Flotsam & Jetsam

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The Next Generation of Science & Technology/Engineering Standards for Massachusetts

Sandra Ryack-Bell

Sandra Ryack-Bell is Executive Director of the Museum Institute for Teaching Science, a member of the MA NGSS Advisory Group and past chair of the MA DESE's Mathematics and Science Advisory Committee.

In April 2013 the Next Generation Science Standards (NGSS) (http://www.nextgenscience.org/) were released by the The National Research Council (NRC). Developed through a collaboration of NRC, the National Science Teachers Association, the American Association for the Advancement of Science, and Achieve, the NGSS are a set of K-12 learning standards that describe important scientific ideas and practices, and establish learning goals in science that will give all students the skills and knowledge they need to be informed citizens. Incorporated into the NGSS are three key components – disciplinary core ideas, scientific and engineering practices and crosscutting concepts. The NGSS are the keystone to educational reform of science and engineering in our schools – and provide a challenge for teachers to implement. To date 12 states and the District of Columbia have adopted the standards. There has been a great deal of speculation on whether or not Massachusetts was going to adopt the NGSS. In December 2013 the Massachusetts Department of Elementary and Secondary Education (DESE) released the draft revised Massachusetts Science and Technology Standards. http://www.doe.mass.edu/stem/standards/StandardsDraft.pdf. They are currently available for state-wide review but have not officially been adopted. They will hopefully be put forth for public comment in June and adopted before the end of 2015. Massachusetts is the only state to date that has developed an adaptation of the standards.

DESE has also published support documents to help schools begin the transition to the revised standards. These include strand maps that show learning progressions of the Disciplinary Core Ideas and Crosswalks that show the similarities and differences between the current and the draft revised Science and Technology/Engineering Standards. As science teachers, marine educators at all grade levels, both formal and informal, should familiarize themselves with the changes occurring in the standards. The new standards create a shift from content-based standards to ones that focus on investigative approaches to learning science with integrated content. These standards include preparation for post-secondary success, coherent

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Tentative 2015-2016 MME Calendar Check web site and F&J for details

September 9, 2015	MME Board Meeting	Stoughton High School
September 26, 2015	Boston Harbor Educators Conference	UMASS Boston
November 18, 2015	MME Board Meeting	New England Aquarium
January 13, 2016	MME Board Meeting	National Marine Life Ctr
March 2, 1016	MME Board Meeting	Location TBD
March 9, 2016	Metro Boston HS Marine Science Symposium	Tentative
March 16, 2016	North Shore HS Marine Science Symposium	Salem State
April 9, 2016	40th Anniversary WHOI Conference	Woods Hole
May 11, 2016	MME Board Meeting	Revere High School

How Can Informal Marine Science Institutions Impact Science Learning?

Sandra Ryack-Bell

Marine science centers, aquariums, science museums, nature centers and other institutions that offer marine science programs for schools are the perfect settings for supporting the implementation of the revised Massachusetts Science and Technology/Engineering Standards (MA STE) that are built upon the Next Generation Science Standards. These informal educational settings can provide experiences both rich in science content and inquiry (hands-on, minds-on) investigation. They can bring together scientists and engineers with students and teachers, providing a rich learning environment for everyone involved. They bring together researchers, educators, learners and community to foster real world STEM experiences and an understanding of the role science plays in our everyday lives. Many of their already established programs and resource materials for teachers and students are founded upon the principles underlying the revised standards.

The scientific and engineering practices embedded in both the NGSS and the MA Revised STE Standards - asking questions and defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, constructing explanations and designing solutions, engaging in argument from evidence and obtaining, evaluating, and communicating information - are the same scientific and engineering principles exhibits and programs are built upon. This learning model shifts instruction from memorization of facts, figures and formulas to an investigative approach that has students using evidence to construct explanations, develop models and design solutions just as scientists and engineers do in their daily work. Through exhibits and programs this type of learning is embedded quite naturally in visits to museums, aquariums, environmental centers and marine field centers whether they are schools trips or more casual visits such as family vacations or scout/youth programs. The disciplinary core ideas – Life Science, Earth and Space Science, Physical Science, Engineering and Technology – and the crosscutting concepts (patterns, cause and effect, scale, proportion and quantity, systems and system models, energy and matter, structure and function and stability and change) focus the K-12 curriculum. While not woven into the Massachusetts standards, these crosscutting concepts identified in the NGSS have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas. Together the crosscutting concepts and the disciplinary core ideas that provide the foundation for presenting the interdisciplinary aspects of science and engineering are already built into programs offered by these institutions. Programs — such as water quality monitoring; citizen science tracking sea turtles or waterfowl; student supported research looking at climate change indicators, the impact of oil spills, or the environmental quality of tidal marshes — and engineering projects such as building and deploying model underwater removed operated vehicles or oceanic drifters all immerse students in the science and engineering practices while providing this foundation. They provide data sets for students to work with, the opportunity to design experiments, the exposure to using or creating models, the experience of designing an investigation and the development of skills for communicating information.

The National Science Teachers' Association position statement on the NGSS states "K-12 science educators, including teachers and educators in both formal and informal settings are central to the successful implementation of the NGSS." This holds true for the MA STE standards as well. Long term systematic support through curriculum resources, professional development and real world experiences is key to achieving the goals of these educational standards. These resources can bring the real work of scientists into instructional materials and the excitement of the discoveries within our oceans into the classroom. They can share with students and teachers the innovation that takes place in developing underwater research equipment or engineering applications that allow us to use the resources from the ocean. This in turn provides great opportunities for marine educators to develop programs that support teacher and school districts with preparing their students for STEM college and career readiness. By developing and providing exciting minds-on, hands-on programs and real world experiences, informal institutions can help teachers and schools rebuild and revamp sciences programs as they seek enriching experiences for their students. This can be accomplished both by providing student programs and by providing professional development programs that help teachers change the way science is taught and learned.

(Informal - cont on page 4)

President's Message Summer 2015

This issue of F&J focuses on the forthcoming revised Science and Technology/Engineering Standards. These represent a significant systematic change in the way science and engineering will be taught in our schools, shifting to a more investigative approach that integrates practices and content across the disciplines. It also allows for collaborations between formal and informal educators which is already the backbone of many marine programs. I hope you will familiarize yourself with the exciting changes taking place and take the opportunity to be on the forefront of new and exciting partnerships we hope to see develop from the process.

The theme of the 2015 Woods Hole Conference and MME Annual Meeting was Marine Technology. It was an exciting event with the topic being very timely to the new standards. Attendees heard about life aboard Mission 31 and the missions of autonomous underwater vehicles. They also participated in field trips to research labs, an extended dock tour and a nautical piloting field trip to Nobska Light House. Our next event will be the Boston Harbor Educators Conference on September 26th. I hope you will join us for this event.

At the WHOI conference 3 longtime, dedicated Board members stepped down from the MME Board. Carolyn Shield has tirelessly chaired the MME Annual Meeting for the past 2 years, providing us with exciting programs each year. I want to thank her for organizing these conferences and wish her the best of luck as she moves on to new endeavors. Bill Andrake stepped off the Board following his numerous years as President-Elect, President, and Past President but can't seem to stay away since he joined us for the May Board meeting. We highly value the leadership Bill has given to the organization and thank him for his years of service on the Board. However the hardest departure from the Board for me has been that of Gail Brookings. In many ways Gail is the face of MME – she has served as the treasurer for over 15 years and has kept all of the financial records for us. When I first joined MME in 1984, Gail fast became a close friend and mentor. While we know she is not going far I will certainly miss her leadership and presence on the Board.

It seems fitting that I should be stepping into the MME presidency this year as the NMEA conference returns to Rhode Island. The last time the conference took place in RI in 1987, I served as the conference chair. The conference was hosted by the Northeast Marine Education Council, a regional collaboration of the MME, SENEME, GOMEA, NYSMEA, and NJMEA. NEMEC no longer exists, but at the time this regional group provided a networking opportunity and support for marine educators through New England, NY and NJ. It was a great conference and I am excited to attend this year's conference in Newport which is being hosted by SENEME. I hope you will all take the opportunity to attend the national conference, June 28–July 2nd. It will be a great opportunity to explore the marine resources of our neighboring state and network with marine educators from across the country. Information on the conference may be found at http://www.marine-ed.org/.

Finally I want to thank Erin Hobbs for her guidance as President these past two years. I am excited to have her pass the belaying pin on to me and to continue the work she has begun. Erin was charged with guiding the implementation of MME's strategic plan which included increasing our membership, improving our marketing and communications, revitalizing our events and programs and bringing fiscally sound management to the organization. She has made great strides in all these areas and I look forward to working with her to continue the progress.

Have a great summer and I hope to see you in Newport!

Sandi Ryack-Bell
President, MME

(Informal - cont from page 3)

Teachers need to experience this first hand and these institutions are uniquely positioned to offer these opportunities. So it is important that informal educators familiarize themselves with the revised Massachusetts Science and Technology/Engineering Standards and the accompanying documents and incorporate them into their programs for K-12 students and professional development programs for teachers. Definitions of the cross cutting concepts can be found in the Next Generation Science Standards Framework, http://nstahosted.org/pdfs/ngss/MatrixOfCrosscuttingConcepts.pdf. By making the effort to show how your programs address the standards you will be identifying your organization as an invaluable resource for the long-term systematic shift in the way science learning takes place in our schools.

39th Annual MME Conference and Meeting

Carolyn Sheild, MME Conference Chair

The 39th MME Annual Conference and Meeting was again held in Woods Hole, on May 2, 2015. This year's theme was "Adventures with Marine Technology." Attendees enjoyed listening to stimulating speakers, and many took part in enriching afternoon options.

Dr. James Yoder, the Vice President for Academic Programs and Dean at Woods Hole Oceanographic Institution, welcomed us and gave a WHOI update. Our first speaker, software engineer Gwyneth Packard, spoke about "*REMUS AUV's*: Autonomy, Tracking, and Imaging." She described the range of autonomous underwater vehicles that have been used for a variety of challenging tasks and missions, from examining underwater tunnels to finding plane wreckage on the sea floor. To better understand shark behavior, the REMUS SharkCam has been deployed on several occasions. The footage was fascinating, especially when a shark bit the vehicle tracking it! The use of AUV technology has improved our capacity to attain data and make new discoveries.

The second speaker, Liz Magee, gave an engaging talk entitled, "Two Weeks Living Under the Sea: Research and Daily Life on Mission 31." Liz, who is a Diving Safety Officer at Northeastern University, was an aquanaut who participated on Mission 31 last June with Fabien Cousteau. She spoke about the research scientific divers conducted off the coast of Florida while living underwater in the Aquarius habitat. Being saturated gave divers the unique opportunity to collect two years worth of data in just a few weeks. Intriguing videos illustrated the many aspects of climate change being studied including sampling coral polyps and giant barrel sponges, and collecting zooplankton. Liz knows this adventure was a chance of a lifetime, and we were fortunate to have her share the experience with us.

After a delicious lunch of Chef Roland's Clam *chowdah* or Joe's bean soup, participants enjoyed receiving eclectic and sometimes useful door prizes. This year, instead of having an afternoon speaker, the MME Board decided to offer more afternoon field trips and tours. Attendees could choose from five options: the Zephyr cruise, a tour of the MBL Marine Resources Center, an extended WHOI dock tour, a piloting lesson at Nobska Light, or a self guided tour at WHOI's Ocean Science Exhibit Center. It was a beautiful day to be outside, and see more of what Woods Hole has to offer. Those who journeyed out on the water were pleased to be able to collect and examine a wide range of organisms. Dock tour participants were thrilled to get the opportunity to go aboard the *RV Knorr*, from which the *Titanic* was located and the *Atlantis*. The tour of the Marine Resources Center excited those interested in seeing a diverse array of organisms. Since the Exhibit Center had the "Shark Cam" on display, many attendees took a trip across the street to check out the bite marks! And the new Nobska piloting lesson challenged those who took part to use math and navigation skills while enjoying the scenery. The afternoon concluded with a relaxing social reception at the Sea Education Association campus.

Thanks to all who attended, and to all those who did so much to make this conference run so smoothly. Hope to see you next year!

From the Editors Desk

Another busy school year is becoming history. What with massive snow piles, no school days, new testing and NGSS looming in the future, this has been anything but a normal school year. MME offered three excellent programs this year, the Boston Harbor Conference, the High School Marine Science Symposium in a new location, and our 39th Annual Woods Hole Conference. Your MME Board and many additional volunteers have spent hours making sure that these events were a success.

After the annual meeting, the MME Board has reorganized with its new officers and board members. Thank you to the outgoing board members, Bill, Gail, and Carolyn for many years of work for the membership. Special thanks to Erin Hobbs who has completed her two year term as president, and now becomes the MME representative to the National Marine Education Association (NMEA).

Speaking of NMEA I would be remiss if I did not mention the 2015 Conference in downtown Newport RI. NMEA 2015 is being hosted by the Southeastern New England Marine Educators (SENEME). The conference will be held June 29 through July 2 at the Newport Marriott, right in the middle of downtown Newport. Sessions and plenaries will include speakers that draw from around New England and beyond through our rich connection to the sea. An impressive variety of field trips have been planned. Complete details are found at http://www.marine-ed.org/general/custom.asp?page=NMEA_2015 It is also important to remind you that our Executive Director, Bob Rocha will take the reins as NMEA President at this conference. Whether for the full conference or a day, plan to attend this exciting event.

Recently, I found one of the most spectacular sets of photos from the *Tara* Oceans expedition, of plankton discoveries that were released on May 22, 2015. These come from a multinational team of researchers who spent three and a half years sampling the ocean's sunlit upper layers aboard the schooner Tara unveil the first officially reported global analyses of the Tara Oceans consortium. They are available at http://mashable.com/2015/05/22/scientists-find-new-ocean-species/

Just a quick reminder to those of you who were unable to join us at Woods Hole in May. Your MME membership has expired. Click on this link

I will finish my column with a wish that all have a restful and relaxing summer. See you again in the fall.

Howard Dimmick
Editor ***F&J***

French Tall Ship Hermione

VIRGINIA CAPES (June 2, 2015) The Arleigh Burke-class guided-missile destroyer USS Mitscher (DDG 57), right, provides a warm welcome to the French tall ship replica the Hermione in the vicinity of the Battle of Virginia Capes off the east coast of the United States. The original Hermione brought French General Marquis de Lafayette to America in 1780 to inform General Washington that a French army was headed for the United States to assist in the war effort.. The symbolic return of the Hermione will pay homage to Lafayette and the Franco-American alliance that brought victory at the Battle of Yorktown in 1781. During the Hermione Voyage she will visit Yorktown, Va June 5 and then continue up the east coast visiting cities of Franco-American historical significance. (U.S. Navy photo by Mass Communication Specialist 1st Class Michael Sandberg/Released).

(Standards - cont from page 1)
progressions of learning (practices and concepts), integrations of practices with concepts and preK-8 integrated, grade by grade standards.

As with the NGSS, the MA revise standards include:

Science and Engineering Practices:

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Disciplinary core ideas

Life Science
Earth and Space Science
Physical Science
Engineering and Technology.

The overarching goal of the MA Revised STE Standards is to ensure that by the end of 12th grade, *all* students have some appreciation of the beauty and wonder of science; possess sufficient knowledge of science and engineering to engage in public discussions on related issues; are careful consumers of scientific and technological information related to their everyday lives; and are able to continue to learn about science outside school.

The standards are organized by grade level for K-8 and by introductory science/engineering courses for high school. For grades K-8 integrated instruction of all 4 disciplinary core ideas is encouraged and the science and engineering practices are embedded into the standards. At the high school level the standards maintain the current model of course choices, flexibility for different pathways and provide options that lead to student development of science and engineering practices by the end of 3 years of lab science. Progressions of the DCIs and practices occur from K-8 and through the high school standards. All of the grade levels include an engineering component.

Massachusetts was a lead state in the development of the NGSS and gave significant and on-going input into the process. However when the final document was released, the state level committees working to revise the standards felt the model did not completely fit the needs of Massachusetts. The chart below identifies the differences between the MA adaptation and the NGSS:

NGSS	MA Adaptation
4 dimensions	2 dimensions
Broadly written; inconsistent interpretation	Balances broad concepts with specificity to inform more consistent interpretation
MS grade span	MS grade-by-grade
Engineering design as occasional application of science	Technology/Engineering as a discipline
No CCR definition; all HS courses expected	Define CCR; maintain HS options

Other differences are that the MA Standards stand on their own without need for significant interpretation and include explicit links to math and ELA standards.

(Standards - cont on page 8)

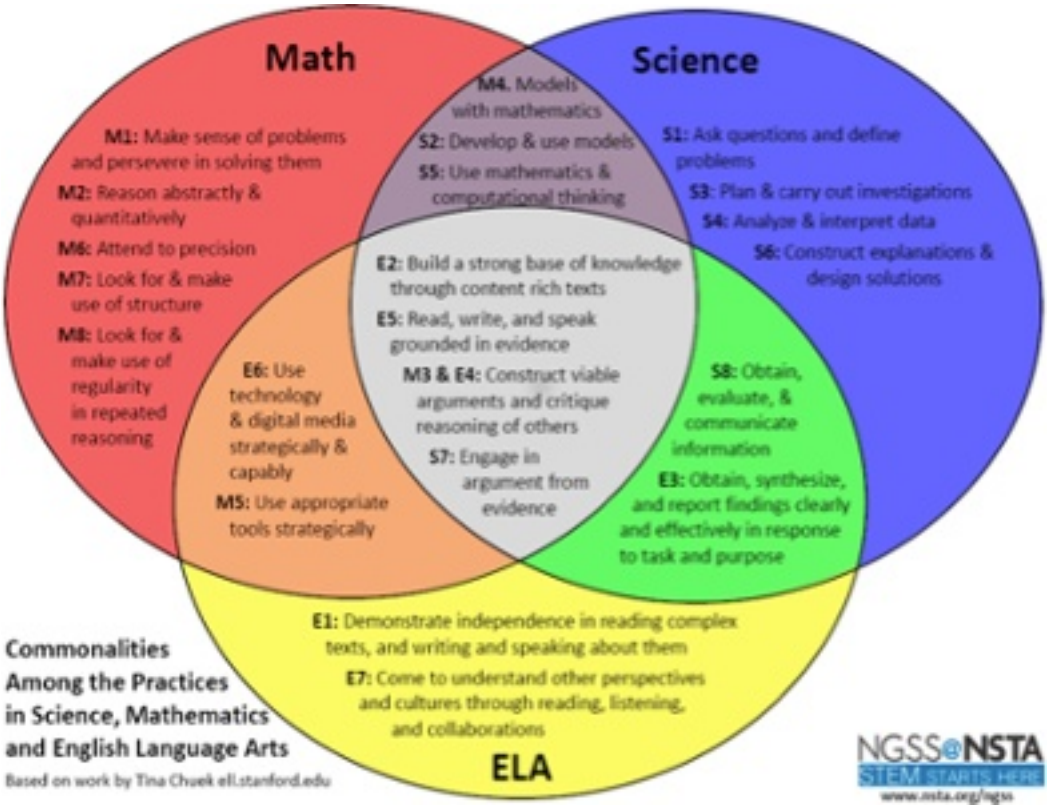
(Standards - cont from page 7)

The DCIs, science and engineering practices and the coding system are consistent with NGSS. This enables teachers and districts to find and use NGSS-aligned resources available from sources outside Massachusetts. However the construction of the standards differs. In the NGSS the standard and foundation boxes indicate what is to be learned. In the MA Revised Standards, the standard can stand alone. Foundation and connections boxes are included that further describe what is to be learned but they are not integral to understanding the intent of the standard. The boxes include the DCIs, Science and Engineering Practices, Connections to the Common Core and Articulation of the DCIs.

Adaptions of NGSS For Massachusetts Standards (MA DESE)

NGSS	MA Adaptation
Organized around core explanatory ideas	The goal of teaching needs to shift from facts to explaining phenomena
Central role for science and engineering practices	Inquiry- and design-based teaching is not a separate activity; all STE learning should involve engaging in practices to build & use knowledge
Coherence: ideas and practices build across time and between disciplines	Teaching involves building a coherent storyline across time

To bring about a more investigative approach to science learning, the revised standards incorporate shifts in the organization of the standard as well as shifts in curriculum and instruction.



Source: Brian Reiser, Northwestern University, 2013

The MA standards are also linked to the State Common Core Math and ELA Standards:

Once the revised standards are adopted by the MA Board of Education, DESE, and other key organizations in the state will be offering professional development to assist school districts and schools with transitioning to the new standards.

All of the documents – the Revised MA Science and Technology/Engineering Standards, the Crosswalks and the Strand Maps, can be access at mathsciencetech@doe.mass.edu.

MME Holds Third Annual North Shore High School Marine Science Symposium at Salem State University

Bill Andrake

For over thirty years the Massachusetts Marine Educators have held High School Marine Symposia, where high school students and their teachers have an opportunity to hear from speakers and participate in workshop sessions led by scientists, students, educators, and other professionals working in a variety of marine related disciplines.

In 2013, after many years of running a single event, MME expanded this program by holding two Symposia simultaneously, one on the South Shore of Boston at UMass Dartmouth, as well as an event on the North Shore. This year's North Shore High School Marine Science Symposium (NSHMSS) was held on March 18th at Salem State University in Salem, Mass.

The program began with a continental breakfast and welcome from the Salem State Administration and Faculty: Mary Dunn, Assistant Dean of Undergraduate Admissions; Ryan Risher, Biology Department Chair; and Steve Young, Assistant Professor of Geography. Students and teachers spent the next two hours in classrooms and labs for hands-on workshop sessions.

Each student had the opportunity to select and participate in two workshops from the fourteen offered on the program. The sessions engaged students in hands-on activities which covered a wide range of marine related topics. Students were able to explore relevant environmental issues by constructing computer maps of sea level rise as well as perform chemistry experiments to understand ocean acidification. Through squid and fish dissections, students learned about the fascinating biology of cephalopods and how to determine the age of a fish from its otoliths (ear stones). Techniques for exploring the deep were presented in sessions that mapped shipwrecks and engineered underwater vehicles. Students learned about important ecosystems such as coral reefs and the rocky intertidal and could even play detective as they pieced together the actual skeletons of marine mammals. The 28 workshop presenters included scientists, graduate students, educators, as well as other high school students who shared their projects in ocean stewardship.

Following the workshop sessions all participants gathered in Veteran's Memorial Hall for our keynote speaker Liz Magee who manages the Three Seas Program and diving operations at Northeastern University's Marine Science Center located in Nahant, Massachusetts. Liz told the story of her two weeks of living and working under the sea as an aquanaut in Fabien Cousteau's "Mission 31." She was a part of a team that conducted over one hundred hours of research in 63 feet of water inside and out of the Aquarius Reef Base off the Florida Keys. It was a fascinating adventure and inspirational story and we were so thankful to have Liz share it with all of us.

Following our keynote address the day concluded with a lunch for all the participants as another successful MME event came to a close.

(HSMSS - cont on page 10)

(HSMSS - cont from page 9)

This year's NSHSMSS was attended by over 150 students and their teachers. Our South Shore event at UMass Dartmouth did not happen this year, however we do plan to hold it in 2016. The High School Marine Science Symposia are events that MME is especially proud to continue to offer as we fulfill our mission which is *to support all educators to inspire students of all ages to be stewards of the ocean.* In addition this event may serve as a vehicle for addressing a "Key Focus Area" in the new Strategic Plan of the National Marine Educators Association to "Engage Youth Leaders."

More information about our presenters, workshops, and program can be seen by downloading our program:

http://ma-marine-ed.org/wp-content/uploads/2015/03/2015-program-final.pdf

For more about MME and other events visit our website: http://ma-marine-ed.org

Acknowledgements

It is not easy to get students out of the building and bring them to an event. It is a lot of work and responsibility that goes above and beyond the normal duties of a classroom educator. MME is very appreciative of the effort that the teachers made in order to bring their students to Salem State for the NSHSMSS.

MME would like to thank Salem State University for hosting us. Thanks to Ryan Fisher of the Biology Dept. who made sure that we had appropriate lab space for our workshops and a very special thank you to Geography Professor Stephen Young who handled all of the many logistics for us at Salem State.

Thank you to the sponsoring institutions and organizations, Northeastern University and the Massachusetts Division of Marine Fisheries, who also provided financial support for the event.

MME is grateful to the many presenters who were so generous with their time and also to their participating organizations:

- "Girls Inc." Lynn, MA
- Maritime Gloucester
- Massachusetts Audubon
- Massachusetts Board of Underwater Archaeological Resources and SEAMAHP
- Massachusetts Division of Marine Fisheries Age and Growth Lab
- M.I.T. Sea Grant
- New England Aquarium
- Northeastern University Marine Science Center in Nahant MA
- Salem Sound Coastwatch
- Seacoast Science Center in Rye NH

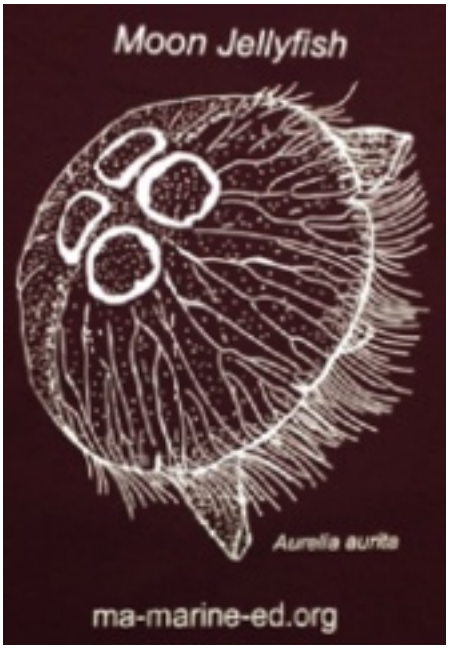
Thanks to our many volunteers from the rank and file of MME who organized the symposium and helped out the day of the event. A very special thank you goes out to MME Board Member, Carole McCauley, who chaired the event and her intern, Shannon Freyer (Northeastern University student), who devoted a tremendous amount of time, energy, and work toward making this event happen. Shannon did an amazing job!

MME Members in the News

MME Board member Elaine Brewer is the Chair Elect of the New England Ocean Science Education Collaborative (NEOSEC).

At its meeting in Chicago this spring, the National Earth Science Teachers Association (NESTA) presented to MME Board Member Howard Dimmick The Jan Woerner and Harold B. Stonehouse Lifetime Achievement Award. In recognition of his service to NESTA and his extraordinary contribution to Earth Science Education in New England and at the National Level over a distinguished career. He was presented with a plaque and NESTA Honorary Life Membership number 11.

DR. Michael Passow, NESTA President, Howard Dimmick, NESTA Treasurer and Dr. Roberta Johnson, NESTA Executive Director



MME T-Shirt

This year's MME t-shirt is the moon jelly *Aurelia aurita*. It is the first time we've had a t-shirt dedicated to a Cnidarian. The illustration depicts the medusa stage in the development of moon jelly which can reach over 1 foot in diameter.

It is very common along the coast of Massachusetts and found in waters around the world. *Aurelia aurita* may very well be the world's most recognizable Scyphozoan.

To learn more about the moon jelly a fact sheet from the Mystic Aquarium is available at: http://www.mysticaquarium.org/animals-and-exhibits/species-of-the-month/664-moonjelly

A teacher's guide and kit for teaching about jellies in the classroom is available in the Teacher's Resource Center of the New England Aquarium. To view a copy of the curriculum and materials list : http://www.neaq.org/documents/education_and_activities/teachers_resources/guides/jellies_trc_guide.pdf

Members interested in purchasing a moon jelly t-shirt should contact Bill Andrake at billandrake@hotmail.com.

Massachusetts Marine Educators
Boston Harbor Educators Conference

Sharks
and Other Keystone Species

Saturday, September 26th - 9:00 am - 4:00 pm
UMass Boston

Schedule
8:15-8:45 - Registration, Coffee/Pastries, Exhibits
8:45-9:00 - Welcome
9:00-9:45 - Speaker 1: Dr. Greg Skomal, Program Manager, Senior Marine Fisheries Biologist
9:45-10:00 - Coffee, Exhibits, etc.
10:00- 11:00- Education Workshops
11:15-12:00 - Speaker 2: John Mandelman, Research Scientist, New England Aquarium
12:00-12:30- Lunch & Exhibits
12:30-1:30 - Education Workshops
2:00-4:30- Boat Trip and Tidepooling on Lovell's Island

Education Workshops - TBD

Boat Trip to Lovell's Island
Join us aboard the Columbia Point for a brief boat ride followed by an exploration of the tide pools on Lovell's Island.

Registration
*Free Parking or MBTA reimbursement to the first 50 registrants.

To register for the conference:
https://massmarineeducators.wufoo.com/forms/z1m53dja0e04hlo/

- $50 for current MME members (includes lunch)
- $65 for non-MME members (includes lunch and half year membership to MME)
- $25 MME student rate (includes lunch)
- $35 non-MME student rate (includes lunch and half year membership to MME)
- $60 Walk-in registration MME member (includes lunch)
  $75 Walk-in registration non-MME member (includes lunch and half year membership)

For questions, please contact Conference Co-Chairs
Peg Collins [ccndpcllns@aol.com]

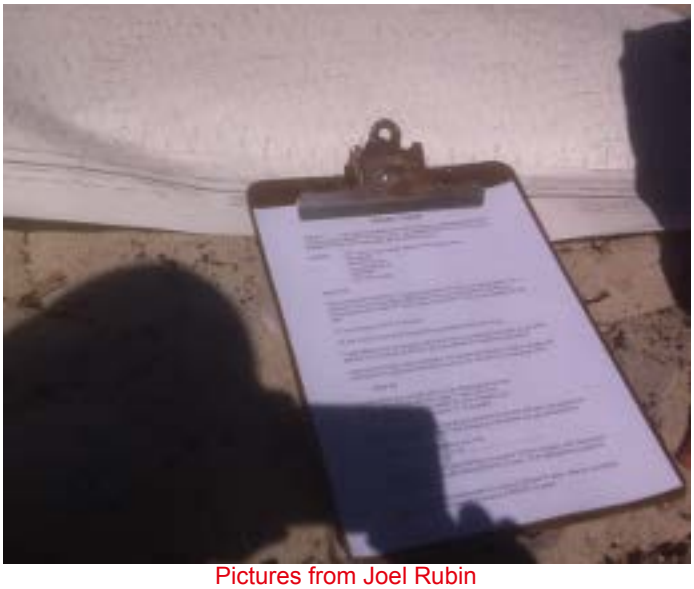
http://ma-marine-ed.org/

WHOI Conference Piloting Workshop

Joel Rubin (MME Board Member)

I participated in SEA's (Sea Education Association's) piloting workshop at this year's MME WHOI conference. SEA runs a sea semester and other tall ship programs and has its headquarters/campus in Woods Hole where we later gathered for the apres conference social.

Workshop participants rendezvoused after lunch at a beach off of Church St., where our 2 SEA instructors, Liz Maloney, Assistant to the Dean at SEA and Michelle Rossi, an Admissions Counselor at SEA and a SEA alum, had gathered materials (pencils, magnetic compasses, charts glued to pieces of scrap cardboard for easier drawing, pairs of drafting triangles and dividers) for us to use in the afternoon's activity.



Pictures from Joel Rubin

The workshop introduced piloting as something we do in daily life, finding our way using directions, landmarks, and maps.

At sea, charts are used. Charts differ from maps by emphasizing features of the sea, such as depth, underwater hazards that could wreck a ship, buoys, the shape of the coastline, and guides to navigation including coastal landmarks such as lighthouses.

We were guided to observe the green and red buoys marking the channel into Woods Hole Harbor: "red-right-returning." We were also oriented to early 19th century Nobska light at the other end of the beach.

Working in pairs, we first split into 2 groups: one half of the group had a refresher on using the compass (notably including the subtraction necessary to account for shift in "declination", the significant difference between the magnetic north read by our compasses and the north printed on the compass rose on our chart because of the wobble of Earth's magnetic field in the years since the chart was printed). The other half of the group learned how to slide 2 equilateral triangles against each other across a chart in order to transfer headings and bearings between the chart's compass rose and various buoys and lighthouses to figure out our location on the beach. By demonstration we learned to do this by sliding 1 triangle while keeping the other steady until, reaching the right location on the chart we could pencil a line through the landmark and parallel to its bearing taken from the compass and applied to the compass rose.

Pictures from Joel Rubin

Finally the challenge! Each team received a chart with a sheet giving a set of directions ("so many paces on a bearing of 96° then sight red buoy #4...") and places to fill in on the worksheet to show what latitude and longitude (°)degrees, (') minutes, (") seconds we had figured out for each location (based on compass bearings and pencil lines to landmarks that we had to locate on our copies of the chart, and the latitude and longitude markings on the chart margins).

The idea was to walk a certain number of paces to each of several "stations" along the beach. To know where and in which direction to go, we first had to figure out where we already were. We did this by sighting on 3 landmarks with our compass, making the appropriate subtraction for the shift in magnetic north (declination), then finding that bearing on the chart's compass rose and walking the triangles across our chart from the compass rose to the buoy or other landmark, and transferring that bearing with a pencil line from each landmark's position on the chart.

(Piloting - cont on page 14)

(Piloting - cont from page 13)

The effect of using 3 different landmarks to pin down the location of our position at each station was a series of lines from different spots on the chart angling in to (hopefully) small triangular areas on the chart somewhere within which our location was fixed. The reason these areas are triangular is that while it is easy to make 2 lines cross anywhere on a chart, it is not likely that all 3 lines drawn in this way will actually intersect because of all the possible sources of error. Such errors might include: matching a hand-held compass to a sighting of the landmark, reading the numbers off the compass, calculating the declination, finding the true bearing on the chart's compass rose, and walking the triangles across the paper to transfer that line to the parallel location elsewhere on the chart where it will pass through the landmark and help to define one's position. Each member of the team tried it to see that our lines agreed.

Pictures from Joel Ruben

Once we'd approximated our position in this way, we read the compass heading, number of paces to be walked, and set off for our next station. At each destination we spread our the divider needles and read off our latitude and longitude from the chart edge and wrote this into our worksheet. And so the groups went this way and that across the beach, eventually arriving at the foot of the lighthouse with charts now covered in lines triangulating our turning points and the paths we had taken to reach each station.

The activity was challenging, requiring declination to be calculated for every compass reading (and there were many). Judgement was required to determine what number the compass needle was pointing to. And, it was tricky to identify which object far out on the water we were looking for on our chart and vice versa, from our chart out to natural and constructed elements in our environment. It was a lovely, brisk and sunny spring day with a breeze that sometimes made the eyes water and challenged our ability to keep the chart flat to be drawn on. We enjoyed each others company and the beauty of the beach and of the conceptual puzzle we had been assigned. Our mastery of the chart gave a wonderful feeling of accomplishment and camaraderie. If you have the opportunity, I highly recommend this activity which could be enacted in playing field but is certainly very enjoyable by the sea.

Preview SFS Videoes

Calling all Teachers! The School for Field Studies (SFS), the leading environmental educational study abroad program for undergraduates, is seeking formal and informal educators to preview new educational materials. SFS has created 4 short videos that feature environmental research direct from our field stations in the Turks and Caicos Islands and the Amazon-Andres region of Peru. The videos show professors and undergraduate students conducting real research -- tagging sharks, laying a transect, collecting specimens – with real world implications. The videos spark discussion on the importance of research in solving environmental problems faced by communities around the world.

Please join us this summer at our head office at the Cummings Center in Beverly, MA to give us your thoughts and suggestions in a discussion based viewing session of the videos. Possible dates are July 27, July 28, August 4, or August 5 from 9am-12pm. Lunch will be provided. Please RSVP to Marta Brill, Institutional Advancement Manager, at mbrill@fieldstudies.org with dates you are available. We will notify all respondents with the final date. We look forward to sharing our unique and inspirational materials with you!

Marta Brill, Institutional Advancement Manager
The School for Field Studies

Check out SFS's blog: www.fieldstudies.org/blog

Classroom Activity

SECCHI DISK INVESTIGATION PLAN

Adapted for MITS 2009 Summer Institute from Global Ocean Survey, OceanQuest

Objective: Students will make a scaled-down model Secchi disk for measuring water clarity. Using their Secchi disks, students will compare the clarity of water in five containers. Students will also use the Forel-Ule color scale to assign a color number to each container.

Disciplinary Core Ideas: Physical Science, Life Science, Earth and Space Science

Subject areas: physical oceanography, physics, biology, limnology, math (measuring)

Science and Engineering Practices: Developing and Using Models, Analyzing and Interpreting Data; Constructing Explanations and Designing Solutions; Obtaining, Evaluating and Communicating Explanations

Skills: observing, measuring, predicting, comparing, group work, analysis

Materials

- (5) 1,000-mL or 500 mL graduated cylinders (OR clear, 1 Liter soda bottles)
- (1) 50 mL beaker
- water
- food coloring (green, yellow, blue, red)
- 2 Liter soda bottles for mixing
- Opaque, black material (inexpensive Halloween tablecloths or black garbage bags work well)
- Tape
- (1) Permanent marker for teacher labeling
- Student data collection sheets
- (5) thumbtacks
- (1) Forel-Ule Scale per group

BACKGROUND INFORMATION:

Turbidity: What Is Turbidity? Turbidity is the measure of suspended solids in water. Water with high turbidity will look cloudy or opaque. Turbidity indicates the clarity of water and water quality. The word comes from the Greek, and means confused, obscure, disordered or crowded.

People are becoming aware of the need for safe, clean pure water for drinking and other purposes. It is helpful to look at the ways we describe “good” water—both fresh and salt water.

What do we care about?

- Is there enough water?
- Is there too much water in places where we don’t want it?
- Does the water look, smell, or feel right for our uses?

We almost always seek clear, cool water. Sometimes water that does not look or smell clean is useful and safe for certain purposes. Water that is clear can typically be used for more purposes, such as drinking, than water that is muddied or cloudy.

Scientists who work in deep water may be challenged by water that is not clear and by dimness resulting from limits of penetration. Even with bright lights, visibility of a deep-water exploration site is limited where there is poor water quality. One indicator of water quality is clarity. Turbidity is a measurement of water’s clarity. What makes the water turbid is related to the total suspended particulate matter (SPM). The precise amount of turbidity is also a function of the type of suspended material found in the sample. For example the

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(Activity - cont from page 15)
same mass of very small particles may make the water very turbid in one sample while a few larger particles weighing the same amount will not be as turbid. There are various factors that affect water clarity and color; the most prevalent being suspended sediment or plankton. Measurements of seawater and Great Lakes clarity are made with a Secchi disk. This is a white disk, 20-30 cm in diameter on a long line that is marked incrementally. This is used as a standard for comparing clarity measurements. In the field, the disk is lowered from the side of the boat until it disappears from view in the water. It is slowly raised until it can just be seen again, and then the measurement is taken from the surface of the water to the end of the line with the disk on the depth of visibility.

Ocean Turbidity: Turbidity Currents: (Density Currents)
These are dense mixtures of sediment and water that flow rapidly down the continental slope.
Turbidity currents are mixtures of water and sediment particles. The turbidity currents are much denser than normal seawater. These currents move like avalanches along the ocean floor slope, transporting large amounts of sediment particles onto the deep-ocean floor. Earthquakes can cause turbidity currents. They are also triggered by large discharges of river-born sediment during floods. As turbidity currents move, they pick up particles of all sizes, eroding the bottom as they pass. The largest of the erosion particles settle out first. Later, as the flow decreases and slows, the current can transport only finer particles.

Forel Ule Scale
The scale is a standardized measurement tool used to determine and analyze water color. It is used in both limnology and oceanography. The vials are numbered (00-21) and the observer finds the closest match with the color of the water being analyzed. The colors correspond to open sea and lake water colors, as viewed from the shore or boat. Often in the field, Forel Ule Scales are used with the Secchi disk.

Teacher preparation

1. To mix water samples: Each sample must vary. Different brands of food coloring vary in intensity. You may need to experiment. Mixing large amounts (4 Liters per sample) is helpful in the long run. Mix each sample below and place in 2 Liter bottles. You can modify to have 2 samples at each station, depending on class/group size. Put the bottles up to the light to ensure that they are different. Number each sample and make a key that will identify the ocean region (listed below) with a number.

Samples: (try to match the colors to the Forel-Ule scale)
Estuary- muddy green (green, yellow)
Indian Ocean- muddy green (green , yellow, red)
Mid-Atlantic- blue green (green with a small amount of blue)
North Atlantic- green
South Pacific- blue

2. To make Secchi disks: (may be done with students or prepared ahead of time):
   a. Use (white) lids of gallon milk or spring water jugs or cut circles from white plastic lids to create 1.5” diameter white disks.
   b. Tack each disk to the end of a 30 cm wooden dowel.
   c. Calibrate each dowel consistently with 1 cm marks from the disk to the top end of the dowel.
   d. Note: Secchi disks used in ocean studies are not divided into quadrants of black and white, freshwater Secchi disks typically have this pattern.

3. Create 5 cylinders with outsides covered in tablecloth (tape) so that no light leaks in. The top is left open.

4. Before students arrive, set up 5 samples in cylinders at 5 stations around the room. For larger groups or larger sample size you can have multiple stations with the same samples. Label the cylinders 1-5. Fill each cylinder with one of the samples above about 1.5” from top.

(Activity - cont on page 17)

(Activity - cont from page 16)

With Students

1. Challenge students to think of other reasons why knowing the degree of turbidity for water would be important. Responses may include: using turbidity as a measure of drinking water quality, plankton density, or runoff from the shore. Information on the turbidity of water is collected over time to examine the health of a body of water.
2. Divide students into 5 groups. Each group receives a Secchi disks. Explain that real disks are 20 to 30 cm in diameter and instead of dowels have a line that may have marks or knots to measure depth.
3. Demonstrate the use of the disk. Lower the disk into the cylinder until the white can no longer be distinguished, and then raise the disk until the disk is just visible.
4. Remind students that they measuring the depth to which light can penetrate, not the depth of the cylinders. Have students take a practice round.
5. Students visit each of the 5 samples, measuring the marks from the surface of the water down to the disk. (Not from the top of the cylinder.) This number is recorded on the data sheet at each station.
6. At each station, students also check the water color (against the white backdrop of the Secchi disk and find the best match for that color using the Forel-Ule Scale.
7. Report findings as a whole class and refer to the key of colors. Discuss thoughts about why water may have different turbidity.
8. To conclude, discuss as a class how the Secchi disk aids the eye in judging water clarity.
9. Ask students why they think the outside of the cylinders were covered with black material. How is this similar to or different from water in the ocean or lake. Ask students to repeat their measurements and compare the Secchi data to their first attempt.

Adaptations

For younger students:

1. Point to the clarity of a lake or ocean varies greatly from place to place and season to season as well as distance from the shore. Challenge students to think of possible reasons why.
2. Students can make their own Secchi disk or another tool that uses calibrations like those on the Secchi disk. Compare and contrast the Secchi disk with other tools that students have learned to use.

For older students:

1. Have students show their findings visually using a bar graph. Students can estimate how many times clearer S. Pacific water looks than the estuary.
2. Ask students: does turbidity affect the depth to which algae can carry out photosynthesis? Is there a limit to how deep they can live? Provide sources for students researching additional questions they may have.
3. Introduce the Forle-Ule Scale. This is a color scale used with the Secchi disk to further qualify turbidity. Scientists collect this information to measure changes in turbidity over time in an area.

Additional Resources on Turbidity and Secchi disks:

Water on the Web, “Turbidity”, http://waterontheweb.org/under/waterquality/turbidity.html
Minnesota River Basin Data Center, “What is Turbidity”, http://mrbdc.mnsu.edu/mnbasin/wq/turbidity.html
EPA, “Monitoring and Assessing Water Quality”, http://www.epa.gov/volunteer/stream/vms55.html
Dip-In, “Make your own Secchi Disk,” http://dipin.kent.edu/makedisk.htm
Indiana Expeditions, “The Secchi Disk-A Classroom Simulation”, http://www.wfyi.org/indianaExpeditions/SecchiDisk.pdf

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(Activity - cont from page 17)

Secchi Disk Investigation Data Sheet

Group Number _____
Group Members_____

Procedure:

1. Hold up one beaker and describe that although most water looks perfectly clear in a beaker, there are many microscopic particles floating in fresh and salt water. The amount of sediment is measured in terms of turbidity. High turbidity can make it difficult to see under water. Even if water has very little turbidity, it is very dark deep under water because light does not pass very far through water. Scientists use a tool called a Secchi disk to measure how clear water is before they decide how to survey underwater objects (sunken ships, deep water habitats).
2. Each group receives a model Secchi Disk, Forel-Ule Scale and Data Sheet
3. Start at one of the 5 stations. At each of the 5 Stations do the following:

4 Lower the disk horizontally into the water sample until it is no longer visible. Then, raise the disk until it is just visible.

5. Count the marks down from the top of the dowel to the surface of the water. Record this number on your data sheet. Please note: you are not measuring the depth of the water. You are measuring the depth to which light can penetrate the water sample
6. Find the best match on the Forel-Ule Scale. Record on data sheet.
7. Report findings as a whole class and refer to the key of colors. Discuss thoughts about why water may have different turbidity.
8. Discuss the questions below with your group and write an answer on the back of this page for each.

After visiting all 5 stations, rank them in order of clearest to least clear:

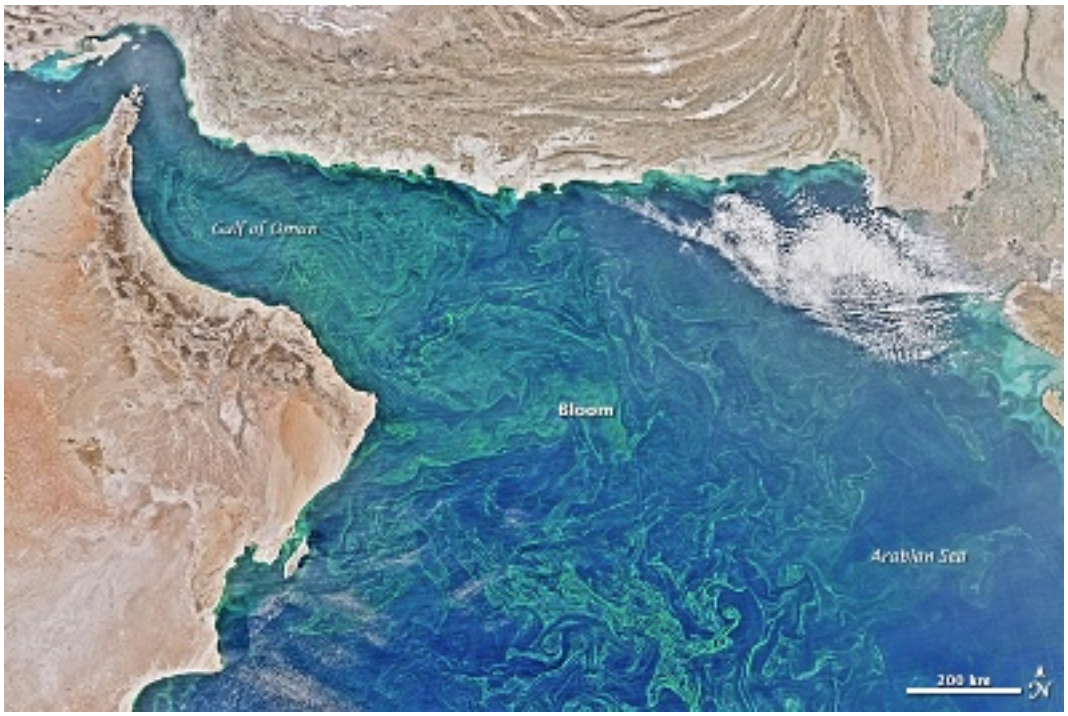
_____

Data Sheet

Station	Match on the Forel-Ule Scale	Depth
A		
B		
C		
D		
E		

1. Why is turbidity important?
2. Why might the colors vary?
3. What questions might a Secchi Disk help you to answer?
4. Why were the outsides of the cylinders covered with black material?
5. What does this investigation show about how turbidity works in the global oceans? How is this model different than the global ocean?

Winter Phytoplankton Blooms



Acquired February 14, 2015 download large image (6 MB, JPEG, 7355x6376)

Winter is the prime season to see filaments of phytoplankton twist and curl amid the Arabian Sea. On February 14, 2015, the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite acquired this image of the region's winter blooms.

Why winter? It turns out that in this part of the world, seasonal wind patterns have a large effect on blooms. The winter monsoon brings a reversal of wind direction—from southwesterly to northeasterly—which stirs up nutrients that help phytoplankton thrive.

Not all phytoplankton are the same, however, and research has shown that the composition of the communities in the Arabian Sea has shifted. A study published in 2008 reported that an unusual abundance of *Noctiluca scintillans* (also called *Nocticula miliaris*) has started showing up in winter blooms over the last decade. The newcomers have replaced the populations of diatoms that previously prevailed.

Research published in 2014 confirmed that the outbreak of *N. scintillans* in the Arabian Sea is due to an unprecedented amount of oxygen-deficient water near the sea's surface. The exact reason for the influx is still under investigation. What is apparent, however, is that *N. scintillans* is better equipped to handle the low-oxygen environment.

The shift could have implications for the food web of the Arabian Sea. In the past, fish ate the copepods that fed on the plentiful diatoms. In contrast to the diatoms, *N. scintillans* appears to be too large for consumption by copepods and instead feed creatures like jellies and salps. How this disruption to the traditional food chain will impact regional fisheries remains to be seen.

References

Gomes, H. do R. et al. (2014, September 9) Massive outbreaks of *Noctiluca scintillans* blooms in the Arabian Sea due to spread of hypoxia. *Nature Communications*, 5 (4862).

Gomes, H. do R. et al. (2008, June) Blooms of Noctiluca miliaris in the Arabian Sea—An in situ and satellite study. *Deep Sea Research Part 1: Oceanographic Research Papers*, 55 (6), 751-765.

NASA Earth Observatory (2010, March 8) Phytoplankton Bloom in the Arabian Sea. Accessed April 17, 2015.

NASA image by Norman Kuring, NASA's Ocean Color web. Caption by Kathryn Hansen.
Instrument(s): Aqua - MODIS

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