard. Here, the tides rise and fall, the breeze blows steady out of the southwest, ospreys wheel overhead, crabs skitter about in the shallows, towhees bid you to “drink your tea”. It's easy to forget about it all here. Or at least be comforted by the knowledge that as the human world sputters, clangs and grinds, there is a world without us, going about its business, moving to its own rhythms.

Perhaps by the time you read this, some of the uncertainties will be resolved. Those of us who teach in school will be adjusting to whatever model our communities chose.

Being highly adaptable creatures, somehow we manage to adjust. I would like to think that in the end, we will be better off for all this.

Like many of you, your MME board takes a breather during the summer months, with the exception of the Boston Harbor Educators Conference Committee. Led by President-Elect Pat Harcourt, they have been hard at work planning this virtual event to be held live on October 3. I am very excited about the program and I look forward to seeing you all there.

As always, please feel free to reach out to me directly if you have any questions or concerns about MME. My email address is [dpinkerton1019@gmail.com](mailto:dpinkerton1019@gmail.com), or you can call or text me at (781) 718-5770. I am on Instagram and Twitter @pinkerteach.

Best regards,

*Don*

Don Pinkerton, President

## Flamboyant cuttlefish save their bright patterns for flirting, fighting and fleeing

Source: *The Well, Marine Biological Laboratory*



The flamboyant cuttlefish (*Metasepia pfefferi*) is known for its bright purple and yellow patterns. Recent field observations caught females laying 15 to 25 eggs at a time in coconut shells and suggest that the animals may either return to the same shell over and over again or share shells with other females.

Steven Kovacs/Biosphoto/Alamy Stock Photo

By Helen Thompson  
September 1, 2020 at 4:12 pm

Don't let the name fool you. Flamboyant cuttlefish (*Metasepia pfefferi*) look anything but flashy most of the time. Images and [videos](#) of the marine mollusks flashing bright purple and yellow hues litter the internet, perpetuating the idea that these animals are constantly putting on a show in the wild. But a new study proves just the opposite: Flamboyant cuttlefish spend most of their time looking like a pile of mud.

“These animals have superb camouflage,” says Roger Hanlon, a marine biologist at the Marine Biological Laboratory in Woods Hole, Mass. Specialized cells and structures in their skin allow the animals to instantly morph into ostentatious patterns, as well as blend in.

Keen to see how the animals balanced flamboyance with camo in nature,

Hanlon organized two field studies in a cuttlefish habitat off the coast of North Sulawesi, Indonesia. Citizen scientist divers scouted the Lembeh Strait area over eight days in 2002 and again for 11 days in 2019, being careful to eavesdrop without disturbing the animals. Video footage collected by the team now [reveals intimate details of the species' mating practices and defensive behaviors](#) as well as what the animals do in their downtime. Hanlon and Gwendolyn McManus, a marine biology student at Northeastern University in Boston, describe the results in the August *Journal of Experimental Marine Biology and Ecology*.

The solitary species slowly ambles along the seafloor, foraging in a drab region of mud and sand between coral reefs. “It’s like a moonscape or a desert,” says Hanlon. Flamboyant cuttlefish take on the color and texture of their muddy seafloor backdrop and masquerade as a lump of sand or a rock. Like some other

cephalopods, these cuttlefish spend most of their time incognito, reserving their displays for special occasions: confusing a predator, courting a mate and sparring with rival suitors.

Flashing their good looks 24/7 would attract unwanted attention. But it comes in handy if their first line of defense—camouflage—fails. Then, both males and females will engage in a campaign of unpredictability. When confronted by a threat, the animal might quickly flash its colors to frighten the predator, sometimes in just 700 milliseconds. Next, it cycles through other confusing behaviors — jetting, shooting ink and reverting to camouflage — until it has eluded the enemy.

Males also show flamboyant displays to attract the ladies. After spotting a female in the distance, a male will flaunt bright colors and undulate their mantle stripes in a move called “the passing cloud.” Researchers also observed two types of gestures during this colorful routine: arm waving (reminiscent of a human bowing) and kissing (a tap on the female’s arm with his arms). “These displays are really elaborate and dynamic,” says Hanlon. “And they’re comparable to what some of the most sophisticated birds do and even some primates.”

Love triangles happen, and males sometimes guard females and [fight off other males](#) (*SN: 5/12/17*). In brawls, male body patterns split flirting and fighting. The side facing the female flashes the bright motif, while the side facing the male takes on an aggressive white pattern.

Video footage from field studies in Indonesia provides an inside look at the lives of flamboyant cuttlefish.

All of this pizzazz can put males at risk. Hanlon recalls an instance where a

*continued on page 12*



## From the Editor's Desk

**M**uch has happened since the summer issue of *Flotsam and Jetsam* was completed. Summer was a period of many cancellations, changes in plans, and lots of time spent away from friends, school buildings and visits into the city. The board has had time to look into the coming year as discussion occurred about plans for it.

*Flotsam and Jetsam* in past years has featured many of the marine related organizations in the region in our fall issues. This issue features two of these organizations. The Marine Biological Laboratory (MBL) at Woods Hole was founded in 1888 and draws scientists from around the world to Cape Cod to carry out far-reaching work. Fifty-eight scientists affiliated with MBL have received Nobel Prizes for their work. MBL is affiliated with the University of Chicago and is dedicated to scientific discovery. When we think of Woods Hole, too often only the Woods Hole Oceanographic Institution comes to mind when thinking about this important coastal town. The feature articles discuss some of the research that occur at MBL. Initial contact with MBL was done by MME member Lee Anne Campbell. Lee Anne worked hard with the staff there to prepare these articles and help gather materials you will see here. Many things happen at MBL which many of us have never heard about.

MBL has for several years offered a High School program with four courses featured. Plans for the future include adding a fifth course to the program. You will find information on this program in this issue of *F&J*.

*The Well* is a feature of the MBL website, frequently posting information from the scientific work being carried out there. In this issue you will find some of the material from *The Well* under our section **Marine Science In the News**. In future issues we will continue to add materials from *The Well*.

Also in this issue is an article on Pleasant Bay Community Boating on Cape Cod and their new boat. Sarah Griscom from the MME Board is the Science Program Director at Pleasant Bay.

With many schools now on a program where they will be on an online or hybrid program as the new school year unwinds, I have tried to find materials online that can be used in your marine science classes. This issue has the first set of materials that have been produced by NOAA as well as other organizations you might find helpful. Hot links will be found to these. They are a few of the many individual useful marine science articles. In the summer issue, on page 10 were some of these materials from WHOI. In future issues of *F&J* I will add more links from the MBL as well as from NOAA and the National Marine Sanctuaries.

I hope you have an uneventful start to the new school year.

*Howard*

Howard Dimmick, Editor



# MASSACHUSETTS MARINE EDUCATORS (MME)

presents

## VIRTUAL CONFERENCE 2020

*The conference committee has been hard at work planning for this conference.*

### THEME

#### **The Ocean Connection: Increasing Diversity in Marine Education**

The ocean is a sustainer of life and a major factor in climate on Earth, and we want every student and citizen to understand and enjoy our wonderful ocean and the beautiful coasts of Massachusetts. In this conference presenters will share their ideas for making marine education welcoming and inclusive for all!

### FORMAT

Web-based video conference with live sessions, and links to optional pre-recorded sessions that can be viewed any time

### DATE

#### **SESSIONS Saturday, October 3, 2020**

The sessions will include two presentations on increasing diversity in marine education, with opportunities for questions and discussion after each session.

Links to pre-recorded sessions will be available starting October 3

### TIME

#### **9:00 AM – Saturday, Oct. 3 – Welcome**

Two sessions to follow, including breaks, until 11:15 AM.

#### **7:00 PM – Monday, Oct. 5; Tuesday, Oct. 6; Wednesday, Oct. 7**

Three 30-minute pre-recorded sessions will be available for viewing. All registered conference participants will receive the links via email along with information about how to share the videos with students after the initial release. Session topics will include sharks, investigations at your local beach or coastal area, and robots in the ocean.

### FEE

No charge for current members

\$30.00 for non-members (MME Membership for the year included)

### SATURDAY SPEAKERS



**KWANZA JOHNSON** is a member of the [Woods Hole Diversity Advisory Committee](#) and works with the Partnership Education Program in the Woods Hole scientific

community. She has also taught middle school science in Florida. Ms. Johnson will share ideas and experiences for identifying and removing barriers to broad participation in programs, and increasing diversity in marine education.



**ELIZABETH JAMES-PERRY** is an artist and a member of the Wampanoag Tribe of Gay Head-Aquinnah, located by the richly colored clay cliffs of Marthas

Vineyard/Noepe. As a member of a Nation that has lived on and harvested the sea since ancient times, Elizabeth's is a perspective that combines coastal Algonquian culture, traditional beliefs and science in her ways of relating to the North Atlantic.

### **Pre-Registration is necessary**

to get the necessary information to join the conference –

[massmarineeducators.wufoo.com/forms/mme-fall-conference-2020/](https://massmarineeducators.wufoo.com/forms/mme-fall-conference-2020/)

# The Marine Biological Laboratory: Where Basic Biology Leads the Way

continued from page 1

than 500 scientists from hundreds of institutions around the world. Fifty-eight Nobel Prize winners (since 1929) are among the scientists who have had a significant affiliation with the MBL during some part of their careers.

Central to the MBL's identity are its advanced courses. Students in these graduate-level research courses learn from internationally renowned scientists and are immersed in the laboratory, learning cutting-edge approaches while investigating contemporary research problems. Students come from (in 2019) 344 institutions and 38 countries. Course directors and faculty are leaders in their fields; in fact, many of them are authors of the textbooks which the students pored over back home!

The MBL also offers research-based educational programs for undergraduates from the University of Chicago and other institutions, including the Semester in Environmental Science, quarter-long courses, and mentored research internships. A new high-school program emphasizing immersive, discovery-based learning

is described further elsewhere in this issue of *Flotsam & Jetsam*. In addition, the MBL hosts dozens of workshops, training courses and conferences during all seasons of the year—accommodating thousands of participants from around the world.

In addition to its beautiful campus, the MBL has numerous resources that make it a mecca for marine scientists. The research building used in that first summer of 1888 had a running seawater table where collected organisms were held for further study. Today, hundreds of thousands of gallons of seawater are pumped each day from Woods Hole waters to holding tanks atop the Lillie building from where they travel via gravity to replenish the “sea-tables” in most of the MBL's buildings. Nowhere is that more apparent than the three-story Marine Resources Center, or MRC. On the ground floor, row upon row of tanks hold the critters requested by the scientific staff, and the ceiling is rigged with what seem to be miles of pipes. Almost every summer day the collecting staff replenishes the stock using nets aboard the dedicated vessel *Gemma* or diving with SCUBA gear or squatting in the marshes with buckets in hand. Over the years, MBL staff have perfected the art of shipping live organisms to research labs and universities throughout the world. The second

floor of the MRC houses an innovative cephalopod mariculture program, where squid, octopuses, and cuttlefish are grown from eggs to reproductive adults to new generations of eggs (see article about Research Organisms). The in-house veterinarian has an office on this floor, a holding room for injured or diseased organisms, a necropsy room, labs for histology, microbiology, and parasitology, and a water quality/chemistry laboratory. The third floor contains the mechanical equipment that is crucial to the life support systems of the MRC plus additional laboratory space and offices.

The Lillie Laboratory is home to many important MBL assets, including the Bay Paul Center, whose research explores the evolution and interaction of genomes of diverse organisms that play significant roles in environmental biology and human health and the Central Microscopy Facility, part of the MBL Imaging Initiative, which convenes biologists, instrument developers, and computational scientists to advance research and training in next-generation microscopy and computational image analysis. Lillie also houses the MBLWHOI Library, which has been the intellectual heart of the Woods Hole scientific community for more than 120 years. The library provides scientists and students with print and electronic resources to help conduct their research, with publications from the biological, biomedical, ecological, and oceanographic sciences. Rare artifacts on display include the actual Nobel Prize awarded to Thomas Hunt Morgan in 1933 as well as the microscope he used when studying in Woods Hole.

The Rowe Laboratory houses both year-round and visiting scientists. Some of the vibrant research happening inside includes the lab of MBL Director Nipam Patel, who studies evolution and development in animals from butterflies to marine crustaceans. The building is also home to the Eugene Bell Center for





Regenerative Biology and Tissue Engineering. Scientists in the Bell Center explore the remarkable regenerative capabilities of animals such as the sea lamprey and Mexican salamander, both of which can fully recover from a severed spinal cord without medication or treatment.

The MBL has a long history of research in ecosystems science and carries out studies on ecological change and its impact in a number of locations, from coastal oceans to the Arctic. The Ecosystems Center is the continuous recipient of large National Science Foundation Long-Term Ecological Research grants at Plum Island, MA, the largest remaining salt marsh in the northeast, and Toolik Lake, AK, 150 miles north of the Arctic Circle. Both projects are collaborative, engaging scientists from many other labs around the country, and both data sets go back to the 1980s. Global change questions can be answered only with long-term data which these two studies are providing.

Since its founding, the MBL has provided scientists around the world with access to the rich marine life found in the waters around Woods Hole.

Research on these species has given new directions in the neurosciences, in imaging, and in molecular and cell biology, and work done at the MBL in these fields has helped pave the way to breakthroughs that inform the human condition. By coupling new imaging and gene editing technologies, computation, and the marine life accessible at its doorstep, the MBL is a center for discovery of basic mechanisms from genes and cells, to tissues and whole organisms.

These overview paragraphs only begin to describe the historic but so very current nature of research at the Marine Biological Laboratory. Other articles in this issue of *Flotsam &*

*Jetsam* will provide more detail, and a cruise around the MBL website at [www.mbl.edu](http://www.mbl.edu) will bring to life this dynamic place. While the summer of 2020 saw Covid-19 cause the cancellation of so many things, the MBL rose to the challenge. The Education Department developed a series of free webinars ([mbl.edu/education/mbl-virtual-programs](http://mbl.edu/education/mbl-virtual-programs)) that include selections from many of the summer courses, and the historic Friday Evening Lecture ([mbl.edu/FEL](http://mbl.edu/FEL)) series was also broadcast virtually. SciShoots ([social.mbl.edu/tag/mblscishoots](https://social.mbl.edu/tag/mblscishoots)) is another virtual series, more appropriate for lay audiences, highlighted elsewhere in this issue of *Flotsam & Jetsam*. 🌿



### About the Author

Gina Hebert is the Director of Communications at Marine Biological Laboratory. She has been at MBL for more than 20 years. During that time she has directed the MBL's media relations program in which she has developed stories and press releases for local and national media. She also develops a wide variety of public outreach activities, events and projects. She has a degree from Allegheny College in Environmental Science. She has also spent time at the Duke University Marine Laboratory.



Due to ongoing health and safety concerns caused by the COVID-19 pandemic, the National Science Teaching Association has decided to cancel the fall 2020 Area Conferences on Science Education. The face-to-face meetings were originally scheduled to be held October 29–31 in Pittsburgh, Pennsylvania; November 19–21 in New Orleans, Louisiana; and December 10–12 in Phoenix, Arizona.

In making this decision, NSTA considered feedback from members and conference participants, including

exhibitors and session presenters, state and local guidance on large gatherings, and guidance from the Centers for Disease Control and Prevention and the World Health Organization. This decision was made for the health and safety of our attendees, exhibitors, presenters, volunteers, and staff.

We appreciate the work our conference committees have put into meeting our members' and the greater science education community's professional needs, and their continued guidance as we re-envision the conferences as a virtual experience in November. We will share additional information as soon as it is available. Thank you for your continued understanding and support while we navigate these unprecedented and challenging times.

## Developing “New” Research Organisms at the MBL

continued from page 3

Today, science possesses dramatic new opportunities to explore the frontiers of science with a rich foundation of knowledge and tools that previously did not exist. The well-known species most commonly used as model organisms today (e.g. mice, zebrafish, *C. elegans* (nematode worm), and fruit flies) are commonly used in part because of their genetic tractability—meaning scientists can alter their genes and understand biological processes in greater detail than ever before.

Building on the strengths of its setting, resources in marine life, and its unique collaborative environment, the MBL’s New Research Organisms Initiative is widening the palette of genetically tractable organisms available for research—and thus expanding the universe of biological questions that can be asked—by taking advantage of the largely untapped wealth of diversity found in aquatic systems.

The MBL Cephalopod Program is part of this new initiative. **Cephalopods**

(squid, octopus and cuttlefish) have the largest brain of all invertebrates, a distributed nervous system capable of instantaneous camouflage and sophisticated behaviors, a unique body plan, and the ability to extensively recode their own genetic information within messenger RNA, along with other distinctive features. These open many avenues for study and have applications in a wide range of fields, from evolution and development, to medicine, robotics, materials science, and artificial intelligence. The MBL launched a groundbreaking effort in 2017 to culture cephalopods in the laboratory so they can be available to researchers at all life stages at any time of year, and the first genetically tractable squid species was recently developed at MBL, meaning scientists can manipulate its genes and study the effects over multiple generations.

By tackling cephalopods, one of the more complex and resource intensive candidate organisms, the MBL has piloted the concept of the New Research Organisms Initiative and will develop a series of candidate organisms across different phyla. By creating these new research organisms, the MBL aims to nucleate cutting-edge biological discovery at the MBL for the foreseeable future. 🐙



### OCEAN LITERACY PRINCIPLE 3

## The ocean is a major influence on weather and climate.

- The ocean dominates the Earth’s carbon cycle. Half the primary productivity on Earth takes place in the sunlit layers of the ocean and the ocean absorbs roughly half of all carbon dioxide added to the atmosphere.
- The ocean has had, and will continue to have, a significant influence on climate change by absorbing, storing, and moving heat, carbon and water. Changes in the ocean’s circulation have produced large, abrupt changes in climate during the last 50,000 years.

# Pleasant Bay Community Boating

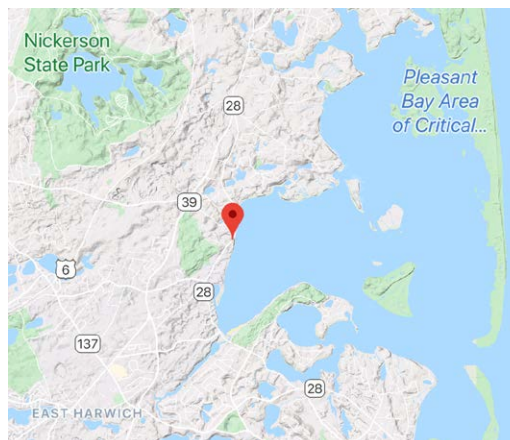


"The Friend" – New 37' Solar Electric Pontoon Boat for educational and research activities in the greater Pleasant Bay estuary on Cape Cod.

The initial spark to build this new vessel was ignited in 2016 when four organizations sat down for a meeting at the Chatham Marconi Maritime Center (CMMC) to discuss creating a collaborative STEM and marine science program on the "elbow" of Cape Cod. It was a magical moment for the four organizations. The Center for Coastal Studies (CCS) was wrapping up a three-year, multidisciplinary survey of the greater Pleasant Bay (the largest estuary on Cape Cod and a watershed designated by the state as an Area of Critical Environmental Concern). The study, largely funded by the non-profit, Friends of Pleasant Bay (FOPB), included a requirement to share the results of their research with the community. Roughly a year before that, Pleasant Bay Community Boating, originally a homegrown operation on a town beach, had just purchased 3.6 acres of waterfront, the original McClennen estate, at the head of Pleasant Bay, and was preparing to greatly expand their mission to include marine science and environmental stewardship. CMMC, renovated to serve as a museum and educational space, was already offering dynamic hands-on STEM classes, so was experienced and well established in this area.

At this historic meeting, a CCS scientist was asked, "what, in your wildest dreams would you want in order

to provide educational and research operations for the community"? She described her dream pontoon boat. From there, FOPB expanded on the collective thought of a floating classroom and pioneered the concept of a vessel outfitted with quiet electric engines, solar panels on the top, designed to easily tow research equipment, equipped with a side davit and a very low draft to enable the vessel to access the broad shallows of the Bay. The evolution of the boat was born from shared love of place and desire to connect people to the natural history of Pleasant Bay. From that point, the wildest dream began to become a reality. FOPB found a reputable builder in South Carolina and began to raise funds to build and outfit the boat. She is now complete and has been christened "The Friend."



Location of Pleasant Bay Community Boating and the greater Pleasant Bay

Pleasant Bay Community Boating will take ownership of the newly commissioned 37' solar electric vessel from the Friends of Pleasant Bay this season, and the boat will be taken through several shakedown trips and captain training trips before being brought into service. Many groups have expressed interest in using the vessel for ongoing coastal monitoring of water quality, seal studies, fisheries research, benthic and geologic surveys. Scientists from the Center for Coastal Studies, UMass Dartmouth and surrounding town governments will use *The Friend* for some of her first excursions. Finally, because of the new and very exciting purchase of Sipson Island last month — a purchase that has transformed a 24 acre piece of real estate, privately held for over 300 years, into a publicly accessible conservation land — *The Friend* will have another important job. PBCB will be working closely with the Sipson Island Trust and possibly the Audubon Society to provide transportation to and from the Island and to collaborate with FOPB and CCS for educational programming.

The new vessel, the island, and the establishment of PBCB's programs represent an exciting confluence of many years of fundraising, program design, building community relationships, and educating the public to protect the Bay, by a dedicated and eclectic group of citizens and non-profits. Please stay tuned and reach out to PBCB for more information about *The Friend* for your school or organization in 2021.

Sarah Griscom, PhD.  
Science Program Director, Pleasant Bay  
Community Boating  
Campus: 508-945-7245  
Cell: 508-241-4334

Friends of Pleasant Bay  
Center for Coastal Studies  
Sipson Island Trust  
Chatham Marconi Maritime Center

# MARINE SCIENCE IN THE NEWS

## Flamboyant cuttlefish

continued from page 5

male swimming backward got scarfed up by a scorpion fish in the midst of his flamboyant display. “There’s the price you pay for displaying to a female not paying attention to where you’re going,” says Hanlon.

But the risk can come with reward — for some lucky guys. Eventually, a female may open her arms and mate for a quick three seconds. Figuring out exactly what flirting tactics a female uses to select her mate requires more data. “Does she focus on the male’s courtship dance? On his ‘kiss’ signal? Or on how bright his passing cloud is? It’s too soon to tell,” says Alex Schnell, a wildlife scientist at Cambridge University who was not affiliated with the study.

Males also got shot down a lot, as picky females appear largely unmoved by



Contrary to previous studies and scuba diver reports, flamboyant cuttlefish don’t parade around the ocean in full getup (left). They actually spend most days pretending to be rocks (right).

Photo Credit L-R: R. Hanlon, F. Bavendam

most of their showmanship. Of 108 kisses observed, only 20 led to something more. The observations hint that the most successful males might be the ones that worked the hardest and remained persistent.

The field observations fill in knowledge gaps about how these animals survive in the wild and contradict two previous studies in [a lab](#) and [an aquarium](#), as

well as photos and videos from scuba divers, that suggested that the animals displayed their flamboyant patterns more frequently. Looming humans, bright lights and higher density tanks may have shifted the behavior of a species that spends most of its time alone and under the radar. 🦑

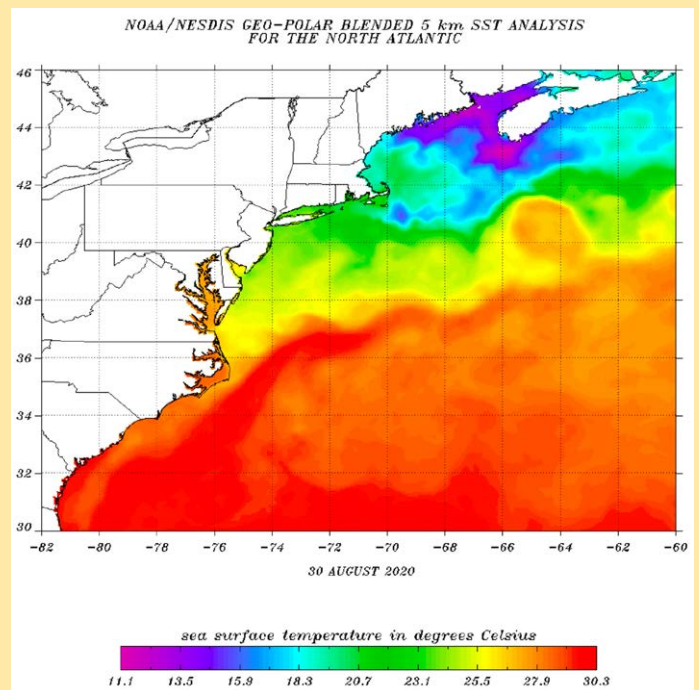
Source: The Well Marine Biological Laboratory

## NOAA GOES Image Viewer

NOAA maintains Geostationary Operational Environmental Satellites (GOES) which provide continuous monitoring of the earth’s weather systems. Currently GOES East and GOES West circle the earth in a geosynchronous orbit. They orbit the earth with an orbital period of 23 hours 56 minutes and 4 seconds matching the earth’s rotation. As a result they return to the same position in orbit after a period of one day. They send data to ground receiving stations every 30 minutes as the earth moves below. These images are visible at <https://www.star.nesdis.noaa.gov/goes/>

At this site you may view both the GOES East and GOES West satellites, and these are connected to many individual bands are visible from these satellites. The image to the right shows the sea surface temperatures of the North Atlantic on August 31 of this year. They show how warm these temperatures are this year.

There are many different bands that are collected by the satellite, and these are linked to the links on the left side of the Image Viewer Page. 🦑



## Water Quality Shows Signs of Decline in Buzzards Bay

Source: *The Well, Marine Biological Laboratory*

By Eve Zuckoff • Jun 29, 2020

Overdevelopment, climate change, and outdated wastewater infrastructure around Buzzards Bay have contributed to a decline in water quality, according to the Buzzards Bay Coalition.

Since 1992, the coalition has relied on volunteers and scientists at the Marine Biological Laboratory to collect water samples and measure the water's temperature, salinity, nitrogen levels, and more. Those factors are then combined, and water quality is measured on the [Bay Health Index](#), which scores harbors, coves, and rivers on a scale from 0-100, or from degraded to pristine. "Around Buzzards Bay, we actually have waters that span pretty much that whole spectrum," said Rachel Jakuba, science director at the coalition.

Overall, area waterways experienced slight declines in water quality in 2019. In fact, 16 percent were found in "poor" health, a rise from past years.

That classification reflects an increase in nitrogen pollution and a decrease in visibility, oxygen, and other markers that help plants and fish survive. But one important factor to explain the decline involves a testing condition. In July 2019, the coalition's volunteers collected water samples immediately after a rainstorm washed pollutants into the bay.

"Large rainfalls tend to wash nitrogen off of the landscape," Jakuba said. "So in that sampling ... we captured the increased nitrogen pollution that had run off into Buzzards Bay."

Across the region, nitrogen is primarily released into the environment through lawn fertilizers and outdated septic tanks that fail to prevent chemicals from seeping through the groundwater.

Now, nitrogen loading is only increasing, and one consequence will be more algae blooms that threaten the survival of fish, shellfish, and crucial bay plants like seagrass.

"So seagrass ... is a nursery ground for a lot of important recreational and commercial fish species," Jakuba said. "That is a rooted plant that requires sunlight penetrating in. If the waters have dense algae blooms and are murky, the sunlight can't get through to the plants and the plants can't get enough sunlight to photosynthesize and ... survive."

Also, climate change, Jakuba warned, will only make the problem worse.

"Heavy rainstorms are predicted to happen more frequently and of greater intensity as climate change happens," she said. "Events that drive a lot of nitrogen into the water at once are expected to happen more."

But she said people shouldn't be afraid to swim just yet. About 37 percent of the water in Buzzards Bay is considered "good," with healthy conditions for fish and shellfish and visibility greater than six feet. Another 47 percent of waterways are deemed "fair." 🌿



2014 West Falmouth algae | Buzzards Bay Coalition

# MARINE SCIENCE IN THE NEWS

## As Hurricane Laura raged, silent sentinels kept watch from below

Source: Woods Hole Oceanographic Institution

By [Evan Lubofsky](#) • August 28, 2020

Far below Hurricane Laura's fury in the churning Gulf of Mexico, an array of underwater instruments have been taking the temperature of the ocean to measure the water's heat content—a key factor that drives the intensity of hurricanes as they suck heat out of the ocean.

The instruments—known as [Argo floats](#)—measure water temperature and salinity as they bob from the Gulf's

surface to a depth of 2,000 meters and back up again. Earlier this week, Hurricane Laura traveled over a half-dozen of the floats as the storm zeroed in on the Texas and Louisiana coasts. Data from the floats are transmitted back to shore every five days, where they are fed into ocean models forecasters use to predict storm strength.

“The floats are like these silent sentinels down deep in the ocean that allow us to keep track of the heat content in the eastern Gulf of Mexico,” says [Amy Bower](#), a senior scientist at WHOI. “We use them for long-term monitoring throughout the year, so when storms like Laura pass through, we can get a profile of what the water conditions are.”

Bower, along with WHOI physical oceanographers Heather Furey, Steve Jayne, and Pelle Robbins, and researchers from the University of Rhode Island and the Center for Scientific Research and Higher Education at Ensenada, deployed more than 20 of the floats in the Gulf last year and expect to add four additional floats to the array this September.

[Karina Khazmutdinova](#), a program officer with the National Academy

of Science, Engineering, and Medicine (NASEM) which funded the instrument array, says one of the key goals of the program is to improve our understanding and predictions of the Loop Current, a massive river-like flow of warm water that moves northward from the Caribbean Sea into the Gulf of Mexico. According to an [NAS publication](#), the Loop Current is the dominant physical process in the Gulf waters and, as such, can impact everything from oil and gas operations to ecologically-based management of marine resources in the region. It can also have a very direct impact on hurricane development and intensity.

“When a tropical storm moves over warm Loop Current waters, it fuels the storm so it can become a hurricane,” says Khazmutdinova. She says that storms can also intensify when they travel over ring-shaped eddies that break off from the main current.

The ability to track ocean conditions ahead of tropical storms can be crucial for predicting storm intensity, but Bower says the floats also provide valuable information that she and other scientists can use in post-storm analysis.

“We can analyze the data after the fact to learn more about how eddies form and break off from the Loop Current, and use that data to create predictive models of what the current and eddies will do,” she says. “And then we can pump that information into hurricane forecasts to improve predictions there as well.”

This research is funded by the Gulf Research Program of the National Academies of Sciences, Engineering and Medicine.



Hurricane Laura travelling over the Gulf of Mexico on August 26, 2020 as it zeroes in on Texas and Louisiana.

(Image by NASA/ LANCE VIIRS, NetCDF file processing by Supportstorm)

## High School Science Discovery Program

Contributing Writers: Stephanie McPherson, Jean Enright

Igniting the flame of scientific curiosity is one of the Marine Biological Laboratory's greatest strengths, honed over a century of immersing students in its research discovery courses. In partnership with the University of Chicago's College of Admissions, MBL extended its educational and inspirational excellence into the high school realm beginning in late 2018.

The [MBL Secondary Education Program](#) shows high school students how to undertake real biological research projects, using cutting-edge techniques and equipment usually reserved for college or graduate students. The courses give the students a unique opportunity to experience hands-on research.

A team at MBL developed the High School Science Discovery Program with input from an advisory board of high-school teachers, to ensure the experience met curriculum expectations. The MBL piloted the program in December, 2018 with students from St. Anne's-Belfield School, a private, co-ed, K-12 school in Charlottesville, VA. The initial course was basically a greatest hits of what the MBL offers on the graduate level. In the spring of 2019, students from Phillips Exeter Academy (Exeter, N.H.), Hotchkiss School (Lakeville, Conn.), Tabor Academy (Marion, Mass.), and Winsor School (Boston, Mass) participated in the program. Over the course of a week, students were immersed in biological and ecological research. They used the gene-editing technology CRISPR-Cas9 to create albino frog tadpoles. They studied structural color in butterfly wings, imaged fly embryos on a confocal microscope and created 3D video reconstructions from image datasets.

The program evolved over 2019 by increasing the diversity of classes offered with a focused range of topics to give students the chance to specialize within their interest areas. The four courses that were developed are *Anatomy and Development of Marine Vertebrates and Invertebrates*, *Exploring Microbiomes of Marine Organisms with DNA Sequencing*, *Coral Reefs in a Changing World*, and *CRISPR/Cas9 Genome Editing of Aquatic & Marine Organisms*. A fifth course will be added for 2021, *Adaptation & Evolution in Aquatic Animals*. Students who have taken the courses have described their experience as unforgettable, impactful, and different from science experiences in their own school.

The MBL High School Science Discovery Program is a residential, intensive program open to public and private high schools who are able to bring a cohort of students to a course, along with teacher chaperones. Most of the courses are six days, except for the gene editing course which is a three-day program. For more information, visit <https://www.mbl.edu/education/secondary-school-programs/>

# MARINE BIOLOGICAL LABORATORY HIGH SCHOOL SCIENCE DISCOVERY PROGRAM

The Marine Biological Laboratory (MBL) in Woods Hole, Massachusetts has expanded its world-renowned education program to offer intensive, hands-on science courses for high school students. The week-long residential experience mirrors the institution's unique research-based tradition of training, allowing students to understand and directly experience the cutting-edge experiments of today's research laboratories. Based on conversations with teachers from across the United States, MBL has designed the courses to meet a need for hands-on laboratory experiences for an extended period of time.

## COURSE OFFERINGS

### **ANATOMY AND DEVELOPMENT OF MARINE VERTEBRATES AND INVERTEBRATES**

The course focuses on anatomy, development, and physiology of marine species. Lab work incorporates advanced microscopy and imaging techniques, including the opportunity to create time-lapse videos and 3D reconstructions, and explores animal husbandry and research. Students learn how major organ systems develop during embryogenesis, how scientists understand organ formation during normal development, and how errors in this process lead to birth defects.

### **EXPLORING MICROBIOMES OF MARINE ORGANISMS WITH DNA SEQUENCING**

Microbiome research is a new and significant aspect of biology and medicine. This course focuses on the microbial communities associated with marine model organisms. Students will be introduced to the fundamentals of microbiome science through a combination of lectures, group discussion, laboratory work—including state-of-the-art molecular techniques—and computer exercises.

### **CORAL REEFS IN A CHANGING WORLD**

This course explores coral reef ecosystems—from cell to reef. Students learn about the symbiotic relationship between coral and dinoflagellates, as well as life on a Woods Hole “coral reef,” through hands-on experiences with micro and macroscopic imaging techniques. Key principles of the biology and ecology of corals are covered. By course end, students can describe key Cnidarian characteristics, identify key threats to coral reef systems, and utilize different tools—from imaging to mapping—used in coral research.

### **CRISPR/CAS9 GENOME EDITING OF AQUATIC & MARINE ORGANISMS**

In this course students will learn how the revolutionary genome editing technology CRISPR/Cas9 works and will apply it in the lab to explore basic biological questions as well as the implications it has for improving human health. Genome editing will be used to understand zebrafish development, a key biomedical research species. Students will manipulate development genes to understand embryogenesis and organ formation and their connection to understanding human health and birth defects. The course will expose students to modern methods in microscopy. The ethical implications of genome editing will also be discussed.

### **ADAPTATION AND EVOLUTION IN AQUATIC ANIMALS**

In this course, students will use aquatic invertebrates and plankton to explore the fundamentals of evolutionary biology, including concepts of adaptation, fitness, genetic heritability, and epigenetic transgenerational inheritance. We will discuss the role of life history strategy—and organisms' abilities to change their life history strategy in response to environmental conditions—in determining fitness and allowing adaptation. Additionally, we learn how studying such traits and mechanisms in model organisms can actually help us to understand human biology, and how research in aquatic animals can lead to improvements in human health. Laboratory studies will use an aquatic invertebrate animal, the rotifer, and explore examples from a variety of other marine animals. Laboratory techniques used will include microscopy, culturing phytoplankton and zooplankton, analysis of behavior, basic molecular biology, and data analysis.



“As much as I learned about the biology, the real take-away from this program for me was what it’s like to work as a scientist in a lab and seeing such a large range of work that I could end up doing.”



In the “Coral Reefs in a Changing World” course, students learn about life on a Woods Hole reef.



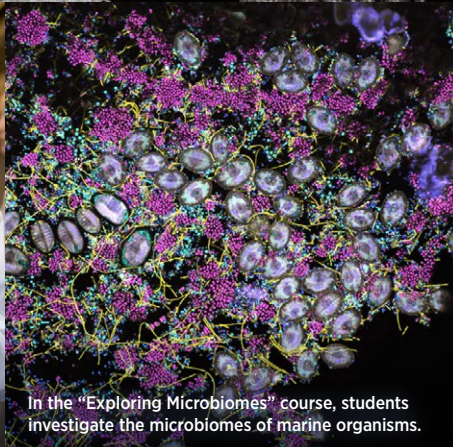
A student collects specimens from Eel Pond, Woods Hole.



All MBL high school courses incorporate cutting-edge microscopy and computer image analysis.



Marine and aquatic species serve as living windows through which students can view basic processes common to all forms of life, including humans.



In the “Exploring Microbiomes” course, students investigate the microbiomes of marine organisms.



Students apply the latest genome editing tool, CRISPR-Cas9, to learn how animal research directly translates into improvements in human health.

**\$2,500 tuition per student (includes room and board)**  
**[mbl.edu/education/secondary-school-programs](http://mbl.edu/education/secondary-school-programs)**

**ABOUT THE MARINE BIOLOGICAL LABORATORY**

Since its founding in 1888, the MBL has drawn the world’s greatest minds in science to Cape Cod to carry out some of their most creative and far-reaching work. Fifty-eight scientists affiliated with the MBL have been recognized with Nobel Prizes.

The laboratory, affiliated with the University of Chicago, is dedicated to scientific discovery—exploring fundamental biology, understanding biodiversity and the environment, and informing the human condition through research and education.

**Marine Biological Laboratory** | **THE UNIVERSITY OF CHICAGO**

7 MBL Street, Woods Hole, MA 02543

Photo Credits: Mayra Sánchez García, Tom Kleindinst, Dee Sullivan, Jessica Mark Welch



### Ocean Exploration

This is a 12 page pdf that introduces students to exploring our oceans. It includes links to various Ocean Explorer materials, a student handout, and a teacher answer key.

### Individual Species in the Deep Ocean

This is a 22 page pdf that presents organisms living in the deep ocean and on the bottom. It includes four lesson plans, student handouts as needed, extensions, and background materials.

## EDUCATION

*Educators, students, and curious people everywhere — come explore the ocean and atmosphere.*

The National Oceanic and Atmospheric Administration (NOAA) provides a tremendous amount of material which you can adapt for use in your classes. Lesson Plans developed by scientists and educators in conjunction with many expeditions are geared for students in grades 5-12. Each lesson plan corresponds with a specific exploration. Images and video captured on the expedition are available resources for educational use.

#### Lessons include

- Focus Question
- Learning Objectives
- Teaching Time
- Seating Arrangements
- Background Information
- Step by Step Procedures
- Assessments
- Extensions and Resources
- Student Handouts

All lesson plans prepared since 2006

also support Ocean Literacy Essential Principles and Fundamental Concepts. Some also support the Next Generation Science Standards.

#### Lesson Plans

**(In each case click on the link to download the pdf to your browser download folder)**

#### [A Bioluminescent Gallery PDF](#)

22 page pdf grades 5-6

#### [To Explore Strange New Worlds](#)

28 page pdf grades 7-8 (Adapt up or down with adaptations supplied)

#### [Mapping the Deep Ocean Floor](#)

12 page pdf grades 7-8

#### [Calling all Explorers](#)

10 page pdf grades 9-12

#### [Sea Level Rise](#)

On Line Module; 5 pages  
Grades 6-8 and grades 9-12

#### [Currents](#)

This is a link to a Currents Tutorial containing several lessons as well as a Reference and Roadmap to Resources section. Each lesson is short and can be used for various grades.

#### [Corals](#)

This link is to a Corals Tutorial with several lessons. Lessons are short and can be adapted for various grade levels. It also contains a reference and Roadmap to Resources section.

# 2020 Marine Art Contest Winners

*As is our policy, we do not list last names for elementary and middle school students.*

## SCIENTIFIC ILLUSTRATION

- 1 Naked Sea Butterflies by Grace Li, gr. 10, Newton North HS
- 2 Two Octopi by DanLi Lin, gr. 9, Luckie Art Studio, Lexington
- 3 Ocean Sunfish and Lion's Mane Jellies by Ella Hou, gr. 9, Newton South HS

## COMPUTER GRAPHICS

- 1 Atlantic White-Sided Dolphin by Ariana Clark, gr. 11, Cohasset HS
- 2 Ocean Sunfish and Diver by Sophia Shin, gr. 8, William Diamond MS, Lexington
- 3 Lion's Mane Jellies by Caytlin Yii, gr. 10, Mr. Gao Art Studio, Boston

## HIGH SCHOOL (grades 9-12)

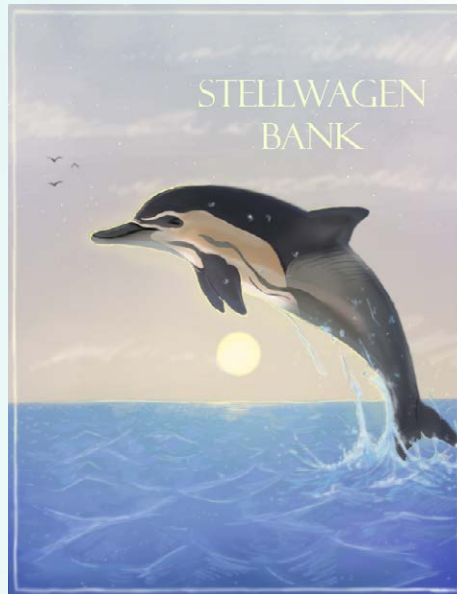
- 1 Gray Seal by Dylan Kostovick, gr. 12, Cape Cod Academy
- 2 Atlantic Octopus by Darsh Patel, gr. 9, The Davidson Academy of Nevada, Reno
- 3 Blue Whale and Krill by Queena Wu, gr. 11, North Quincy HS

## MIDDLE SCHOOL (grades 5-8)

- 1 Basket Star by Jasmine, gr. 6, The Meadowbrook School, Weston
- 2 Common Dolphins by Bohdan, gr. 6, Viz Art School, Northborough
- 3 Red-Necked Phalaropes by Ellie, gr. 7, Luckie Art Studio, Lexington

## ELEMENTARY SCHOOL (grades K-4)

- 1 Sea Angel and Sea Butterfly by Kenzie, gr. 4, Lincoln, RI
- 2 Humpbacks and Diver by Alyssa, gr. 4, Bridge ES, Lexington
- 3 Green Sea Turtle by Grace, gr. 4, LiMao Art Studio, Houston, TX



Atlantic White-Sided Dolphin by Ariana Clark (top left)

Naked Sea Butterflies by Grace Li (top right)

Gray Seal by Dylan Kostovick (left)



Sea Angel and Sea Butterfly by Kenzie (right)



Basket Star by Jasmine (left)

# MME Anti-Racism Statement

We stand with our partner organizations in science education to put an end to racism and to support actions that will ensure equitable access to learning. We feel anger, shock and sorrow for the families of George Floyd, Breonna Taylor, Ahmaud Arbery and countless other Black people, Indigenous people, and people of color who have been senselessly murdered, injured or harassed, often at the hands of law enforcement. This has gone on for far too long, and it is time for real change. Black lives matter.

MME, along with the National Marine Educators Association and all of its chapters, is committed to antiracist science education. We know that racism is ingrained in many of the policies and practices of our government, institutions, schools, and cultural organizations. We must do whatever we can to identify, confront, and change these policies and practices to just and equitable ones.

We ask that you, our members and friends, join us in pledging to:

- Identify racial prejudices within ourselves and our educational practices.
- Call out racism in our schools and learning environments.
- Create safe spaces for all students, especially Black students and students of color.
- Support one another in our quest for a more just and equitable world.
- Encourage and support minority students who are interested in careers in science
- Investigate ways to include Indigenous scientific knowledge into our teaching practices

As scientists and educators, we know that strong biological systems depend on diversity. Evolution drives our world toward beautiful complexity. We will strive to recognize and enshrine this diversity as an essential element of the human condition, and critical to our survival.

In peace and friendship,

MME Executive Committee



**Join MME  
Today!**

If you have not already renewed your membership, it is time to complete it. (In past years it was included in the registration fee for our annual meeting.)

New or renew, visit our website – [massachusettsmarineeducators.org/join](https://massachusettsmarineeducators.org/join)

