ALL HANDS ON DECK

2018 National Ocean Exploration Forum

8-10 November 2018
MIT Media Lab

ALL HANDS ON DECK

mit media lab

NOAA

open ocean

2018 National Ocean Exploration Forum

INTRO

PLAY

IMAGINE

IMMERSE

EXPERIENCES

CREATE

EXPLORE

CONNECT

OUTRO

INTRODUCTION

Why do we need *All Hands on Deck?*

We need EVERYONE on earth to understand the importance of the ocean to their daily lives.

The goal of the 2018 National Ocean Exploration Forum is to imagine creative new ways to make the ocean so pervasive in modern culture that everyone has a positive association with and understanding of the sea. We brought together leaders in ocean exploration, industry, entertainment, recreation, art, and design to empower an open, inclusive global community of ocean explorers. We sought participants who are passionate about ocean exploration, and who exemplify diversity with regard to gender, culture, socioeconomics, geography, and domain knowledge. We believe in the power of diversity to bring different viewpoints to the table in order to creatively reach new audiences about the importance of the ocean and exploration.

The ocean is critical to life on Earth, providing oxygen, food, energy, recreation, and so much more. And yet, we have barely explored a fraction of the ocean. Only 15% of the seafloor has been mapped by modern methods, and perhaps 5% has ever been seen by human eyes. Despite the ocean's relevance to humankind, too few people have an elementary knowledge of the role that the ocean plays in making our planet habitable. Our limited understanding stems largely from the challenges associated with traditional exploration of the ocean and its natural resources. With a growing global population and ever increasing anthropogenic pressures on Earth, the time for a bold, exciting initiative to explore, understand, and share the full depths of the oceans is now.

Too often, the ocean is a medium for raising alarms about pollution, climate change, overfishing, and other stories of doom and gloom, issues that are alienating and tend to resonate with sectors of society that already know and care about these challenges.

In contrast, ocean exploration has the potential to capture the imagination of the public; it is exciting and has the capacity to turn the spotlight of public awareness to the importance of the sea to humankind.

"The ocean is critical to life on earth, providing oxygen, food, energy, recreation, and so much more. And yet, we have barely explored a fraction of the ocean."

Our Values

We are positive and optimistic. We want to leave the world better than we found it, and we believe that together, we can.

We are open and inclusive. Oceanography is traditionally white and male. It has historically been a field of affluent western countries. But now, we are at a critical time when we truly need everyone on this planet to contribute to the exploration of our ocean so that we can understand what lies at the depths of the sea.

We are creative and collaborative. Oceanography is inherently multidisciplinary, but we need to go further than biology, geology, physics, chemistry, and engineering. We will bring together oceanographers with artists, designers, and storytellers to create new ways for people to experience, share, and enjoy the ocean.

We are community-driven. We aim to create a welcoming and inclusive space that will allow us to build a new community of explorers. We strive for co-creation, and seek to amplify the work of people who are already pushing the boundaries of exploration in their local communities.

We are explorers. We are curious. We are prepared. We are resilient. We push boundaries. We go to places that have never been visited. We learn new things about the world. We do things that have never been done. And, we do all of this for people and for the planet.

NATIONAL OCEAN EXPLORATION COMMUNITY

In 2009, Congress passed legislation that formalized the National Oceanic and Atmospheric Administration's (NOAA's) ocean exploration responsibilities to hold periodic national meetings to "establish an ocean exploration forum to encourage partnerships and promote communications among experts and other stakeholders in order to enhance the scientific and technical expertise and relevance of the national program." Since 2013, six National Forums on Ocean Exploration have been held, hosted by community members around the United States.

The first forum, *Ocean Exploration 2020: A National Forum*, was co-hosted by NOAA and the Aquarium of the Pacific. The event brought together ocean exploration stakeholders to discuss what our nation's ocean exploration program should be and a strategy for getting there. The event concluded by encouraging members of the public to come to the Aquarium of the Pacific for a day celebrating ocean exploration.

In 2014 and 2015, the National Aquarium hosted forums focused on the connections among Ocean Exploration 2020 recommendations, ocean exploration results, and NOAA mission requirements as an environmental information services agency. *Characterizing the Unknown 2015* focused on establishing a formal, dedicated national strategy and program of ocean exploration as called for in the statute authorizing NOAA's ocean exploration program.

In 2016 and 2017, the focus of the forums turned toward exploration technologies. The Rockefeller University hosted *Beyond the Ships* in 2016, focusing on the tools and technologies needed to propel deep-sea exploration forward in the next decade. The following year, the University of California San Diego hosted *Ocean Exploration in a Sea of Data*, bringing together the data science and ocean exploration communities to develop recommendations for how we can collaborate to expand traditional concepts of ocean exploration to drive toward new discoveries, provide greater access to data, and better engage the public.

On November 8 -10, 2018, the MIT Media Lab Open Ocean Initiative hosted the sixth National Ocean Exploration Forum, *All Hands on Deck*. Our goal was to convene leaders and changemakers to imagine creative new ways to make the ocean so pervasive in modern culture that everyone has a positive association with and understanding of the sea. Through panel discussions, demos, and workshops, we consider how to link people with the ocean and each other through play, imagination, immersion, creativity, exploration, and connections.

"This is all about building and growing the ocean exploration community."
-- Alan Leonardi

Antaeus Nekton | The Deep

EVENT SUMMARY

All Hands on Deck was a 3-day event focused on broadening engagement and participation in ocean exploration. The first two days were held at the MIT Media Lab and included a combination of speakers, panel discussions, and hands-on workshops and demos for invited participants. The third day included free, public activities at the New England Aquarium. Throughout the course of the forum, we addressed the following themes:

- **PLAY -** *Sparking curiosity in the ocean through playful learning*
- ***IMAGINE*** **-** *Imagining a bright, optimistic future for the ocean*
- ***IMMERSE*** **-** *Bringing people to the ocean and the ocean to the people*
- ***CREATE*** **-** *Engaging the heart and mind through the arts*
- ***EXPLORE*** **-** *Empowering a global community of ocean explorers*
- ***CONNECT*** **-** *Connecting people to the ocean and to each other*

Given the goals of *All Hands on Deck,* we wanted a broad cross-section of people to participate in this event. Previous forums had generally been invitation-only and resulted in a small, homogeneous cohort of people who attended each of the past events. We knew that change would not happen accidentally, and that we had to be intentional about it. We put a lot of thought into how we would select participants, speakers, workshop leaders, as well as to engage everyone during the event itself.

We therefore made six major changes to this forum:

1. **Open application process.** An open application was posted online and advertised on social media. 305 people applied from 35 countries and 37 US states.
2. **Ocean Discovery Fellows.** We committed funds to making travel assistance available to those who otherwise would not be able to participate. 145 of the forum applicants also indicated financial need and requested consideration for a travel fellowship.
3. **Caregivers.** We invited people with young children to bring caregivers with them so that parents could participate in all activities, eliminating the barrier of caregiving for children.
4. **Public Accessibility.** We wanted to make as many of the activities as possible open to the public. We live streamed all plenary sessions, held one of the workshops concurrently online, and hosted free activities to the public at the New England Aquarium for one day.
5. **Representation Matters.** We recognize that who we put on stage matters for demonstrating openness and inclusion. 56% of the speakers and/or panel moderators on stage were female, and approximately 35% were non-white.
6. **Mens et Manus.** MIT's motto is "mind and hand." In addition to speakers and panel discussions, we dedicated a significant amount of time to hands-on activities, such as demos and workshops, to reinforce exploration and learning during this event.

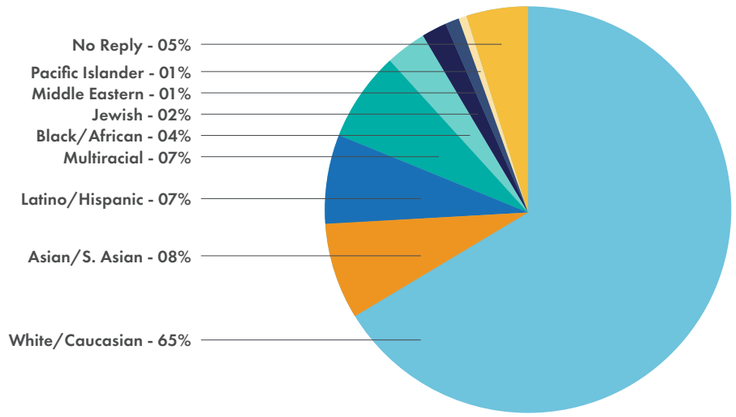
Our hope is that these changes not only made a difference at *All Hands on Deck,* but will also be brought forward to future forums so that we can bring a broader choir of voices together to address future challenges and opportunities in ocean exploration.

PARTICIPANTS

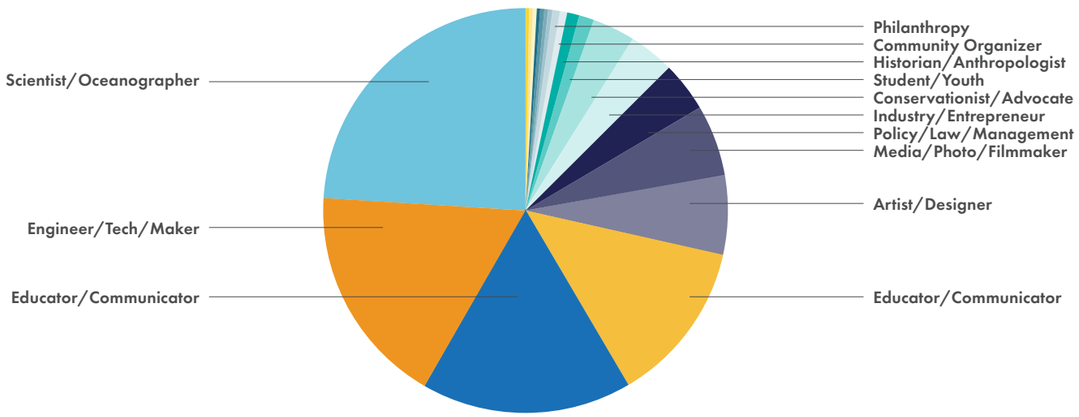
All Hands on Deck convened the most diverse group of people at a National Ocean Exploration Forum to date.

A total of 370 people registered, including applicants, invitees, and caregivers, from 22 countries and 29 US states, as well as a broad cross-section of expertise, ranging from scientists and oceanographers, to comedian paleoanthropologist television presenters, and everything in between. Forty Ocean Discovery Fellows were supported through travel assistance, representing 11 US states, Puerto Rico, and 17 countries around the world. The livestream also attracted 488 viewers, more than doubling the total number of participants in the event. Finally, more than 500 people attended events at the New England Aquarium Simons IMAX Theater for Boston Ocean Day.

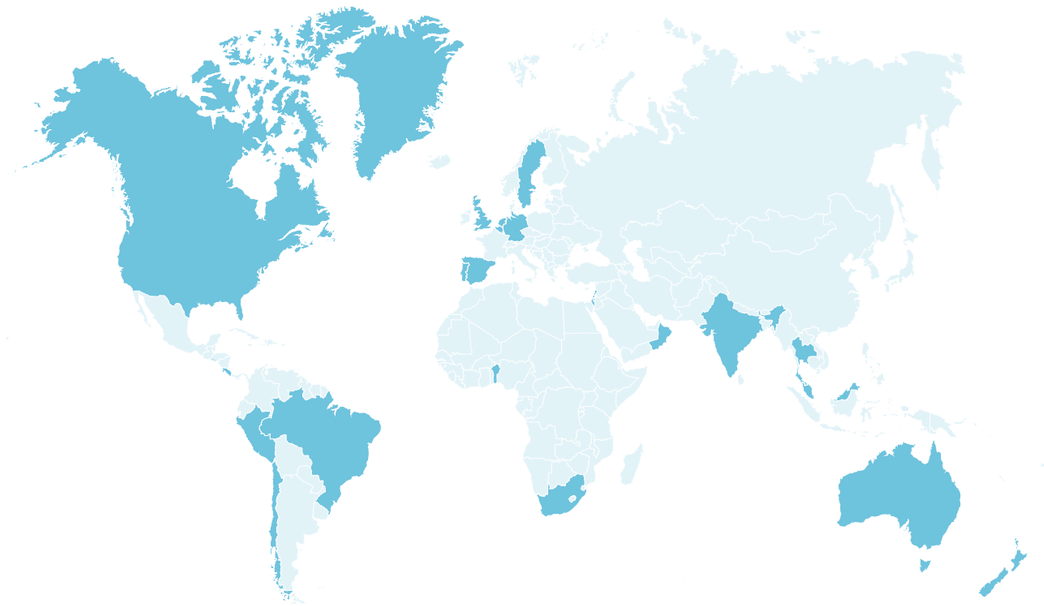
Demographics



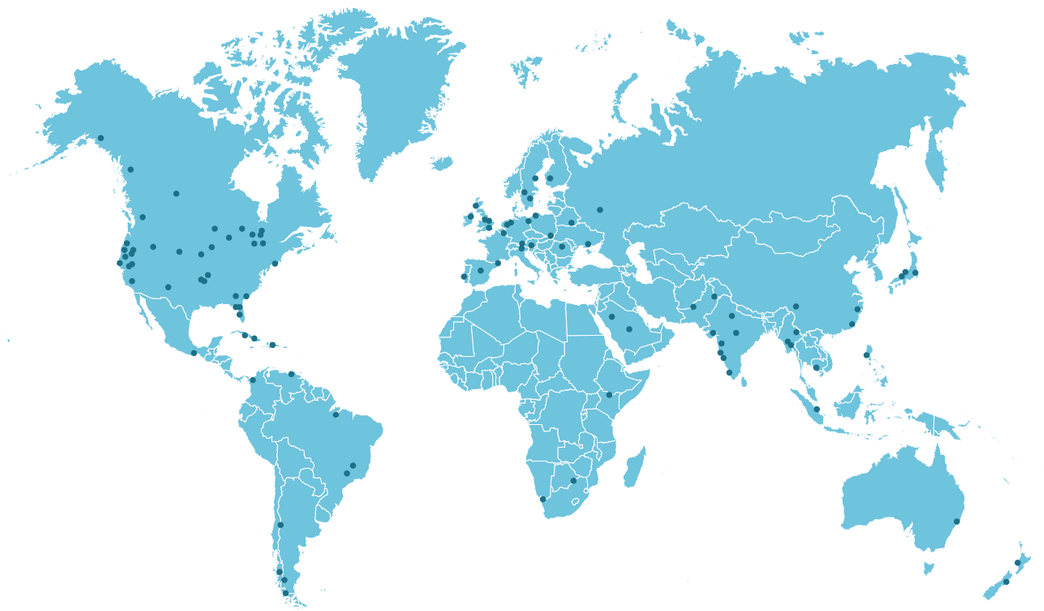
Expertise



Participant World Map



Livestream World Map



Keynotes

One distinguished keynote speaker opened each day of *All Hands on Deck*. On the first day, Dr. Neil Jacobs, Assistant Secretary of Commerce for Environmental Observation and Prediction, spoke about how the how the dry and the wet sides of the National Oceanic and Atmospheric Administration connect in ways that are meaningful and powerful for the American public. On the second day, Nainoa Thompson, President of the Polynesian Voyaging Society, discussed the ancient art of Polynesian voyaging and the need for humanity to come together for the greatest voyage of protecting planet Earth.

Panel Discussions

Six panel discussions addressed each of the six themes of the forum: play, imagine, immerse, create, explore, connect. Each panel consisted of three or four speakers who gave short presentations on their work and its relation to the panel's theme. Each panel was hosted by a moderator who set the stage for each discussion and thoughtfully included audience participants in the conversation. Speakers and moderators included both those who have been involved in deep sea exploration for many years, as well as those from other fields and industries to offer new perspectives on broadening the ocean exploration community.

Lightning Talks

Twenty-seven students and Ocean Discovery Fellows highlighted their work to all forum participants through 2-minute Lightning Talks. The talks spanned a wide variety of topics from new discoveries in the deep sea to community-driven exploration, complementing the six themes of the forum. While many more expressed interest giving a Lightning Talk, preference was given to ODFs and students to give them the opportunity to share their work at this major event.

Workshops

Workshops were held each afternoon of *All Hands on Deck*. There were a total of ten workshops available to participants, and each attendee participated in four workshops, two per day. Workshop topics were intended to reinforce the themes discussed each day in a hands-on, participatory environment. They were led by experts in oceanography, engineering, storytelling, art, and design, to address topics ranging from low-cost robotics to extended realities, community-driven exploration to crowdcomputing.

Art of Discovery

During lunch, breaks, and reception on Day 1, the Schmidt Ocean Institute Artist-at-Sea program, along with two panel speakers, exhibited their work ranging from glass sculpture to painting, highlighting the breadth of work portraying ocean science and data interpretation. Forum participants engaged with more than 20 pieces in the gallery, contributing to the discussion on how to bring more engagement to the ocean through the arts.

Demonstrations

Demonstrations of nine projects were available to participants during the lunch break on Day 2 of *All Hands on Deck*. Project leaders presented their research and results in an informal, conversational setting to allow participants to get an in-depth look at recent advances in ocean exploration and communication. Projects included advances in community-driven exploration, machine learning for automated analysis of underwater data, and a regional-scale perspective of coral reef health.

Boston Ocean Day

On Day 3, we deepened our commitment to engaging the public with a free event at the New England Aquarium's Simons IMAX Theater. More than 500 participants -- locals, tourists, families, young adults and mature -- enjoyed one of our 7 sessions that included underwater photography from Stellwagen Bank National Marine Sanctuary, animated television show screenings of *The Deep*, Q+A's with scientists and ocean explorers, live interaction with NOAA Ship *Okeanos Explorer*, panel discussions, and a 45-foot long inflatable humpback whale for guests to walk inside!

POST-FORUM ACTIVITIES

Surveys

Following *All Hands on Deck*, participants were asked to complete three surveys to get a sense of what they took away from the event, what they planned to do as a result of it, and what they have accomplished in different timeframes:

1. **2 weeks after the event:** 106 responses (35%)
2. **3 months after the forum:** 50 responses (17%)
3. **12 months after the forum:** 38 responses (13%)

One hundred thirty two forum participants (43%) completed at least one of the three surveys: 12 completed all three; 36 completed two; and 84 completed one survey.

2 - Week Survey

The first post-forum survey focused on participants' immediate perceptions of *All Hands on Deck*, as well as what they planned to do in the coming months to years. We asked the following five questions:

- **Who knew?** What did you learn? What were you surprised about?
- **So what?** Why does it matter?
- **Let's go!** What do you plan to do in...1-3 months?...1-3 years?...3-5 years?
- **What do you need?** What resources would enable you to meet your goals?
- **What can you provide?** What can you offer to help someone else meet their goals?

Who Knew?

Many participants were surprised by the diversity of people in the ocean exploration space, both in terms of demographics, and disciplinary/domain expertise. This diversity led to unexpected learnings (*"I learnt a lot about the importance of indigenous cultures preserving the environment and natural resources"*), and introductions to new perspectives (*"I was surprised by the variety of backgrounds present at the conference, especially the interest of artists wanting to learn more about oceans"*).

The importance of storytelling and communication were key themes that emerged for participants coming out of the event. Storytelling and communication were seen as important strategies for making the ocean more accessibile to people beyond science communities (*"I was surprised by the power of storytelling to convey scientific content in a meaningful way...I had not previously considered this tool as a scientist focused on veracity"*).

So What?

The power of optimism and community were important takeaways for participants. This forum gave participants a chance to imagine a world where positive change is possible when people come together from different backgrounds with a common goal (*"I get bogged down a lot in politics and funding and 'science friction.' It kills my optimism as an educator that we can't be more collaborative and open. I feel this underlying optimism can drive real social change at a global level. It matters because the ocean is our lifeline"*).

Many participants also noted that the event's focus on communication was refreshing and timely (*"As was repeated many times, we have a communication problem as scientists and the ocean especially does not have time to wait for the world to come around, so we have to find ways of connecting with people where they are"*).

Let's go!

The third question focused on what participants plan to do as a result of *All Hands on Deck*, and were asked in three timeframes: 1-3 months, 1-3 years, and 3-5 years. The responses were free-form, and therefore not constrained by preconceived

notions of what the organizers thought participants would do. After they were received, responses were categorized into 13 groups, and compiled to understand where people were planning to focus their efforts in each of the three timeframes:

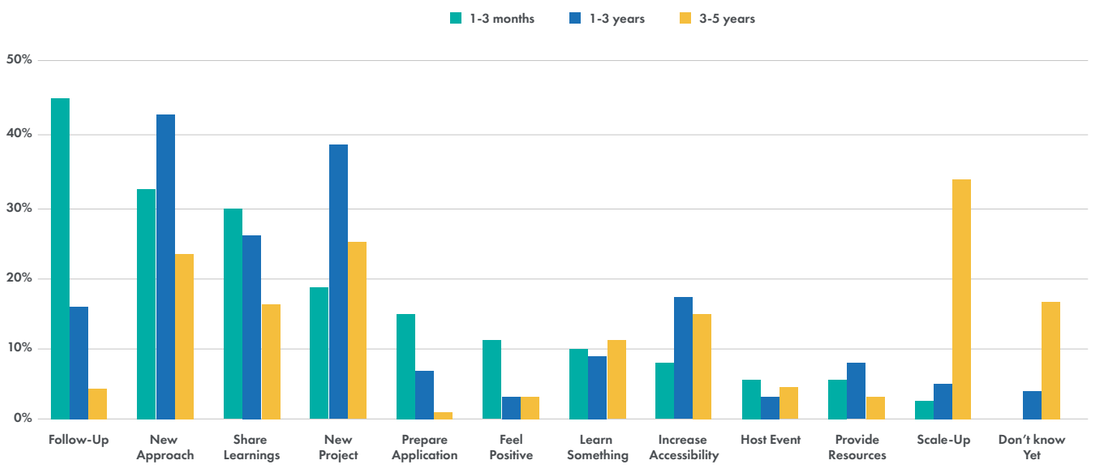
1. Follow up with connections I made / new collaborations
2. Bring new skills or approaches to my work
3. Share/tell others about my learnings
4. Start a new project(s)
5. Prepare/submit a proposal/application
6. Feel positive, optimistic, have new energy and confidence
7. Learn something new / back to school / self development
8. Increase accessibility / inclusivity in my work
9. Host my own event
10. Provide resources to someone else
11. Scale up [regionally/globally]
12. Don't know yet

In the short-term, participants focused on following up with new connections, making new collaborations, bringing new skills or approaches to their work, and sharing what they learned at the forum. In the longer-term, there was a shift to starting new projects and scaling up work on a regional and/or global level.

The top three categories for each timeframe are as follows:

- **1-3 months (green)**
  - *Follow up with connections I made/make new collaborations*
  - *Bring new skills or approaches to my work*
  - *Share/tell others about my learnings*
- **1-3 years (blue)**
  - Bring new skills or approaches to my work
  - Start a new project(s)
  - Share/tell others about my learnings
- **3-5 years (yellow)**
  - Scale up my work
  - Start a new project(s)
  - Bring new skills or approaches to my work

What do you plan to do as a result of *All Hands on Deck*?



What do you need?

Almost all participants mentioned the need for increased funding for their work. Additionally, participants requested access to new tools (e.g. *"Low cost, educational quality instruments that students can use at field sites or with pop-up labs to conduct real science in a short amount of time"/ "Underwater Film equipment. Video editing capacitation [sic]. An ROV for research and filming"*). In addition to new tools, participants also discussed the need for better data (*"We rely heavily on open-access data made available to members of the public by institutions that conduct work in remote sensing, oceanography, ocean conservation an other oceans research (we need as many narratives as we can find!)"*). Participants also highlighted the need for mentorship, increased collaboration, and more opportunities for gatherings like *All Hands on Deck* to meet people from different disciplines (in particular, policymakers and members of the media who can help spread the message about ocean exploration and conservation).

What can you provide?

Although few could provide funding, participants had an extremely wide range of resources they could offer to help others meet their goals, and, notably, everyone offered something. Some of these offerings include: technical and engineering consulting, educational content like lessons and curricula, equipment, opportunities for students, artistic and communication skills (e.g. *"Story consulting, composition, video editing, and animation"*), free access to open-source tools, access to data, social media support, citizen science networks, and much more. Additionally, participants were willing to be thought partners on issues related to research approaches (for example, *"Advice on how to support the self-determined vision of indigenous peoples"*).

"Everyone offered Something."

3 & 12-Month Surveys

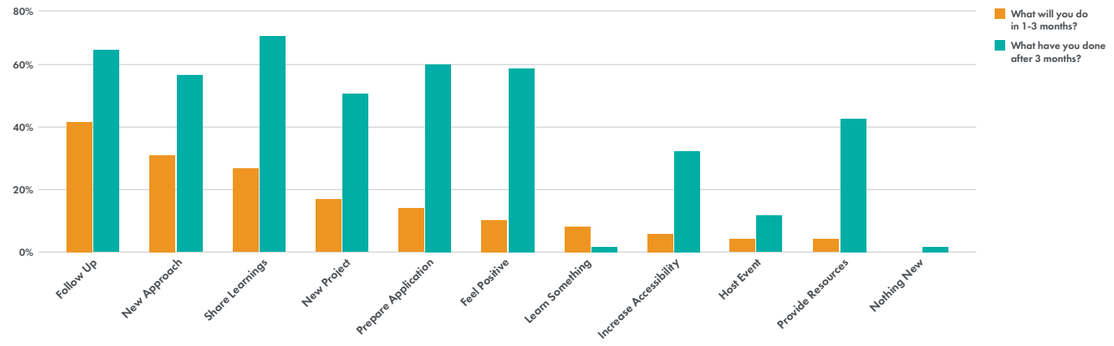
The 3- and 12-month surveys focused on what participants had accomplished in those timeframes after the forum. In both surveys, 98% of respondents reported that they had done something new, directly as a result of *All Hands on Deck*. Activities range from following up on connections they had made at the event, starting a new project, hosting an event, increasing accessibility in their work, or bringing new skills or approaches to their work.

Comparing the 2-week survey question "what do you plan to do in 1-3 months?" to the 3-month question "what have you done?", we find that a higher percentage of people have accomplished more than they anticipated they would after three months. For example, after two weeks, 4% of respondents anticipated providing resources to someone else, while after 3 months, 42% of respondents actually had -- a tenfold increase. Similarly, after 3 months, more than 4-5 times the percent of respondents said that they had prepared/submitted a proposal or application; increased accessibility/inclusivity in their work; or, felt positive, optimistic, or have new energy and confidence in their work. In only one category -- "Learn something new / go back to school" -- did we see a decrease in the percent of respondents after 3 months; after two weeks, 9% said they would learn something new in three months, while after that time period, 2% reported that they had.

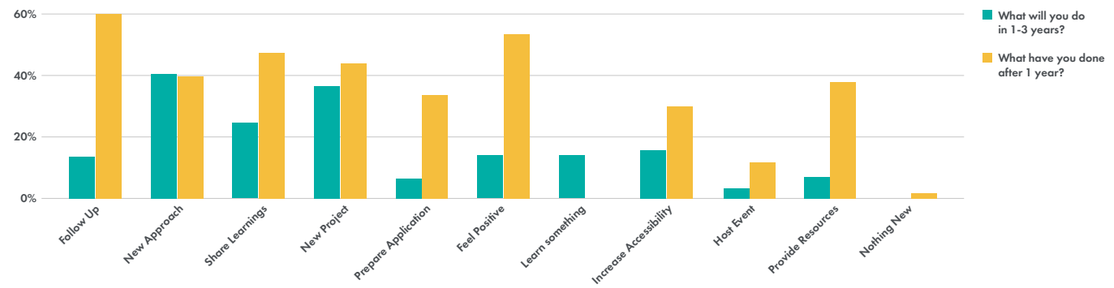
After one year, we saw similar results to the 3-month survey, where a higher percentage of respondents reported that they had accomplished more than the percent of the respondents said they planned after 2 weeks. The most dramatic increases (5+ times) were in "Prepare/submit a proposal/application," "Feel positive, optimistic, have new energy and confidence," and "Provide resources to someone else," followed by (4+times) "Follow up with connections I made," and "Host my own event." Again, there was a drop in the percent of people who said they planned to "Learn something new / go back to school", from 8% to 0%.

My Deep Sea, My Backyard

What will you do vs what have you done in 3 months?



What will you do vs what have you done in 1- 3 years?



Accomplishments

All Hands on Deck participants have accomplished a great many things in just over a year following the event. This is a selection of activities that were the direct result of, or were inspired by, the 2018 National Ocean Exploration Forum.

Hosted Events

I met Megan Lubetkin who did a lightning talk about her event series *Synergist Volumes*. I was organising a week-long festival in living rooms in Berlin in December 2018 curating music performances, workshops, and discussions by friends for friends. She came to visit and together we did an immersive deep ocean music improvisation, featuring deep sea footage from E/V *Nautilus*. Megan improvised on the cello and I on the flute to interpret what the ocean sounds like to us, bringing our synergy of an oceanographer and ocean roboticist into a living room in Berlin, to people who rarely are in touch with ocean exploration, but share the love for it equally. In February 2020, there was another session in Stockholm. I continue to develop this idea to explore an alternative way of science, technology, and ocean communication.

Anna Madlener, KTH Royal Institute of Technology Sweden

I designed and started a series of virtual workshops hosted by the IDB about key topics of the ocean, such as *The Imperative of Ocean Exploration* and *Emerging Technologies for the Blue Economy*. I invited several *All Hands* participants to speak for these workshops, including Katy Croff Bell, Diva Amon, Alan Leonardi, Kakani Katija, and Brennan Phillips, and am continuing to host workshops in 2020.

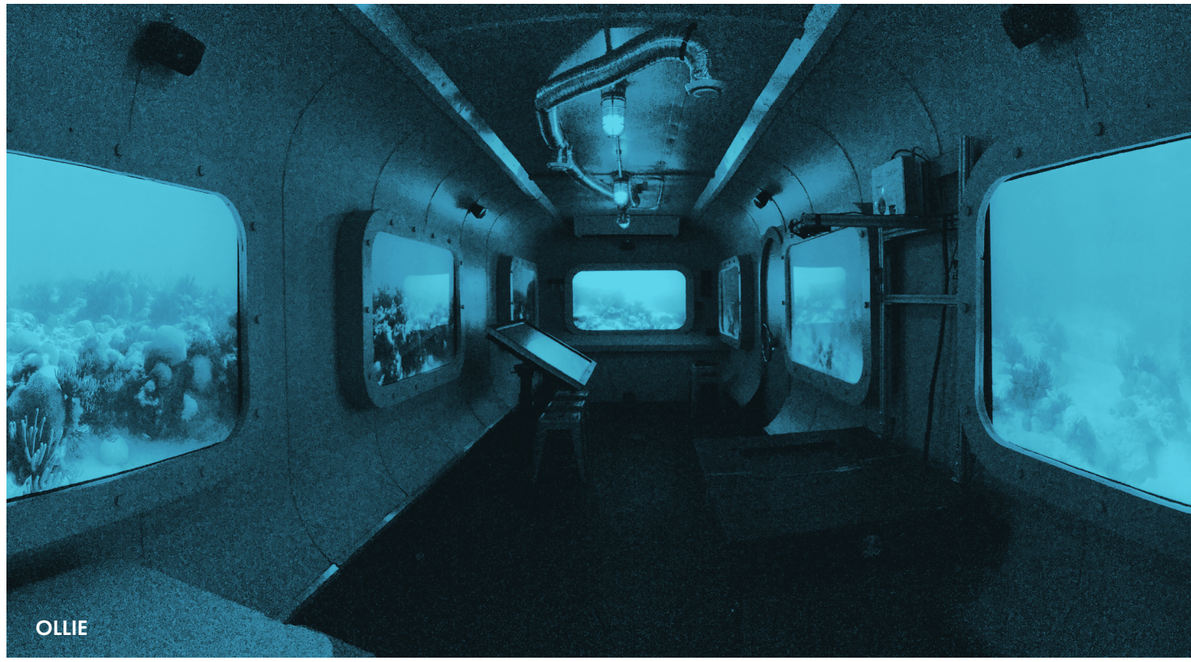
Rafa Anta, Inter-American Development Bank

Synergist Berlin

Provide Resources To Someone Else

After *All Hands on Deck*, I hosted Alan Turchik to train a young Trinidadian marine scientist, Laura-Ashley Henderson, as a part of the My Deep Sea, My Backyard project, and Brennan Phillips to test new equipment at BIOS. Both shared their work with local schoolchildren, and Brennan's research resulted in a publication that was featured on the cover of *Deep Sea Research* | in November 2019. We plan to continue these joint efforts into 2020 and beyond.

Kaitlin Noyes, Bermuda Institute of Ocean Sciences, & Ocean Discovery Fellow



OLLIE

New Collaborations

In April 2019, I collaborated with *All Hands* attendees Carlos Toro, Alex Hornstein, JP Rouja, and Kaitlin Noyes to film Bermuda reefs for OLLIE's immersive learning lab. Later that year, I worked with *All Hands* participant Jeremy Raguain to connect with and film a coral restoration project in the Seychelles.

Patrick Flanagan, OLLIE

Following *All Hands on Deck*, Andrew Thaler of OpenCTD held a CTD making workshop in the boathouse of Stellwagen Bank National Marine Sanctuary. He instructed Sanctuary staff and crew from the sail training vessel *Roseway* of the World Ocean School on building two super low cost CTDs.

Ben Haskell, Stellwagen Bank National Marine Sanctuary, NOAA

OpenCTD

Submitted An Application

I came to *All Hands on Deck* to learn more about how to connect art and ocean research. At the forum, I learned about the Schmidt Ocean Institute's Artist-at-Sea Program aboard *R/V Falkor*. I thought it was so incredible, and I was eager to apply. In December 2018, I put in an application to be a part of the program and was accepted for a voyage from Mexico to Oregon. I brought a robot that draws on to *R/V Falkor* to create art that humanizes the experiences and data of discovering the uncharted, and what it feels like for the boat to discover new things. While aboard, I connected to Virginia Commonwealth University in Virginia to a class of students learning about sound and talking about how sound, art and ocean exploration can come together.

Meredith Brindley, George Washington University

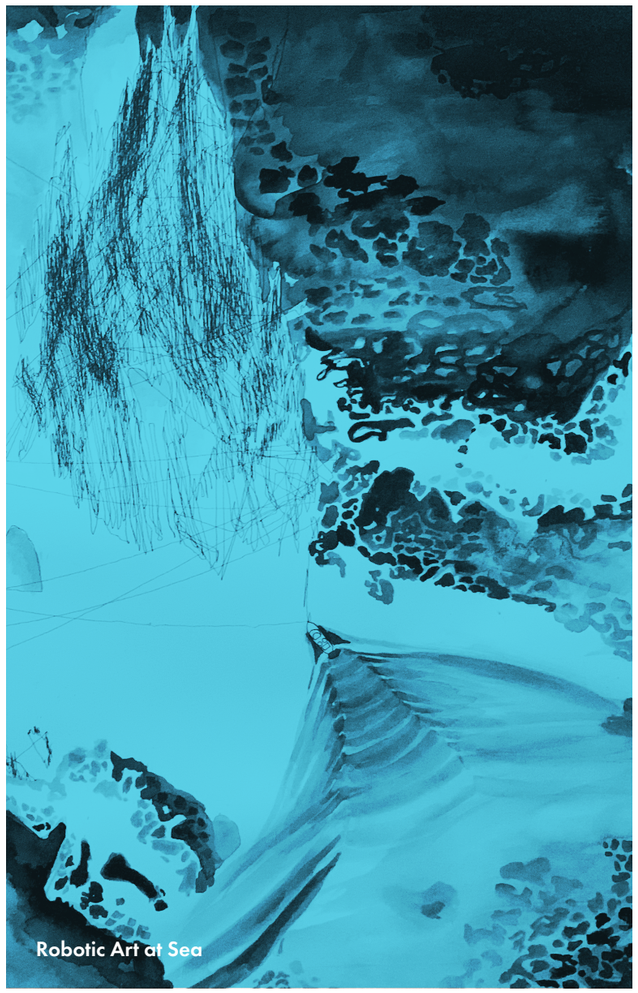
Increase Inclusivity

As a result of *All Hands on Deck*, the Ocean Exploration Trust, NOAA Office of Exploration and Research, and Schmidt Ocean Institute came together to discuss how we can better expand our educational reach with imagery and stories coming from our three ships. As a result, an initial one day off-site with design consultants from Human Design was held in Washington, D.C., in September 2019 to idea board a new website that would combine the work of all three vessels. The group is now in early stage development and has plans for a soft launch in July 2020. The website will feature short video clips highlighting important ocean concepts, a comprehensive map showing all three vessels in real time, and expedition updates. Emphasis will be on a user-friendly interface, with items mapped by concept, and an interactive gallery.

David McKinnie, NOAA/OER; Carlie Wiener, SOI; Allison Fundis, OET

I co-hosted the National Marine Educators Annual conference in July 2019. Planning was already in the works when I attended *All Hands on Deck*, and I absolutely incorporated some of the ideas, people, and thoughts that I had during the forum, such as expanding presentations to larger audiences (I loved the short presentations you had). We also had sign language interpreters, and offered free registration to childcare providers.

Tara Hicks Johnson, University of New Hampshire



Robotic Art at Sea

Started A New Project

Based on a key takeaway from the Future Aquarium workshop, I created an initial proof of concept that will end up being a sort of "Alexa for Zoos & Aquariums." It's a custom, secure voice recognition solution which can be placed near any exhibit. I'm building a database of recognized questions visitors might ask that the AI recognizes, with set programmed responses the zoo or aquarium can curate to their specific location. Long-term, I'm hoping for it to serve as an "AI Specialist" to get your questions answered that you would typically ask park staff, and am now looking for an open-source voice assistant software to continue the project.

Casey Sapp, VRTUL

New Approach To My Work

I dedicated myself full time to the vision of bringing the art, science, and storytelling of deep-ocean exploration through a Dropcamera lens to its initiating phase. My first mission was joining the Nekton "First Descent" mission in the Seychelles for 7-weeks at sea, during which I sketched the location and her life within.

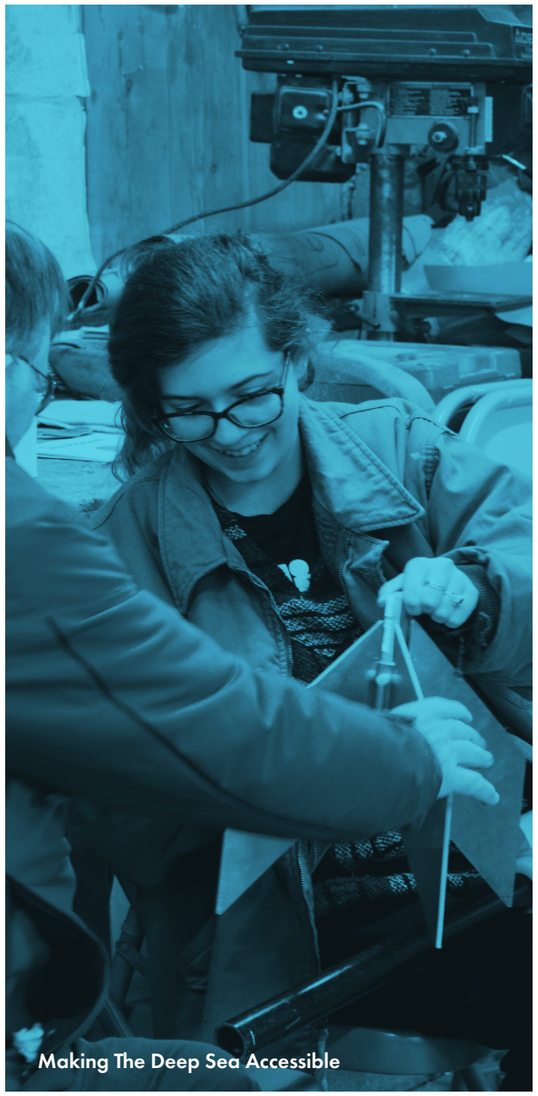
Jonatha Giddens, National Geographic Explorer

Sketching at Sea

Share Learnings With Others

We were energized and confident by our interactions at *All Hands on Deck* that we are not alone in championing ultra-low-cost and accessible tool development for deep water and ocean exploration. We have been enthusiastically sharing the conference goals and ideas with almost anyone that will listen from advisors and possible funders to community NGOs and citizen scientists.

Julie Silverman, Summit2Shore Consulting, & Graham Hawkes, HAWX



Making The Deep Sea Accessible

> *"I allowed myself to say I am passionate about ocean exploration." -- Jovita Ho*

All Hands on Deck got me excited about spreading the word about ocean conservation and inspired me to take on more speaking engagements about my marine science collaborations. In the past year, I spoke at several institutions about these collaborations and communicating about stewardship in the face of climate change.

Rebecca Rutstein, Artist, & Ocean Discovery Fellow

New Energy & Confidence

In terms of confidence, I felt an increased appetite for diverse and diverging methods to engage with the ocean. Being part of the ODFs, I allowed myself to say I am passionate about ocean exploration, and tried to doubt less the relevance of my background, and the legitimacy or value of my questions to myself and others.

Jovita Ho, Ocean Discovery Fellow

Before *All Hands on Deck*, I never felt anyone really understood what we were trying to do. We have a Marine Ecology Centre and a swimming academy which teaches the local community to swim and that feeds into a lifesaving and ocean stewardship program. When speaking to people, they always seemed a bit confused on what we do due to the diversity of our activities. *All Hands on Deck* made realize we are right where we need to be and it helped me communicate what we do much clearer.

Ernst van der Poll, ConnectOcean & Ocean Discovery Fellow

Speaking About Art and the Sea

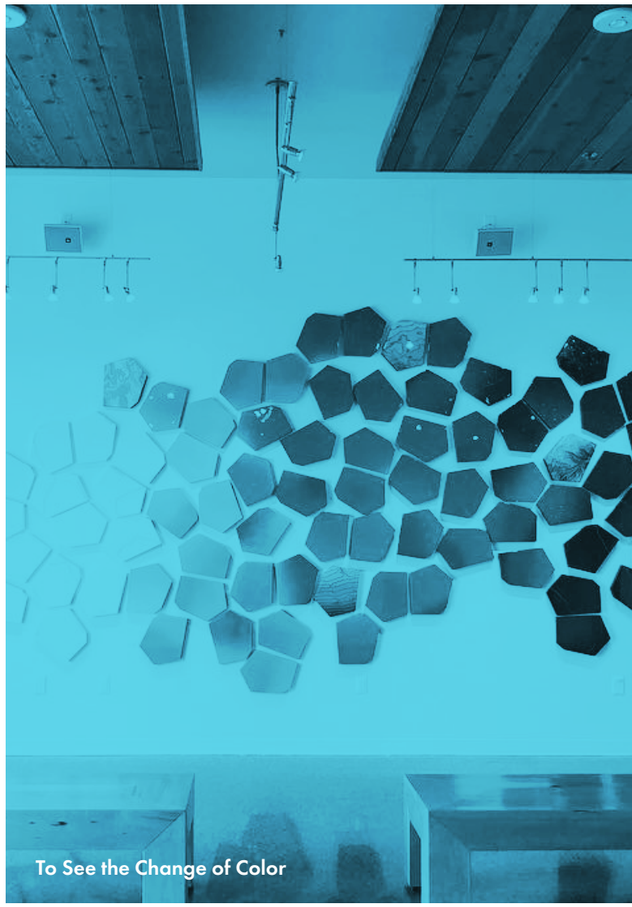
Newfound Confidence

Youth Ocean Stewardship Programming

I Finished my MFA Thesis at Arizona State University which was an art exhibition, Opallios, inspired by ocean exploration from my artist at sea residency with Schmidt Ocean Institute. My exhibition directly reflects that with my installation, *To See the Change of Color*. This piece is 100 paintings, each representing 1% of the earth's surface. There are 29 white paintings to represent dry land and 71 blue paintings - out of those blue, I've only included maps on 5, to visualize how little we know of this tiny blue marble. Being at the conference gave me the last push I needed to make this exhibition happen. It was definitely a risk - and I am so happy I took it! It turned out wonderfully and I am proud of the results. The Ocean Exploration Forum left me feeling awake, inspired, and determined.

Lizzy Taber, Artist

> *"The Ocean Exploration conference left me feeling awake, inspired, and determined."-- Lizzy Taber*



To See the Change of Color

RECOMMENDATIONS

It will take effort, resources, and intentional changes to the way we think and operate to truly broaden participation of groups historically and consistently underrepresented in ocean sciences. The following are actionable recommendations that can and should be made to encourage expanded engagement and participation in a national program for ocean exploration in the US and beyond.

Diversity & Inclusion

How can we ensure diversity, equity, and inclusion in all projects, events, and other ocean exploration opportunities?

- **Include representatives from all demographics** you are trying to reach from the beginning of all efforts to avoid disconnects and missteps.
- Ensure that your **recruitment, application, and selection processes are open** and inclusive.
- **Diverse representation matters** in all forms including culture, national origin, age, religion, physical ability, socioeconomics, and gender identity. Create platforms to elevate all voices at all levels including leadership, speaking roles, and committees, etc.
- **Create an inclusive environment.** Suggestions include: closed captioning and language interpreters; private areas for breastfeeding; on-site childcare; accessibility guidelines; guidance on Indigenous land acknowledgements; and, diversity, equity, and inclusion policies.

Passionate Play

How can we create fun, participatory experiences for engaging with ocean exploration?

- Support initiatives to **increase diversity in water sports**, such as swimming, sailing, and surfing, to ensure lifelong connections with the water.
- **Work with toy companies** on developing fun, play-based learning experiences for children to encourage cognitive flexibility, systems thinking, and adaptive social functioning.
- Support initiatives to **combine ocean learning experiences with water sports and outdoor exploration**. Collaborate with local, national, and international organizations such as the World Surf League or Aspen Institute Sports & Society Program, YMCA, USA Swimming, Black Girls Surf, Scouts, National Parks, and National Marine Sanctuaries.
- **Incorporate and support art and music and other appropriate social contexts,** such as traditional artists, to enable cultural connections and relevance, bringing ocean exploration to new audiences.

Immersive Storytelling

How can we create new, compelling stories to capture the imagination of new audiences?

- **Diversify storytellers** to encompass a broad range of perspectives so that all voices are heard. Communication and engagement efforts must be rooted in culture, inclusion, accessibility, and relevance.
- **Imagine how things can go right**. Highlight success stories, and invite the audience to be a part of the story -- how can they be invested in a better future for the ocean?
- Don't be afraid to **use humor, adventure, and imagination** to connect with audiences.
- Not everyone can visit, swim in, or dive into the ocean. **Create immersive experiences** that intersect the digital, physical, and interpersonal to demonstrate why the ocean is such an amazing, important place that needs to be explored.
- Use a variety of media -- podcasts, spoken word, visual -- and locations -- aquariums, theme parks, STEAM carnivals, libraries -- to **bring your message to targeted audiences**. Collaborate with them as centers of community, fun, and learning.

Expanding the Field

How can we enable new participants to enter and expand ocean exploration?

- **Low-cost sensors and systems** need to be developed to dramatically bring down the cost of entry for new explorers and to efficiently cover large volumes of the ocean.
- Create **advanced data access and analysis** capabilities to make ocean exploration data more discoverable and user-friendly, for scientists and non-scientists alike.
- Establish programs for **training and capacity building** within underserved communities and developing nations to expand the number of people who are capable of carrying out high-quality data collection and analysis.
- **Establish funding mechanisms and incentives** for nontraditional projects and support for students, early career professionals, and newcomers to the field.
- **Mentorship, increased collaboration, and more gatherings like *All Hands on Deck* to meet people from different backgrounds** create supportive, inclusive environments, particularly for newcomers to ocean exploration.

KEYNOTES

NEIL JACOBS

"Normally I'm talking about models and equations and high performance computing, and I'd much rather just be in the ocean, to be honest with you."

Explore your connection to the ocean and develop new systems for ocean exploration.

Dr. Neil Jacobs, meteorologist, Assistant Secretary of Commerce for Environmental Observation and Prediction, and acting Under Secretary of Commerce for Oceans and Atmosphere, can lay claim to having surfed on every continent, save Antarctica.

Jacobs made it clear: he pursues the serious work of enhancing the United States' blue economy and improving weather forecasts with joyful zeal. Jacobs' career is rooted in a lifelong passion for ocean recreation and his childlike fascination for its natural wonders.

He shared exciting developments at NOAA that, like *All Hands on Deck*, exemplify the effective outcomes achievable when diverse career sectors coordinate. Jacobs is activating collaboration between academia, government, industry, and non-profits towards a community modeling effort. And NOAA is already implementing novel ocean tools for collecting data.

The utility of weather forecasting is vast. People rely on this data. To get accurate predictions, we need new mechanisms for ocean exploration. New systems need to be established for ground-truthing models with ocean bathymetry data and ocean observations.

To this end, Jacobs closed by sharing his enthusiasm for the promising ideas and projects sure to emerge from the forum's diverse participants.

NAINOA THOMPSON

By bringing together traditional knowledge and technology -- navigated by compassionate human values -- we can solve the earth's environmental problems.

The audience's tears and full hearts were evidence of the deep connection and hope the room felt at the conclusion of the Day 2 keynote talk given by Nainoa Thompson, President of the Polynesian Voyaging Society (PVS). In his humble and resolute character, Thompson shared the cultural renaissance story of the Wayfinders and Hōkūle'a, Hawaii's first traditional voyaging canoe in more than 600 years.

Numerous mentors and teachers from disparate fields -- all dreamers -- fused their knowledge and friendships over decades to forge new ideals and techniques that allowed PVS to bring the message of Mālama Honua "to care for our island Earth" to the world. PVS continues to voyage. From 2021-2026, PVS will travel around the Pacific uniting the people of Oceania and sharing their mission with the world.

Thompson came to *All Hands on Deck* to stand witness to the new collaborations and relationships built between attendees, individuals who have "powerful ideas" born out of kindness, creativity, and bravery. He wanted to express to the audience that this collective is the movement we need to face the challenges ahead: "it's the greatest voyage ever."

"The world needs navigators that know nature, to protect it...You need to learn about the earth, to be able to be knowledgeable to make good decisions."

PLAY

INTRODUCTION

"If you are given a set of blocks that can be combined in innumerable ways, and moments are filled with 'what if?', 'yes', and 'let's try this', then problems become fun projects, and innovation is around the corner." -- Jenni Chow

CONTENTS

Sparking curiosity in the ocean through games, toys, and recreation

The MIT Media Lab is a place where play-based learning and research is the norm, with an eye to creating a better future. The theme, PLAY, celebrates the importance of engagement and fun as a direct lead into an individual finding confidence, sense of connection, and a lifelong passion.

Andre Fountain created the resource guide on children's sports for the communities within Baltimore, 'State of Play Baltimore'. When local youth were asked, swimming was the second favorite sport behind basketball among African Americans at 21%, and it was the top sport among Latino or Hispanics at 29%. How, then, do we take this diverse and inclusive cohort of kids and give them the inspiration and opportunity to take this interest in swimming and nurture it into a desire and decision to pursue a career in the ocean?

Reece Pacheco represents World Surf League (WSL) Pure and all the light, love, and connectedness to nature that the surf culture imbues. WSL Pure is a nonprofit organization that focuses on climate change, coastal conservation, and plastic pollution, helping partner conservation groups tell their story across the WSL network and on site at their events. How can a large platform like theirs be utilized to establish a new

sea of people helping explore and protect the worlds' ocean?

Samantha Chiappetti of LEGO Education brings playful learning experiences to children all over the world. LEGO reaches students' minds by letting their hands do the thinking. While playing, students practice cognitive flexibility, divergent thinking, adaptive social functioning, and systems thinking; all necessary skills for out-of-the-box solutions to interdisciplinary issues. How might those inviting colorful blocks lower the barrier of entry for future ocean engineers and roboticists?

Maria Redin and her team bring science, technology, engineering, art, and math (STEAM) Carnivals to thousands of school children, teachers, and the public. The games, never-before-seen tech, and immersive entertainment inspire the next generation of doers and inventors. If ocean sciences was presented with exciting circus enthusiasm, might it bring on a new wave of ocean dreamers and innovators?

Jeffrey | The Deep

SPEAKERS

Andre Fountain
Aspen Institute Sports & Society Program

Reece Pacheco
World Surf League PURE

Samantha Chiappetti
LEGO Education

Maria Redin
Two Bit Circus

MODERATOR

Jenni Chow, PhD
Open Ocean, MIT Media Lab

"Together, we can help kids see the value of the ocean, but we need to give them the tools and the opportunity to experience it."

ANDRE FOUNTAIN

Play and collective impact methodology can bring diverse youth to oceanography

Could more opportunities for children to play in the water lead to more youth growing up to pursue a career in an ocean-related field?

Collective impact methodology calls for bringing a diversity of stakeholders together to achieve a shared goal. Exercising this methodology, Fountain helped foster a collaboration between U.S. Swimming Foundation and the Baltimore City Recreation and Parks to teach youth essential swimming skills. They also created a partnership making Baltimore eligible to annually apply for grants for up to $15,000 to support city-wide swim efforts.

What if oceanographers and ocean educators were brought on as partners? What if additional experiences were offered such as other water sports, trips to the ocean, and hands-on activities at colleges and marine institutes?

"We must expose kids to the ocean and play settings and bridge the gap to a potential career path as well."

"The earth is an ocean world. As surfers, it's our home, and it needs us to speak up, so we can shine a light on people doing good and making a difference."

REECE PACHECO

The euphoria of riding a wave is a powerful hook for engaging people in ocean conservation.

Through collaboration we can move the surf industry forward, to be better for our oceans.

'Stoked' is that euphoria, thrill, and excitement of being intertwined with the power of the ocean. A surfer has a unique connection to nature, using their body, mind, and senses to listen, feel and respond to the movement of the wave. It is no wonder Pacheco affirmed, "that line between fun and play and stoke is really blurry in surfing."

WSL Pure has partnered with groups like 5Gyres Institute, Surfrider Foundation, NRDC, and Center for Climate and Life at Columbia University to further their mission to inspire, educate, and empower the global surf community to protect our ocean. With ambassadors that are world-class athletes, global competitions drawing huge crowds, and an international media reach, WSL shares this impressive platform to reach thousands of people around the world.

"We can turn the tide by turning up the volume because we love this place, and you do, too."

"You had fun. I could tell by the laughter in the room. You also probably felt a little bit of joy when you completed the task."

SAMANTHA CHIAPPETTI

Bring joyful, socially interactive, actively engaging, iterative, and meaningful experiences to kids and adults

How do products like LEGO offer deeper, playful learning experiences?

Chiappetti set the stage by giving us each one minute to build a duck out of six LEGO bricks. LEGO Education shares these hands-on experiences with schools, teachers, and communities around the world by bringing them products that elicit playful learning experiences in classroom modules, such as engineering and science, with the primary mission of enabling every student to succeed.

Suddenly topics like pH measurements, buoyancy, and ocean engineering that were scary or uninteresting to some students become personally meaningful and relevant as these students collaborate and creatively deploy their designs with the freedom of no pressure to have the right answer and rather the express expectation of rebuilding and redesigning their work.

"Playful learning is something that you can bring back to your work as you are looking towards engaging not only kids, but adults in learning deeper about the ocean or different water around them."

"What is the rockstar equivalent for STEAM? If kids will teach themselves music if they want to be a rockstar, what's the equivalent, for math and science?"

MARIA REDIN

Play is an important lever for building confidence and offering a sense of connection to science, technology, engineering, art, and math.

What happens when you give students an inspiring environment to experience STEAM?

Two Bit Circus's mission is to "bring people together, to play elbow to elbow", where play is social and aspirational. At their STEAM Carnivals, children are briefly coached in how to begin and ultimately are left together to freely explore and play unstructured. Exposure to VR, a robotic bartender, and interactive theater are a few examples of thrills that get kids inspired to be the next doers and innovators.

Two Bit Circus Foundation has reached ~300,000 kids, predominantly Latino, many from underserved schools. Redin explained that after kids gained a connection to science, technology, engineering, art, and math during a STEAM Carnival, their responses to the question if they thought science had anything to do with real life rose from 15% to 60%. And the number of students that believed they would fail science this year dropped from 50% to 10%.

"Play is important in bringing populations that normally don't believe that this is something that's possible for them into the space."

RELATED EXPERIENCES

"Remind ourselves that it's OK to play as adults. Setting up the framework for playing enables more lasting solutions."
-- Elizabeth Tyson

Experiences	Page

IMAGINE

INTRODUCTION

"There's an opportunity to go from bad news to good news and from no vision for the future to an optimistic one. What does futurism look like in an ocean context?"
-- Ayana Elizabeth Johnson

Imagining a bright, optimistic future for the ocean

Those in science understand the details of all the different ways things are going wrong, but we often aren't imagining the ways that they could go right. In this session, our panel discussed various ways that we can IMAGINE an optimistic future for the ocean, including through humor, comics, and science fiction.

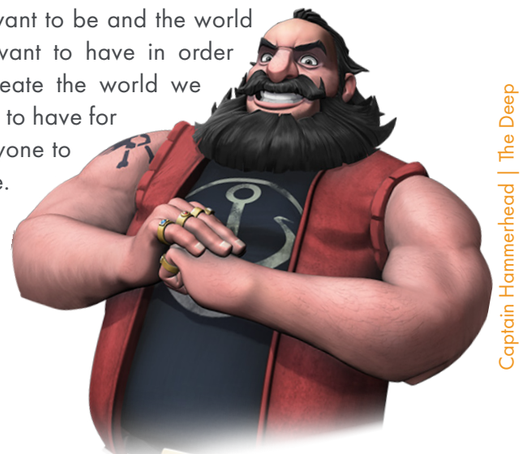
Steven Wendland is the head of creative development at Technicolor and executive producer of season three of *The Deep*, an animated series that helps introduce younger viewers to ocean exploration through a close-knit cast of diverse characters and epic storylines. How can basing stories on the truth but woven with just enough mystery captivate and inspire the next generation of ocean explorers?

Ella Al-Shamahi is a National Geographic Explorer, BBC and PBS presenter, comic, and paleoanthropologist specializing in fossil hunting in hostile territories. Al-Shamahi uses humor, adventure, and the moving image to reach out to those who may feel uncomfortable with established methods of science communication. How could taking an impov class or working with a comic inspire the public to care about the ocean?

CONTENTS

Steven Gould is the author of eleven science fiction novels and is currently working with James Cameron on the sequels to Avatar. Several of his novels involve imaginative ocean solutions, and he has a lifetime love affair with the ocean through diving and sailing. How can complex and often uncomfortable issues of the present be wrapped in fiction to allow readers to examine them with a new perspective?

We cannot change human practices with facts alone. We must change the culture that is created by the stories we tell ourselves about who we are, where we come from, and where we're going. Children all over the world know who Luke Skywalker is. They know to use the Force for light against evil. It's become a shared global mythology. The oceans need a new mythology. If there are no stories of hope, there will be no hope. We must tell the stories of who we want to be and the world we want to have in order to create the world we need to have for everyone to thrive.



Captain Hammerhead | The Deep

SPEAKERS

Steven Wendland
Technicolor Creative Development & The Deep

Ella Al-Shamahi
UC London & National Geographic

Steven Gould
Science Fiction Writer

MODERATOR

Ayana Elizabeth Johnson, PhD
Ocean Collectiv

"The Deep is aspirational. It's fun. Many of our stories are based on a premise that happens to be real, either a real creature, a real occasion, or a real event in history, and we take that premise, and then we build a fun mystery around it."

STEVEN WENDLAND

Connecting younger fans around the world to the real ocean

The Deep builds on real science, history, and events to teach kids about the ocean without talking down to them—it's fun and aspirational, not preachy or condescending.

The Deep started out as an Australian graphic novel called *Here Be Dragons*, written by Tom Taylor, illustrated by James Brouwer, and published by Gestalt. According to Taylor, the novel and its sequel, *The Vanishing Island*, were inspired by the well-known statistic that we know more about outer space than we do about our own ocean; Wendland, too, said that this was a major reason he and his colleagues chose to develop it for television. "I think it's simple," Wendland says, "and it's a powerful premise for telling loads of great story ideas...one of the reasons why this series works so well is that it somehow feels strangely authentic. We're not forcing healthy edu-tainment for kids here."

Through a partnership with the Nekton Oxford Deep Ocean Research Institute, The Deep has been able to connect ocean scientists with the kids who watch the show. This type of storytelling is a powerful medium for interesting the next generation in ocean health.

"Believe it or not, we've had multiple comments from parents that tell us their kids have decided to become marine conservationists because of this show. I can't tell you how amazing it feels. It's almost like we're no longer just making a TV series."

"If you switch off a documentary about plastics, you might still switch on an adventure doc that also has plastics as some kind of a background theme."

ELLA AL-SHAMAHI

Harnessing the power of humor, adventure, and the moving image

If we want to reach the mainstream, they're not interested in nomenclature. They're interested in some wow facts, some of the wow theories certainly, but mostly what they're interested in is feeling.

"We have a massive communication problem in science," Al-Shamahi says. Too many people either refuse to believe the data, or are simply disinterested in it. At least part of the problem may be that so much of the narrative feels like doom and gloom—why care if there's nothing you can do?

Comedy, adventure, and the moving image can help solve this problem. Humor and adventure can communicate important messages in a way that doesn't make people defensive; motion pictures, film, television, and online videos have the potential to impart complex information in a compelling, digestible format, to audiences unlikely to read academic papers or even dense newspaper or magazine articles. This doesn't have to be difficult or expensive—you can work with comics, take an improv class, or take a short film or video course. Look at how you can get the skills that you need and then collaborate from there.

"What's funny about plastic, guys? We keep thinking about what's depressing. How do we solve it? How can we embarrass through the use of comedy? How can we stimulate? How can we raise some kind of emotion using comedy?"

"The things that we are passionate about cannot help but emerge in our works of art, our works of fiction."

STEVEN GOULD

Examining the difficult and complex problems of today through the lens of science fiction and the future

"In my book, *Blind Waves*, I designed a submarine because my main character was doing ocean exploration. Years later, James Cameron said to me, '"You know that sub you did in that? That would work,"' and to have someone who co-designed the submarine that went down to the bottom of the Challenger Deep to say that was just incredibly, a peaked-early kind of moment." Steven Gould continues to use scientific and technical truths to tell important stories.

In the First and Second World Wars, the British Navy used Q-ships—apparently easy targets armed with hidden weaponry—to lure German U-boats to the surface. The arts, too, can act as disguised weapon, letting you examine serious, significant issues in a way that doesn't alienate the audience.

By communicating scientific truths though fantastic narratives—not through propaganda, but through engaging stories embedded in as much scientific, psychological, and physical realism as possible—artists can reach people who might turn away from a news story or put down a newspaper article, and give them the opportunity to absorb these messages in a different way.

"I tell lies for a living to tell an ultimate truth."

RELATED EXPERIENCES

"There are many more people interested in ocean exploration than I imagined -- so many creative people with a positive vision for the future of oceans and the planet."
-- Nicole Raineault

IMMERSE

INTRODUCTION

"How do you create a sense of exploration and discovery or serendipity in immersive experience designs or in the experiences that you create? " --Emily Salvador

CONTENTS

Bringing people to the ocean and the ocean to people

Experiences that transport us to other worlds allow us to become deeply engaged and absorbed. They are illuminating, even leading to insights and breakthroughs. The IMMERSE theme dives into experiences that take us there and that create a sense of exploration and discovery, or even serendipity, through immersive experience designs.

Sven-Olof Lindblad is CEO of Lindblad Expeditions, a business that offers marine-focused expeditions aboard small ships, in partnership with National Geographic. Through a model of global exploration with the goal of further inspiring the world through expedition travel, close to 25,000 people are brought to the ocean each year through experiences of a lifetime. What are triggers that create passion in people's lives and lead them to explore and care about the planet?

Vikki Spruill is President and CEO of the New England Aquarium and served as president and CEO of the Council on Foundations in The Ocean Conservancy. She sees a new conversation being inspired inside walls of aquaria. The centers traditionally viewed as entertainment or educational spaces can provide early life lessons on conservation. With the public at the water's edge in today's aquaria, there is opportunity to spur people to act out in the world.

Carlos Toro is Creative Producer and Director at Steer Digital where he creates impactful experiences. When people come into contact with the world through travel and external opportunities, it can create inspiration. As the son of immigrants, he shares that financial stability is often the focus of first generation Americans who don't have the luxury of participating in fora like this. Immersive, digitally created experiences that draw people in and bring them close-up to the natural world's magic allow inspiration to be accessible. How do we define *All Hands On Deck*?

Dan Fields is Executive Creative Director at Walt Disney Imagineering where he leads and creates live entertainment for Disney theme parks, resorts, and cruise ships. Putting a focus on guests so they are the center of their own story creates empowering experiences and is at the heart of Disney's productions. Guests are connected through character and story and experience, and become instantly more invested. In what ways can you engage more directly with your audience?

Fontaine | The Deep

SPEAKERS

Sven Lindblad
Lindblad Expeditions

Vikki Spruill
New England Aquarium

Carlos Toro
Steer Digital

Dan Fields
Disney Parks Live Entertainment

MODERATOR

Emily Salvador
MIT Media Lab

"This is an interactive process. Science is being done, research is being developed, and our guests are participating in that whole experience. Everybody benefits as a consequence of that."

SVEN LINDBLAD

Extraordinary experiences can inspire people to explore and care

Experiences of a lifetime can spur passion and long-standing interest.

Lindblad Expeditions, in partnership with National Geographic, provides expeditions aboard small vessels that bring greater numbers of people to a greater number of places than professional scientific papers can touch in a year, engaging them in remarkable experiences and connecting them in ways that allow for discovery. At-sea teams bring travelers in connection with ideas, scientists, naturalists, and historians and expeditions are brought to life.

The partnership also has created a fund that raises up to $2M a year that is invested in conservation, education, and exploration. How the ships could be used more effectively as platforms for science, research, and storytelling is in discussion and also how to make the experiences more impactful beyond those fortunate enough to be aboard.

"We're trying to look for creative ways in which we can use these platforms to make those experiences more impactful beyond those privileged few who have to the opportunity to go to remote places."

"My early lessons about conservation actually happened at the New England Aquarium and it really changed the course of my life."

VIKKI SPRUILL

Aquariums can become 21st century conservation organizations

A new conversation is being inspired inside the walls of aquariums.

There is a progression evolving at aquariums, they are moving from a historical perception of them as places of entertainment, to education, to inspiration, and now to what Spruill calls activation. Aquariums can be an early life lesson in conservation and what is inspired inside the walls of aquariums like the New England Aquarium can lead to action in the outside world, and in new and powerful ways. Visitors can be mobilized and make change happen and aquariums can be the place where that conversation begins.

Yet, serendipity comes in the quiet, too, and aquariums also give visitors the space and the quiet to have their own experiences. The inspiration and education happening inside the walls of today's aquariums can be leveraged for action beyond the walls, out in the world, to protect our blue planet.

"All of these things are amazingly important but I'm here to ask the question, to what end?"

"I want to be able to immerse kids in [urban] neighborhoods...I want to be able to show them that there are really amazing things out there."

CARLOS TORO

Experiences that draw in and share inspiration that the natural world creates

Who has access to the remarkable experiences that the environment can provide and the conversations around it?

The focus of first generation Americans is often financial stability and they may not have access to the kinds of remarkable experiences that others witness and draw inspiration from, or be able to contribute to the public discourse. Toro creates immersive, impactful experiences from state-of-the art technologies that draw on scientists to inspire action and which take people to liminal spaces - transitional, transformative spaces that help to immerse.

These kinds of experiences can open the doors to communities and young adults that may not have the opportunity otherwise, and allow them to become acquainted with, and be inspired and awed by, the magic inherent in the natural world.

"There is much out there to be inspired by. Make it accessible."

"It's pretty empowering for a seven year old to believe that they can throw a shield like earth's mightiest heroes."

DAN FIELDS

Finding ways of drawing guests deeper into an impactful experience

Surprising things happen when people are drawn into an experience. They stay longer and play longer and make an investment.

Walt Disney Imagineering uses creative ways to draw guests deeper into Disney productions and become at the center of an experience. Through productions with life-sized puppets that allow young kids to experience Mickey Mouse and his friends as their own size, to characters that interact with audiences such as Darth Vader during the opening of Shanghai Disneyland, guests become part of an inclusive and immersive environment.

Guests young and old also are eager to have heroic encounters with aspirational characters and relate to their heroic qualities, not just their actions, so Disney creates real, dimensional locations and a narrative to back up those experiences. Fields notes it is important to make sure that not every moment is programmed. Surprise and delight are essential human needs.

"When you engage directly with the guests, they'll stay longer and they'll play longer, and then surprising things might happen."

RELATED EXPERIENCES

"The forum reinforced the notion that meaning for individuals comes from authentically felt experience rather than logically compelling facts."
-- Adam Skarke

EXPERIENCES

"This workshop helped me get out of my comfort zone, working with artists, philanthropists, activists, teachers, students, to think about the ocean in different ways."
--Colleen Peters

CONTENTS

MIT's motto "mens et manus" -- mind and hand -- inspired an array of hands-on experiences to complement speakers and panel discussions.

Founded in 1860 with the educational philosophy of "co-operation of intelligent culture with industrial pursuits," MIT reflects the ideal of cooperation between knowledge and practice. To that end, a number of hands-on and alternative experiences were incorporated into the forum in an attempt to expand upon some of the more theoretical concepts that were discussed in the panel discussions.

Workshops

Ten workshops were intended to reinforce the themes discussed each day in a hands-on, participatory environment. They were led by experts in oceanography, engineering, storytelling, art, and design, to address topics ranging from low-cost robotics to extended realities, community-driven exploration to crowdcomputing.

Lightning Talks

Twenty-seven students and Ocean Discovery Fellows highlighted their work to all forum participants through 2-minute Lightning Talks, giving early career scientists and nontraditional participants a platform on which to share their work.

Art of Discovery

The Schmidt Ocean Institute Artist-at-Sea program, along with two panel speakers, exhibited their work ranging from glass sculpture to painting, highlighting the breadth of work portraying ocean science and data interpretation. Forum participants engaged with more than 20 pieces in the gallery, bringing connection to the ocean through the arts.

Demonstrations

Demonstrations of nine projects allowed project leaders to present their research and results in an informal, conversational setting. Projects included advances in community-driven exploration, machine learning for automated analysis of underwater data, and a regional-scale perspective of coral reef health.

Boston Ocean Day

We deepened our commitment to engaging the public with a free event at the New England Aquarium's Simons IMAX Theater. More than 500 participants enjoyed one of our seven sessions that included underwater photography, animated television show screenings, discussions with scientists and ocean explorers, and other activities.

LEGO WAYFINDERS

This project combines LEGO Mindstorms, Scratch programming, and seawater into a playground of project-based learning for budding explorers. Pilot a LEGO robot in the Charles River and envision new directions for the Wayfinder!

Summary

This workshop served as an introduction to the first version of the LEGO Wayfinder — a remotely operated vehicle built with LEGO Mindstorm components and controlled with the online programming platform Scratch. The Wayfinder was designed as an educational tool for teens to learn about engineering and ocean science through hands-on, project-based learning. Its design emphasizes customizability, where students can pour their time and collaborative work efforts into creative engineering solutions to carry out a marine science experiment of their own design. In this workshop, experts in ocean exploration, art, recreation, and education came together to brainstorm different opportunities and future directions for the Wayfinder project.

The workshop started with a brief overview and presentation from the Wayfinder design team, giving participants an overview of the ROV's capabilities, the design process, challenges faced, as well as some initial failures and learnings. The majority of the workshop was spent outside on the Charles River, with participants piloting a Wayfinder and exploring the shores of the Charles. The workshop concluded with a reflection session, where participants imagined future features and applications of the Wayfinder in small groups.

Outcomes

- The beauty of using LEGO is that it makes the Wayfinder easy to build and extend, though there are some concerns about materials cost and durability.
- Turning this into a kit for schools and students is an exciting future direction.
- This kit could include materials to help teachers use it with existing curricula and align with education standards.
- There could be opportunities to engage and collaborate with existing DIY and maker communities.
- The next design iteration should consider: modularity, build time, materials cost, more sensors, longer tether, deeper dives, and harsher environments.

SHARED EXPLORATION BEYOND THE SCREEN

The ocean provides opportunity for immersive exploration. How can we recreate the joy of discovery in constructed experiences and interfaces by leveraging affordances of the ocean? How can we make a virtual tide pool in someone's living room or simulate a deep sea voyage?

Summary

Shared Exploration Beyond the Screen focused on immersive experiences with the idea that we can use them to help bring the ocean into environments and to populations that would not normally have access to it. The group first discussed what an immersive experience is -- an environment where people can use a combination of art and science to have great visuals and experiences that bring them inside a situation. A wide variety of these experiences are available today, from escape rooms to immersive theater to augmented and virtual realities.

Participants then proposed ideas and discussed three major themes:

- Scale: How can we bring the vastness of the ocean down to be accessible or to bring the microscopic up to be something understandable?
- Accessibility: How can we focus on inclusive design to reach underrepresented, indigenous, and landlocked communities such that designs are accessible to them?
- Scalability: How do we use the economy of scale to make this actually work? Consider hardware, content creation, scalability, and access.

A final overarching theme that emerged was how to bring art and science together to build something that is able to bring a message home and inspire people to learn, to open up and bring home more than simply, "That was really cool."

Outcomes

- Participants discussed the definition and examples of immersive experiences -- multisensory environments that bring people into a situation through art and science.
- Major themes that emerged include scale, accessibility, and scalability.
- Shared exploration must consider how to bring art and science together creatively to both pique interest through an exciting experience and inspire a person to learn and bring a message home.

AQUAGAMES

Swimming, surfing, diving, and other water-based activities go as far back as we've been a species. What if we could create new forms of games, sports, and activities that provide deeper connection to the environment around us?

Summary

Play is a universal human need, reducing stress and supporting mental well-being. Games are how we test and explore the possibility-space of ideas. What if we could use play to bring the ocean where there wasn't one? What if we could create new forms of games, sports, and activities that provided a deeper connection to the environment around us? How can we apply new materials and technologies to create playful experiences that take full advantage of the affordances of water? AquaGames is an ongoing series of workshops to explore, discuss, and design the history and future of play in, on, under, or with the water.

Workshop participants discussed the ludic possibilities of game design and how to develop pool games, playscapes , and puzzles that pass the love of the water to peers and future generations. They then delved into the realm of game design, sharing their favorite board games and playground memories from childhood, then extrapolated, augmented, or adapted these cherished activities to aquatic environments. Activities were suggested, evaluated, and sketched with an eye toward wide social adoption and equality, neuro-atypicality, and non-ableist affordances.

Outcomes

- Eight deployable aquatic-based experiences were imagined that could spread across scales from ocean to municipal swimming pool: Connect C4Ir, Flink, Wreck and Build, Blue Jello, Fish Run, Painting with Plastic, Obstacle Course, and H2Go.

- The activities developed span technologies and construction techniques from AR/VR, toy manufacturing, and ocean construction to grassroots and community driven citizen engagement.

- Game design allows a broad spectrum of neurotypicality and ability to participate in aquatic development and deployment, bringing to bear a larger population with a wider skill set and range of abilities than are traditionally present in ocean research. Privilege must be acknowledged and avoided from the inception of the original design sketch.

DESIGNING THE FUTURE AQUARIUM EXPERIENCE

What is the future of the aquarium in a rapidly changing world? How can aquaria adapt to the evolving frontiers of technological progress, megacity growth, and increasing human impacts on the ocean? Tackle these questions and more as we envision the Future Aquarium Experience!

Summary

Given the increasingly important conversation around the health and wellbeing of our planet, the New England Aquarium is transforming its role into that of conservation steward for our (blue) planet. Against a backdrop of technological progress and urban growth, this workshop explored what the aquarium experience might be 50 years from now. Specifically, participants worked in teams to develop ideas related to how the aquarium might operate according to three themes critical to conservation:

- expanding awareness of past and current critical issues,

- providing guidance toward actional steps, and

- projecting the impact of actionable steps visitors can take

This work was followed by three sessions:

- Unpacking the Values of Conservation: how the aquarium can convey the three themes

- Contextualizing Conservation: how ideas might manifest inside the aquarium, the city, or homes

- Telling the Story: development of one idea related to the future aquarium experience

Outcomes

- Expanded awareness of the New England Aquarium's new role as conservation steward.

- Discussion around the difficulties inherent to conveying the need for conservation. How can we tell difficult stories while maintaining a positive experience for visitors?

- How can we increase connections inside and outside the aquarium? Examples include increasing empathy by telling relatable stories about animals in the aquarium (e.g. every animal has a birthday), and creating walking paths through the surrounding city (e.g. Freedom Trail and Green Way).

TRANSMEDIA STORYTELLING

Storytelling formats are exploding as new technologies allow artists, designers, and engineers to explore new ways of engaging audiences and weaving dreams. Join us as we discover exciting new ways to tell the stories the ocean needs told.

Summary

Stories are how we understand the patterns of reality. Storytelling formats -- from film and television to graphic novels, alternate reality games to projection mapping -- are exploding as new technologies allow artists, designers, and engineers to explore new ways of engaging audiences and weaving dreams. Change makers in ocean exploration, entertainment, and art came together to discuss creation of multimedia content that engages audiences across formats to empower an inclusive global community of ocean explorers.

Workshop participants discussed the magic formula of storytelling and how to develop toolkits that translate passion, mission, and research into clear statements, and then take them into powerful narratives that reach across formats and audiences. They then explored and shared their passions in small groups in concise, impactful ways. Target audiences were considered on primary, secondary and tertiary levels, and how narratives should be modified, mindful of those levels and perspectives, in order to best reach people. Logline development, a brief summary that states the central conflict of a story and serves as an emotional hook to stimulate interest, was also practiced. This workshop included online participation by remote participants, facilitated by ML Learning.

Outcomes

- Use the storytelling formula to spur action and empower others.
- When creating narrative, draw from personal experiences and emotion. Where have you felt passion?
- Ponder who your audience is on primary, secondary and tertiary levels. Will they Wade, Swim, or Dive in?
- Modify narratives to address perspectives and write to the interests of others.
- Great stories have a villain, hero, challenges, and positive endings.
- Storytelling is an iterative process.

MY DEEP SEA, MY BACKYARD

Approximately 70% of nations have deep-sea environments, yet only 16% are able to explore them. We will discuss low-cost technologies that enable deep-sea exploration; cultural differences between states and countries; and, capacity building across cultural contexts. These topics will be discussed in the context of a recent pilot project, *My Deep Sea, My Backyard.*

Summary

My Deep Sea, My Backyard was a project that was born from the *Here be Dragons* event hosted by the Open Ocean Initiative in February 2018. The main goals of the project and workshop are to broaden access to participants' own deep sea "backyard" via (1) low-cost technologies, and (2) increasing the base of explorers and creating an inclusive culture of exploration. The workshop opened with an introduction to trial locations that do not currently have deep sea scientific capacity: Trinidad and Tobago in the Caribbean and Kiribati in the Central Pacific, as well as the technologies being used in those locations: the National Geographic Drop Cameras, and 2) the OpenROV's Trident, and 3) URI's custom-made deep sea reel camera.

Workshop participants broke into working groups to discuss the merits and challenges of these projects with regard to (1) technology, (2) culture, and (3) capacity, and to brainstorm solutions. Each group then had a "report-back" to the room. This workshop was a catalyst for inspiring and contributing to a community-based program for ocean exploration. Workshop participants came from a diversity of cultures, backgrounds, locations, and expertise, and all were able to engage with the concept, the low-cost tech, and the potential for expansion around the world.

Outcomes

- Technology: Exploration technology has to be easy to use, low-maintenance, and logistically simple. There was also a universal desire for more data-generating tools with additional sensors or recording capability.
- Culture: Participants considered: power of individual networks, including other aquatic exploration, urban vs rural contexts, and the need and value of an in-country project champion.
- Capacity: Suggestions included engaging community leaders, students, citizen scientists, and recreational fishers. There was also discussion about the role of higher education in capacity-building for exploration.

SEAFLOOR TO SATELLITES

This workshop aims to harness crowdcomputing and artificial intelligence (AI) for deep ocean exploration. We will present and discuss the science of crowd-powered computation, incentives for human-AI performance at scale, and best practices of a community of online citizen explorers.

Summary

Deep ocean ecosystems are an important component of our planet, but they remain scientifically underexplored. Traditionally, ocean research has been decentralized, restricting the advancement and sharing of knowledge.

While the advent of deep learning and unprecedented growth of datasets provide an exciting opportunity to decode patterns in deep ocean ecosystems, ocean datasets tend to be unlabeled, decentralized, and disorganized. Also, existing deep learning algorithms often fail to capture and incorporate human insights and local knowledge in scientific explorations, heightening the need for designing a centralized citizen science platform for collectively exploring the ocean.

Workshop participants discussed four major topics: (1) foundational and methodological building blocks to design citizen science platforms, (2) ethics and best practices of designing and empowering a sustainable community of citizen scientists, (3) leveraging expertly curated data and utilizing it to train uncurated datasets, and (4) making ocean citizen science intellectually stimulating. Each of these topics led to group exercises on harnessing underwater imagery and satellite data to develop a new citizen science platform. Overall, the workshop provided an important opportunity to harness crowdcomputing and AI for deep ocean exploration.

Outcomes

- Participants learned about the science of crowd-powered computational ecosystem and built intuition about developing a citizen science platform for ocean exploration.
- Ethical challenges may emerge while harnessing crowd intelligence with regard to privacy, intellectual property, and data rights.
- Two teams discussed challenges and opportunities in harnessing underwater imagery and satellite data that can be used for ocean exploration.
- Those with citizen science projects shared their work and received expert opinions about the issue they were facing.
- Participants collaborated and formed new connections.

DESIGNING A POP-UP DISCOVERY LAB

Explore how to design and implement a pop-up marine discovery lab. We will discuss how to identify areas of interest and inquiry, methods of shore-based analysis, community involvement, and making use of data generated from a pop-up lab.

Summary

The Pop-Up Discovery Lab Workshop explored how participants could design and implement a pop-up marine discovery lab within their own communities. We began by discussing a pop-up lab framework with considerations for: choosing the area of interest for exploration; who is involved in or impacted by this area of interest; identifying key values, external bodies, and potential funding sources; and a plan for collecting and disseminating the data generated.

We then discussed a selection of existing marine sensing projects and low-cost out-of-lab tools that have been developed to provide participants with the existing landscape. Following this, we paired up participants and provided guided worksheets and a plethora of craft materials for a rapid-prototyping session. The worksheets used the framework introduced in the session to lead groups through their ideation process for a new marine sensing device that could be used in their communities. Materials such as tubing, popsicle sticks, kazoos, and netting were used by the groups to build their sensing devices. Finally, the groups presented their area of interest and corresponding sensing device that they had designed, with most of the groups choosing to focus on citizen science-related sensors for marine monitoring.

Outcomes

- Participants received an overview of the pop-up discovery lab framework that could be implemented when identifying an area of interest for exploration
- Existing tools and projects that employ low-cost marine exploration and monitoring within communities were discussed
- Participants discussed potential areas of exploration within their local communities
- Pairs of participants worked together on rapidly prototyping the marine sensing devices that they ideated using craft materials
- Participants presented their prototypes, with many projects focusing on citizen science marine monitoring devices

DESIGNING TELEPRESENCE ACROSS SCALES

How do we construct systems for remote collaboration on small platforms with wider reach, given constraints like bandwidth, communication latency, and small budgets? Experience a live connection with NOAA Ship *Okeanos Explorer* or *E/V Nautilus* and help design the ideal remote presence environment.

Summary

The goal of this workshop was to host a robust discussion of telepresence in both its current form and to envision future forms of utilizing telepresence across a wide range of exploration platforms. Each session opened with a live interaction with either NOAA Ship *Okeanos Explorer* or Ocean Exploration Trust's (OET's) E/V *Nautilus* to give participants a first-hand look at the state of the art in ocean-going telepresence.

Both ships provided a summary of their current operations then they gave a short presentation about how they use telepresence then took questions from the workshop participants.

We then opened the floor to a discussion session. The diversity of the participants made for wide-ranging conversations about the strengths and weaknesses of the current format of telepresence and ideas for improvements. Broadly, the discussions naturally fell into two categories; education/outreach and science/exploration.

Outcomes

- Participants suggested that NOAA and OET prepare a best practices manual for conducting telepresence operations to lower the barrier to entry for new groups interested in using telepresence.

- Ways to improve two-way interaction between people on shore and exploration platforms was discussed at length. People on shore currently have limited ability to interact with those at sea. Improving the ability of the shore based participants to interact with the ship would likely attract more people to use telepresence and improve their experience.

- New technologies were discussed such as edge computing and the imminent bandwidth revolution that will come with the launch of low earth orbiting communication satellites.

- There was a lot of interest in developing the technologies and protocols to conduct real-time telepresence operations from smaller, more accessible platforms than *Okeanos* or *Nautilus*.

OCEAN IN TRANSFORMATION

We consider the ocean as an aesthetic device, as a sensorium. Gaps between modes of sensing, between the data, hint at new avenues of exploration and experience. This workshop was focused on finding emergent relationships between data affecting the understanding and transformation of the ocean.

Summary

Ocean in Transformation crossed the ocean through data, narrative, and senses, challenging participants with the question: *how to be within the ocean?* Participants explored the ocean as an aesthetic device, sensing transformation of the planet. Participants engaged in a four-step experiment focusing on two sessions, one on the Pacific and one on the Atlantic:

1. Look regions of the Pacific or Atlantic, and intersect the ocean with straight lines.

2. Identify entities that could be sustained in space and time across the lines, and how they are affecting their surroundings.

3. How are the surroundings affecting the entities?

4. Tell stories of the cycles identified in the process.

The final step was the most difficult, where datasets became engaging stories. Participants talked about relationships between whales and fish; the long history of slave trade and labor exploitation at sea; and, sea routes that are changing because of global warming. Gaps in the data, between modes of sensing, hinted at new avenues of exploration and experience.

Participants reached across disciplines to explore this undiscovered territory, ripe with new possibilities of creativity and expression.

Outcomes

- Geographical disorientation during the first step of the process allowed participants to engage with the key element of the workshop -- to think about the ocean as a set of interrelations.

- The ocean is the location of contemporary forms of knowledge production, and that allows us to think about the Anthropocene in a completely different way.

- Participants discovered and explored new interconnections between modes of sensing the ocean and new ways of expressing and sharing the wonder and delight of it.

ART OF DISCOVERY

Artists offer a deeper understanding of our ocean. They are important storytellers that create a new space for dialogue.

The Schmidt Ocean Institute Artist-at-Sea program, along with panel speakers Hansi Singh and Whitney Cornforth, exhibited their work ranging from glass sculpture to painting, highlighting the breadth of work portraying ocean science and data interpretation. Forum participants engaged with more than 20 pieces in the gallery during receptions and breaks, contributing to the discussion on how to bring more engagement to the ocean through the arts. Several of the artists including Lori Hepner, Lizzy Taber, and Whitney Cornforth, participated in the forum contributing their valuable experiences as sea-going artists. Presentations, displays, and workshops exemplified collaborations between artists and some of the world's leading marine scientists, using the ocean as a platform of connection.

Adam Swanson

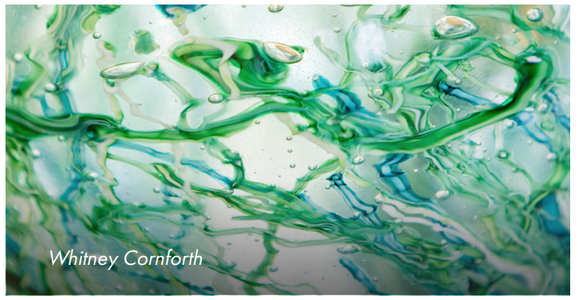

Jessica Orfe

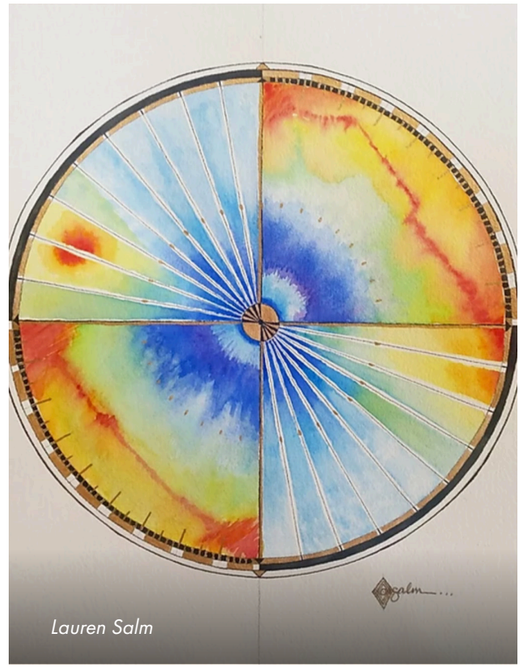

Lizzy Taber


Adam Swanson


Lori Hepner


Hansi Singh


Whitney Cornforth


Lauren Salm


Whitney Cornforth

LIGHTNING TALKS

Students and Ocean Discovery Fellows highlighted their work to all forum participants through 2-minute Lightning Talks. The talks spanned a wide variety of topics from new discoveries in the deep sea to community-driven exploration, complementing the six themes of *All Hands on Deck*.

LIGHTNING TALKS

Anna Guasco
University of Cambridge

Ocean conservation and exploration have significant work to do on issues of access, accessibility, and ableism. We must work together to ensure equitable access to participation and leadership in oceanic research, advocacy, and storytelling.

Fernanda Dobal
Royal College of Art & Imperial College London

Global insights from research in Tokyo, New York, and London on how technology is changing our relationship to nature and what role design might play in engaging young people with the environment.

Lizbeth De La Torre
MIT Media Lab

NASA's travel posters helped us imagine our future for space, particularly Europa, in a variety of different ways. We can use lessons learned to explore and imagine our future in the ocean on Earth.

Miles Lifson
MIT Media Lab

Integrating a museum experience and citizen science campaign has the potential to magnify the impact of both elements. We propose an integrated Antarctic experience to build the public's sense of connection to and stewardship over the continent.

Rebecca Rutstein
Artist

Multi-sensorial experiences can create connections between viewers and ocean places and processes that are hidden from view, forging a dialogue about climate change and environmental stewardship.

Megan Lubetkin
URI Graduate School of Oceanography

Synergist Volumes, an event series, catalyzes new perspectives through intentional curation of creative exploration and experimentation at the foundation of science and art. Each (free) event in the series focuses on a unique abstract theme.

Jonatha Giddens
National Geographic Explorer

The Dropcam program is integrating science, technology, art, and narrative-storytelling in a creative process of ocean exploration that aims to connect people with ocean places.

Nadia Meyers
Healing H2Os, LLC/ Storks Nest, LLC

Marine H2O + Human Body = Healing. Merging marine science with massage therapy to produce a new type of healing therapy using waters from around the world in massage treatments to transform water cells within the human body.

Kyle Sorensen
Singer-songwriter

Humorous, educational music videos about ocean exploration and the many marvels of the deep sea inspire children to form sympathetic attachments to abyss's coolest creatures and learn about its most unique features.

Nadiah Rosli
Freelance Writer

Local and personal stories about our ocean help us to construct narratives of change and disrupt normalization. These stories sensitize us to cultural and natural interactions we have with our seascapes and highlight marginalized and diverse voices.

Julie Jakoboski
MIT/WHOI Joint Program

We know ocean scientists care about the ocean, but what about the rest of the ocean community? A survey discovered exactly what the broader ocean community wants to know about the ocean and what they want scientists to study.

Samuel Mitchell
University of Hawai'i at Manoa

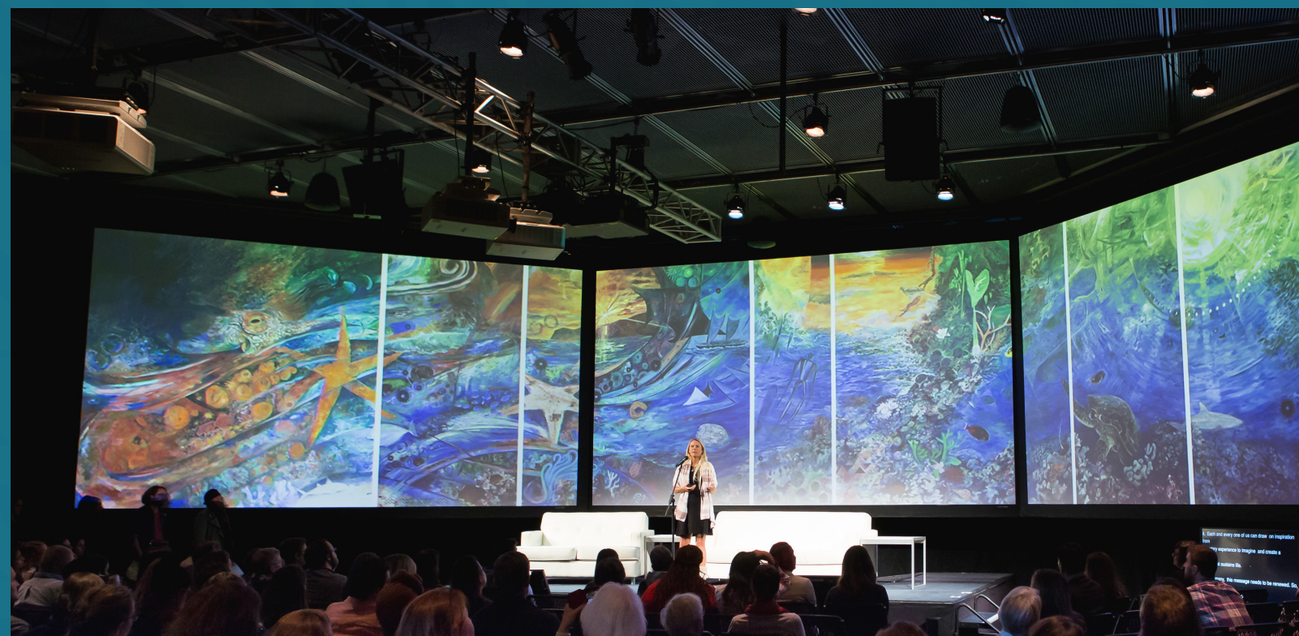
Social media is one of our greatest assets as a global platform for science communication. 'The Scicommunity' is a growing online community of scientists and educators from all backgrounds and walks of life.

Benito Juarez
Fab Lab Lima

Floating Fab Lab Amazon will navigate the river connecting global communities with local communities to develop solutions for many different problems, including detection heavy metals, oil, and urban waste.

Shanee Stopnitsky
The Institute for Emergence

The Community Submersibles Project is engaging makers, builders, dreamers, engineers and artists to experience and communicate the profound psycho-emotional and aesthetic qualities of exploring hidden deep worlds on our own planet.



LIGHTNING TALKS

Leigh Marsh
Oceansturn & University of Southampton

Most discoveries in ocean exploration are unplanned. Using novel applications of deep-submergence technology, we provide evidence of whales diving to abyssal depths (>4000 m) and utilising the deep seafloor in an area designated for mining.

Luis Lara
Chilean Geological Survey

About 40% of Chile's Exclusive Economic Zone is under some kind of protection, but the knowledge about it is still poor. Submarine hotspot volcanoes are windows to the Earth's interior, earth sciences, and national policy for the oceans.

Margaux Filippi
MIT/WHOI Joint Program

Coral reefs are vital habitats for a multitude of marine species and feed millions around the world. With a worldwide increase in coral mortality rates, we must protect these ecosystems and work towards sustainability for all.

Alexis Weinnig
Temple University

When we dive in the deep sea we find a higher marine diversity than we might have expected - often in areas beyond where habitat models have predicted. Therefore, it is important to implement exploration before we exploit what we don't know is there.

Aria Finkelstein
MIT Department of Urban Studies and Planning

We need more research on and better representation of the three dimensionality of ocean space to make sound policy and management decisions.

Sheena Talma
Ministry of Environment, Energy and Climate

Bold steps toward marine sustainability in Seychelles and using storytelling to convey why I became a marine biologist.

Zoleka Filander
Nelson Mandela University South Africa

South Africa has increased protection of marine areas from 0.4% to 5% in the last decade by identifying areas of high conservation interest, with the best available data. A key component for success is public communication about the importance of MPAs.

Harpreet Sareen
Parsons School of Design

Cyborg botany: Interaction design with plant-electronic hybrids allows new interactions with devices that are not digital. Plants can also sense of water quality and pollution analytes, becoming water quality sensors themselves.

Mara Freilich
MIT/WHOI Joint Program

Science for the People engages in research, activism, and science communications for the betterment of society, ecological improvement, environmental protection, and to serve human needs.

Andrew Thaler
Blackbeard Biologic & University of Maryland

The OpenCTD: creating a low-cost, open-source oceanographic instrument for science, education, exploration, and conservation.

Ernst van der Poll
ConnectOcean

ConnectOcean uses place-based ocean education, enabling mentors to teach youth about five marine ecosystems through citizen science, how to collect data, and spatial analysis of what they are recording.

Kaitlin Noyes
Bermuda Institute of Ocean Sciences

Ocean Academy's five programs equip students and teachers with a toolbox of transferable skills to understand the connections between human life and our ocean through hands on, inquiry based training.

Sebastian Kamau & Ashton Strait
MIT Media Lab

What are the different relationships that drive evolution in the ocean? How can we understand how new, artificial reef environments interact with the current population dynamics in the oceans, and engage in work that revolves around this practice?

DEMONSTRATIONS

Big Ocean, Big Data

Kakani Katija

Ben Woodward

Katy Croff Bell

Alexis Hope

Establishing FathomNet, a new baseline data set optimized to accelerate development of modern, automated analysis of underwater visual data.

More ocean data have been collected in the last two years than in all previous years combined, and we are on a path to continue to break that record. More than ever, we need to establish a solid foundation for processing this ceaseless stream of data. This is especially true for visual data, where ocean-going platforms are beginning to integrate multi-camera feeds for observation and navigation. Techniques to efficiently process and utilize visual data sets with machine learning exist and continue to be transformative, but have had limited success in the ocean world due to: lack of data set standardization; sparse annotation tools for the wider oceanographic community; and insufficient formatting of existing, expertly curated imagery for use by data scientists.

Building on successes of the machine learning community, we are developing a public platform that makes use of existing (and future) expertly curated data. Our efforts will establish a new baseline dataset, optimized to directly accelerate development of modern, intelligent, automated analysis of underwater visual data. This effort will ultimately enable scientists, explorers, policymakers, storytellers, and the public, to know what's in the ocean and where it is for effective and responsible marine stewardship.

Micronauts

Jeffrey Marlow

Ben Bray

Keith Ellenbogen

Raquel Fornasaro

Caroline Rozendo

Craig McClain

Inviting visitors on a journey into the dynamic world of microbes through an immersive, multisensory experience around cutting-edge scientific discoveries.

Microbes are the foundation upon which life on Earth depends: they set the boundaries of habitability for all plants and animals and create half of the oxygen we breathe. Ocean-dwelling microbes regulate the global climate and could hold the secrets to the origin of life. Put simply, we wouldn't be here without microbes, yet most people don't realize how ubiquitous and important they are.

The Micronauts project overcomes this concerning knowledge gap by building an emotional bridge. Microscopic creatures are, by definition, typically hidden from view, and the challenge of seeing them and perceiving their importance prevents emotional involvement and investment. Through an immersive, multisensory experience built around cutting-edge scientific discoveries, visitors—"Micronauts"—will venture into the dynamic world of ocean microbes. Aerial videography will provide regional context of the field site—Sippewissett salt marsh on Cape Cod—and a responsive, large floor projection will illuminate the frantic business of the microorganisms, as they go about their daily business of finding food, reproducing, transforming chemicals, and breathing metals.

The Micronaut journey is the first production of its kind, enabling a better understanding of the ocean through its microbial foundation and connect visitors with that process of discovery in an innovative way, revealing a vibrant world they never knew existed.

Boston Intertidal

Avery Normandin

Devora Najjar

Immersing neurodiverse Boston-area youth in urban coastal ecosystems to learn about the ecology of rocky and intertidal systems.

Field Exploration in Boston's Intertidal Zone was a two-day, hands-on educational workshop for neurodiverse youth in the Greater Boston area, in which participants used the city of Boston as a classroom, laboratory, and creative playground. Together, scientists, engineers, and artists took to the field as explorers in order to answer questions related to ecology, biology, chemistry, art, and more.

"Citizen science" (or Open Science) movements have generated robust momentum for allowing communities to delineate the natural world—or speculate on its future—in hands-on and creative ways. As part of a larger effort to cultivate a future generation of environmentally engaged and justice-focused citizen scientists—and in line with the outreach efforts of the Media Lab's Open Ocean Initiative—we developed Field Experimentation in Boston's Intertidal Zone: a two-day pilot workshop for Boston-area neurodivergent (e.g., autistic, dyslexic, dyspraxic, ADD, ADHD) youth, in which participants dove head first into the ecology of rocky and intertidal systems, developed a hypotheses surrounding these bodies, and subsequently executed field investigations to test hypotheses.

We envision that use of easy-to-access, public sites for the pilot workshop will further democratize the potential to recapitulate similar endeavors in ecological exploration and immersive learning.

Ocean Cultures

Devora Najjar

Avery Normandin

Integrating modern data and indigenous knowledge as a new platform for community-led monitoring of marine microbial ecosystems in New Zealand.

Māori have a long and deep connection to their island and ocean ecosystem. The Māori concepts of Rahui and Mātaitai reserves focus on traditional methods of ocean protection that long predate marine protected areas. Ocean Cultures hopes to support the younger generation of islanders to understand and monitor their own ocean surroundings at a time when it is critical.

We hope to do this through a dual set of tools, monitoring through science as well as culture. Monitoring through science will consist of educational hands-on workshops teaching participants fundamental concepts within marine ecology, which governs the health, biodiversity, and innumerable processes that occur on our planet. Additional workshops on low cost sensors and remotely operated vehicles (ROVs) will be explored as well. To monitor through culture, we hope to collaborate with Māori kaumātua to teach participants traditional and cultural knowledge about their ocean ecosystems and how best to preserve that though generations.

DEMONSTRATIONS

Project Prometheus

Allan Adams

Jake Bernstein

Corey Jaskolski

Kenny Broad

Developing and deploying a low-cost, high-resolution underwater 3D camera system to quickly and beautifully map caves, coral reefs, and sunken cities.

Most of the underwater world remains far off the map. For many of the most exciting exploration challenges–from Maya cenotes to urban aquifers to archaeological treasures to coral reefs–map-making remains largely pre-industrial and time consuming. The difficulty and expense of mapping these spaces is a major barrier to storytelling for science, conservation, and stewardship. While many tools exist for open-ocean bathymetry (such as multibeam sonars), cost-effective diver-deployable tools for rapidly mapping complex and enclosed spaces are sorely lacking. Our goal is to create diver-deployable tools that are orders of magnitude faster, more precise, and less expensive than current practice–to enable mapping and imaging of these underwater resources at a societal scale.

To this end, we are developing low-cost, high-resolution, diver-deployable underwater optical 3D scanning and navigation systems with which to quickly, safely, and beautifully map caves, aquifers, coral reefs, sunken cities, and other large-scale underwater spaces. To satisfy scientific and storytelling needs, these devices must be easy to use, have fine spatial resolution, map at swimming speed, produce data in industry-standard formats, and be completely open source at both hardware and software levels.

My Deep Sea, My Backyard

Randi Rotjan

Diva Amon

Alan Turchik

Brian Kennedy

Alexis Hope

Brennan Phillips

Katy Croff Bell

Empowering developing countries to explore their own deep-sea backyards using low-cost technology, while building lasting capacity.

70% of nations have deep-sea environments within their Exclusive Economic Zones, yet only 16% are able to explore them. This is especially true for less economically developed communities. The dearth of technological capability and knowledge leads to a lack of exploration, inappropriate or inadequate management decisions, and unaware populations. Our goal is to empower communities to explore their own deep-sea backyards, while building lasting local capacity.

Our pilot project takes place in two small island developing states—the Republic of Kiribati, and Trinidad & Tobago. It utilizes Deep-Sea Drop Cameras developed by National Geographic's Exploration Technology Lab, OpenROV's Trident remotely operated vehicles, and a custom-built ReelCam. All technologies collect compelling imagery, but require minimal resources and expertise. In our pilot study during summer 2018, our team members traveled to each country to train a group of scientists, students, and communicators in the use of these technologies, which are to be left in-country for further exploration. Next steps include training in data analysis and creation of outreach materials for sharing discoveries and knowledge with the local communities.and immersive learning.

Connected Coral

Emily Salvador

Nina Lutz

Creating a tangible, at-scale experience telling the story of coral reef bleaching and climate change that can help individuals empathize with the ocean.

Connected Coral integrates physical and digital elements in a visualization of the environmental impacts on reefs. This complex projection mapping uses multiple projectors, angled mirrors, and a motion sensor to create an interactive digital skin on a complex three-dimensional surface.

To integrate the projected content with the physical design, the students fabricated the physical coral model based on photogrammetry scans of real coral, warped and blended the projected areas, and factored in hardware specifications. These modifications minimize visual distortion on the uneven surface and allow for an uninhibited interactive experience.

This project was created through the Open Ocean Initiative and was on display at the MIT Museum through Spring 2019.

Wheels of Poseidon

Dan Oran

Rachel Smith

Generating a living, glowing display built of bioluminescent plankton stimulated by a programmable pattern of pressure waves in the water.

Throughout the ages bioluminescence has inspired myths. Long ago, sailors in the Indian Ocean encountered massive bioluminescent blooms as they sailed through the water, lighting the wakes of their ships like the spokes of a wheel carrying them to their destination in a chariot of wind and water. They called this phenomenon "The Wheels of Poseidon". Our goal is to harness the beauty of bioluminescence to create a new medium for artistic expression. We will generate a living, programmable bioluminescent display, with pixels and voxels built of bioluminescent plankton (Pyrosystis fuciformis) floating freely in the water column and stimulated to glow by a programmable pattern of pressure waves in the water.

100 Island Challenge

Stuart Sandin

Jennifer Smith

Brian Zgliczynski

Clinton Edwards

Nicole Pedersen

Chris Sullivan

Hugh Runyan

Falko Kuester

Vid Petrovic

Dominique Rissolo

Eric Lo

Christopher McFarland

Investigating how reefs are structured, how they change over time, and how we can better manage them in the face of global change.

Coral reefs cover less than 0.1% of the Earth's surface, yet are estimated to support greater than 25% of marine biodiversity, providing shoreline protection and food security for hundreds of millions of people. Alarmingly, a combination of local human influences and global climatic changes are altering the structure and function of many reef ecosystems. We are conducting a campaign of field surveys across the tropical Pacific and beyond that will generate critical data about reef ecosystems through time, establishing a regional-scale perspective of coral reef health.

To collect more detailed demographic and spatial information on the benthic communities, we employ a large-area imaging approach. At each island, 6-8 100 m2 plots are established and georeferenced, enabling repeat surveys of the exact same area over time. Within each plot we capture 2,000-3,000 individual images, which are combined using structure-from-motion software to create detailed 3D models of the benthos, as well as distance-corrected 2D models similar to satellite imagery. Once the models have been created, we use a custom point-based visual analytics engine to visualize models and extract spatial ecological information. We revisit each plot after 1-2 years, allowing us to watch life-death processes and track the fates of thousands of individual organisms. With the gathered data and resulting models, we hope to increase our understanding of the factors controlling reef development across physical and ecological gradients.

BOSTON OCEAN DAY

On Saturday, November 10, we deepened our commitment to engaging the public with a free event at the New England Aquarium's Simons IMAX Theater. More than 500 participants -- locals, tourists, families, young adults and mature -- were drawn into the IMAX theater over the day to enjoy one of our 7 sessions that included mesmerizing underwater photography, animated television show screenings, Q+A's with scientists and ocean explorers, live interaction with an oceanographic research ship, panel discussions, and a 45-foot long inflatable humpback whale for guests to walk inside!

"The Deep" Animated Show Screenings and Science Q&A

The Deep is an animated TV show from Universal Kids and Netflix, based on the eponymous comic book by Tom Taylor. It follows the fictional Nekton family as they uncover the secrets of the deep sea. They work and live underwater, protect its fascinating marine life, and come across adventure and discovery! Screenings were introduced by Technicolor's Pam Kunick-Cohen and followed by a Q+A with an expert in the science portrayed on the show. The animated show screening was presented by Universal Kids and Netflix.

The Deep "Junior Nektons"

Fontaine and Antaeus are visited by their fan club while dealing with two life threatening situations with a pod of Sperm Whales. Q+A on whale entanglement with Amy Knowlton.

The Deep "The Field of Giants"

The Nektons race to save a new species of Giant clams, before a new underwater volcano can erupt. Q+A on underwater volcanoes with Dr. Samuel Mitchell.

The Deep "The Bloop"

The Nektons race to save the creature behind the Bloop from a Deep Sea Mining Machine. Q+A on marine acoustics with Dr. Adrienne Copeland.

PUBLIC LECTURES

Exploring our Ocean Backyard: Local Waters Through the Eyes of Animals

A panel discussion featuring Kara Dodge and Amy Kukulya investigated technological advances in tags and underwater robots that are allowing us to go beneath the surface and follow these mysterious animals, giving us a glimpse into their daily lives. We are starting to be able to answer difficult questions, such as: How many jellyfish can a leatherback turtle eat? What does a white shark do at night? Where does a bull shark spend its day? And how do local conditions impact animal behaviors?

Dive Deep into Ocean Exploration

We dove deep into the world of ocean exploration with experts in the field, Dr. Alan Leonardi, Dr. Diva Amon, Dr. Randi Rotjan, and Adrienne Copeland. Guests learned about state-of-the-art deep sea exploration, asked questions of ocean exploration experts, and joined the conversation with NOAA Ship *Okeanos Explorer* as it investigated the deep waters and water column organisms off Puerto Rico.

Space to Sea: A Photographic Journey into Stellwagen Bank National Marine Sanctuary

Keith Ellenbogen and Dr. Tom Consi explored the local marine habitat of Stellwagen Bank National Marine Sanctuary just 25 nautical miles outside of Boston. Beneath the surface is a dynamic environment with extraordinary marine wildlife that includes apex predators such as great white sharks, ocean giants like humpback whales, schools of mackerel, and an entire microscopic ecosystem of planktonic creatures that are even visible from space. Guests learned about their expedition through a photographic journey.

Stellwagen Bank National Marine Sanctuary

Within the Simons IMAX Theater lobby, Stellwagen Bank National Marine Sanctuary invited the public to experience Salt, the sanctuary's inflatable, life-sized humpback whale. Children were able to walk inside Salt, where the magnitude and reality of a whale's anatomy came to life. Stellwagen Bank National Marine Sanctuary staff shared with the guests the riches of this nearby marine protected area, a site of vast biodiversity that serves as precious whale feeding and nursing grounds.

PLAYLIST

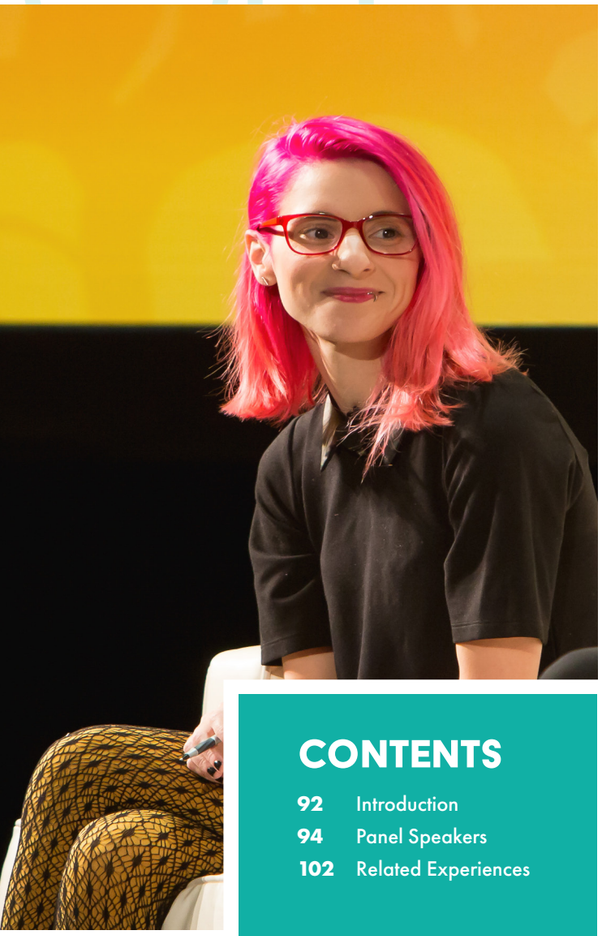
Curated by Katy Croff Bell

Beyond the Sea, Bobby Darin
Boots of Spanish Leather, Bob Dylan, The Times They are A-Changin'
Bustin' Surfboards, Tornados
Calypso, John Denver, Windsong
Captain Octopus, Pat Dailey, Underwater Land
Catch A Wave, The Beach Boys, Endless Summer
Cuttlefish, Pat Dailey, Underwater Land
Fisherman's Blues, The Waterboys, Fisherman's Blues
I Used To Be A Sailor, Tracy Chapman, Matters of the Heart
I'm Always Here, Jim Jamison, Baywatch
Ickety-Ackity, Pat Dailey, Underwater Land
Jamaica Farewell, Harry Belafonte, Calypso
Les Poissons, Rene Auberjonois, The Little Mermaid
Let Me Tell You About My Boat, Mark Mothersbaugh, The Life Aquatic with Steve Zissou
Misirlou, Dick Dale
Octopus's Garden, The Beatles, Abbey Road
On the Good Ship Lollipop, Rudy Valley with the Stewart Sisters
Open Sea Theme, Sven Libaek, The Life Aquatic with Steve Zissou
Part of Your World, Jodi Benson, The Little Mermaid
Ping Island, Mark Mothersbaugh, The Life Aquatic with Steve Zissou
Sail Away, David Gray, White Ladder
Shiny, Jemaine Clement, Moana
Shiver Me Timbers, Tom Waits, The Heart of Saturday Night
Sitting on the Dock of the Bay, Otis Redding
Sloop John B, The Beach Boys, Pet Sounds
Surf Rider, The Lively Ones
Surf Wax America, Weezer, The Blue Album
Surfin' Safari, The Beach Boys, Endless Summer
Surfin' U.S.A., The Beach Boys, Endless Summer
Team Zissou, Seu Jorge, The Life Aquatic with Steve Zissou
The Banana Boat Song (Day-O), Harry Belafonte
The Mermaid, Great Big Sea, The Hard and the Easy
The Minnows, Pat Dailey, Underwater Land
Under the Sea, Samuel E. Wright, The Little Mermaid
Underwater Land, Pat Dailey, Underwater Land
We Know the Way, Opetaia Foa'i, Moana
Whale of a Tale, Jim Salestrom, Nautilus
When the Ship Comes In, Bob Dylan, The Times They are A-Changin'
Will and Elizabeth, Klaus Badelt, Pirates of the Caribbean
Yellow Submarine, The Beatles, Revolver
Yo Ho (A Pirate's Life For Me), Pirates of the Caribbean
You're Welcome, Dwayne Johnson, Moana

CREATE

INTRODUCTION

"One powerful way to open up a conversation is with our hands — through making things, and through the arts."
--Alexis Hope



CONTENTS

Building connections and engagement through the arts

How can we use the arts to broaden participation in science and open up conversations about the future of our oceans? The theme, CREATE, explores the practice of four working artists who all use different approaches to reach new audiences and share their passion for the natural world.

Daniel Kohn is an artist whose work stands at the crossroads of art and science. Long immersed in questions of place and representation, his engagement with science began in 2003 when he was invited to the Broad Institute where he became Founding Artist in Residence and co-founded the Viz Group. He now co-leads a 4-year National Academy of Sciences interdisciplinary grant based on the question: Does the ocean have memories?

Hansi Singh began knitting peculiar undersea oddities following the birth of her son in 2006, inspired by hours spent marveling over the fauna at the Seattle Aquarium with her newborn. In the following years, her knitting brand Hansigurumi became synonymous with hyper-realistic knitted cephalopods, anglerfish, and other sea creatures. Now, with a PhD in Atmospheric Sciences and Applied Mathematics, she remains interested in how awareness of the ocean through science and art can inspire action on pressing issues.

Geoff Shelton is a filmmaker whose work has been featured on the websites of numerous publications including: Rolling Stone, Vanity Fair, Spin Magazine, Time Magazine, NPR, AOL and HuffPost. Shelton's documentary work with the band OK Go has accumulated over five million views across multiple platforms and was featured on CNN, ABC News and premiered at the Museum of Contemporary Art in Los Angeles.

Magical childhood summers in Maine kindled Whitney Cornforth's love for the ocean and a passion for creating all manner of things. While earning degrees in Naval Architecture and Marine Engineering at MIT, he discovered glassblowing, and the course of his life was dramatically changed. Upon graduation in 2001, he decided to pursue glassblowing full-time. Cornforth now teaches at the MIT Glass Lab, while exploring his own designs and ideas.

Anteaus Nekton | The Deep

SPEAKERS

Daniel Kohn
Kohnworkshop

Hansi K. A. Singh, PhD
Hansigurumi & University of Victoria

Geoff Shelton
Hank Films & OK Go Sandbox

Whitney Cornforth
MIT Glass Lab

MODERATOR

Alexis Hope
MIT Media Lab

"To see the ocean, we may have to shift our point of view. Not just shed light on it, but perhaps even leave light behind, and find other ways to hear, touch, sense, smell."

DANIEL KOHN

Exploring questions artists bring to research.

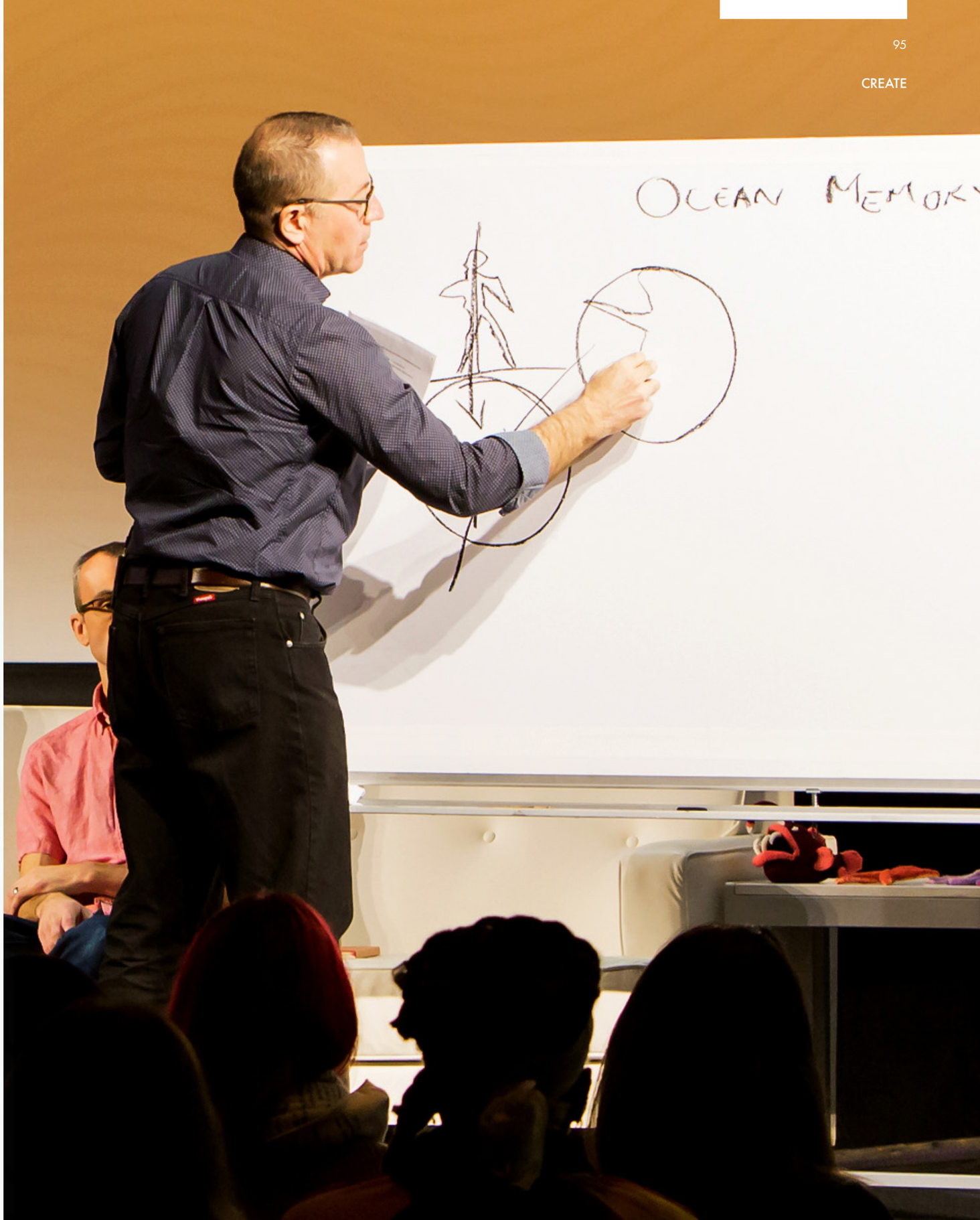
Can connecting with our senses help us understand the ocean?

Kohn is a painter who explores intersections between art and science. He is a co-Principal Investigator of the Ocean Memory Project, which aims to connect people to the ocean through storytelling. The collective embraces a diversity of stories—from the scientific to the sensorial—in hopes of helping humans understand the deep rhythms of nature.

The world is made up in large part by the ocean, yet our connection with it is mostly intellectual, says Kohn. The senses we rely on—sight and touch—no longer work when we talk about a dark and pressurized environment. Marine organisms, however, find the ocean to be rich in meaning, gathering signals about pressure, chemical makeup, salinity, and more.

How can we help humans make meaning of the ocean, in order to learn from past events and predict future outcomes?

"We see memory as a core component of life. An ocean memory encourages us to think of the ocean as made up of living elements, both biotic and abiotic, in gene and geology, in stasis and flow."



“How do we bring the ocean into our lives in a central way? “

HANSI K. A. SINGH

Using knitting and hand-craft to explore undersea oddities

Can we use unexpected artistic media to explore the ocean?

Singh is a knitter and a scientist with a passion for creating marine creatures with anatomical accuracy. She likens knitting to computing code, with lines, numbers, and instructions that make up a pattern. In addition to knitting incredible creatures, she has also pioneered new models for making art, not just showing her work in galleries, but sharing her knitting patterns with the world.

Singh nurtures a community around her patterns, where people help each other and “remix” or modify elements of her knitting code. By creating art that can be replicated by others, She is helping others discover their own passion for the ocean.

“There’s a nautilus hovering over the dining room table, and the big question that this brings up is: how can we bring the ocean so deeply into our lives, into our metaphorical living rooms? One way is through art.”

"I think the real life application of science is what our kids need to see. Far too often, they see what happens within four walls, and don't see the relevance of the science, technology, engineering, mathematics in the real world."

GEOFF SHELTON

Using video arts to help students get real-world knowledge of science, technology, engineering, and math

What unique teaching methods can help students become more passionate about science?

Shelton is a filmmaker who works with the band OK Go to document "behind the scenes" of some of their popular music videos. OK Go's music videos are highly technical and creative—for example, they shot the first music video in zero-gravity! Shelton works to explain science and engineering concepts that make these videos possible.

Shelton also works on OK Go Sandbox, a free online platform that helps teachers use the music videos as entry points into teaching. Music videos can help start discussions about things like art, math, and science. Can playful, video-based learning also be useful for helping students better understand ocean science?

"Right now, we know that there are teachers out there who are using our art to actually do something really good in the world, and that's such a rare and wonderful thing, that we just want to help it."

"At the time I made the decision to become a glassblower, it seemed fairly insane. I had never been particularly artistic, and I'd just spent all this time in engineering school."

WHITNEY CORNFORTH

From marine engineering to glassblowing — falling in love with the ocean through craft

What does it look like when you blend engineering with the arts?

Cornforth grew up on the ocean and came to MIT to study Naval Architecture and Marine Engineering. While studying, however, he discovered glassblowing and was hooked. When he finished his Master's in engineering, he became a full-time glassblower. Now his pieces use a glass vocabulary to explore the feeling and beauty of the ocean.

Cornforth says that glass has so many similarities to the ocean. His pieces are reminiscent of kelp moving in the sea currents, the refraction and reflection of ocean waves, the texture of seashells, and more. All of this helps us rediscover our instinctual connection to the sea.

"I can't try to replicate it and do justice to what nature does, but I constantly borrow ideas, and try to use glass in ways that captures some of that feeling that the ocean evokes."

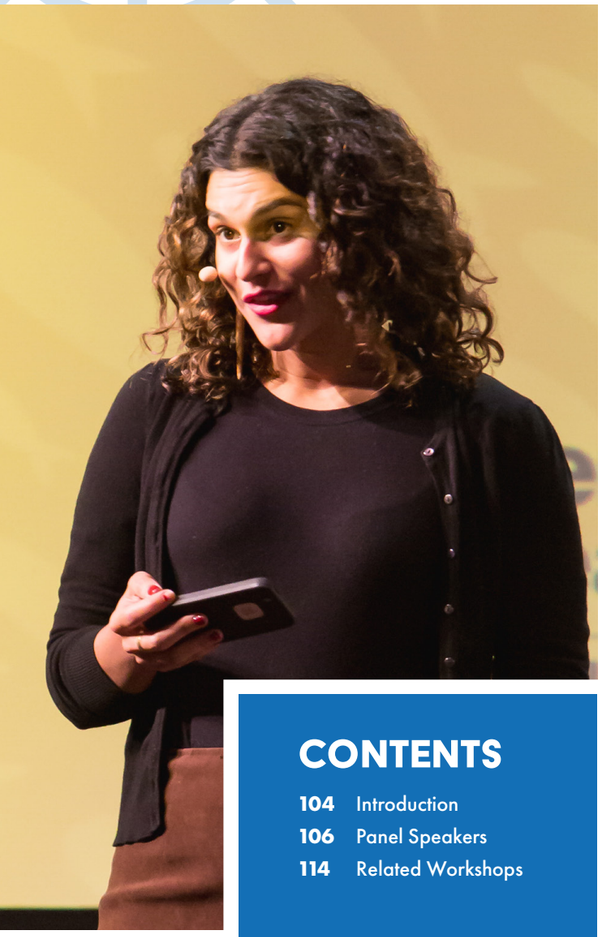
RELATED EXPERIENCES

"Connecting to problems from the heart, not just from a scientific perspective, can be both a powerful motivator and generate creative solutions."
-- Beckett Colson

EXPLORE

INTRODUCTION

"We have the necessary skills; so how do we broaden participation past the incredibly elite model of sticking a handful of experts on a ship in the middle of the ocean?"
--Diva Amon



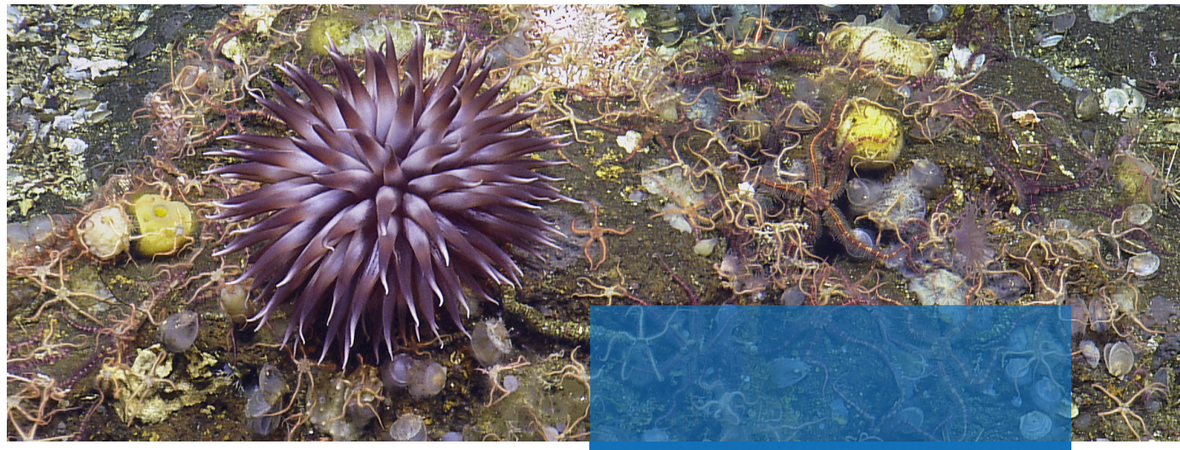
CONTENTS

Empowering a global community of ocean explorers

Through the theme EXPLORE, leaders and change makers in ocean science and exploration discuss ways to empower an open and wider global community of explorers who can then engage in and benefit from new technologies and scientific understanding of the ocean.

Alan Leonardi, is Director of NOAA's Office of Ocean Exploration and Research, the only federal program dedicated to exploring our deep ocean and delivering the data needed to strengthen the economy, health, and security of our nation. He discusses OER's mission its approach that catalyzes exploration and uses unique capabilities, technology, and infrastructure to explore the largely unknown ocean. How can we expand capacity to explore?

Antonella Wilby is a PhD student, National Science Foundation Graduate Research Fellow at the Contextual Robotics Institute at the University of California San Diego, and a National Geographic Explorer. She develops autonomous underwater vehicles to explore extreme environments, such as those we find in the ocean. How can we use robots to push the limits of our current understanding of ocean exploration and hasten data availability?



Allan Adams leads the MIT Future Oceans Lab where his team is developing low-cost tools for ocean exploration to document the world's changing ocean. The cost of technologies used to study the ocean make much of the core domains of ocean exploration unobtainable, often bottlenecked by bringing commercial, at-scale, already commoditized technology into the ocean. How can we decrease the cost of tools needed to explore?

Elizabeth Tyson is a National Geographic Fellow in the Citizen Explorer Lab, refining programming on public participation in scientific research. Tyson provides an overview of legal and administrative barriers influencing the practice of citizen science and highlights an initiative called Earth Challenge 2020 that has a goal of one billion data points by one million citizens on the 50th anniversary of Earth Day. How can citizen science advance your mission?

Jeffrey | The Deep

SPEAKERS

Alan Leonardi, PhD
NOAA Office of Ocean Exploration and Research

Antonella Wilby
University of California San Diego

Allan Adams, PhD
MIT Future Oceans Lab

Elizabeth Tyson
National Geographic Fellow

MODERATOR

Diva Amon, PhD
Natural History Museum London

"We're looking for a more active national program. This isn't just about NOAA and NOAA's program, it's about a national program."

ALAN LEONARDI

Catalyzing a broader community to explore the deep ocean

NOAA's Office of Ocean Exploration and Research (OER) provides high-value environmental information needed by the U.S. through exploration of the world's deep ocean and catalyzes others to work in this space through a collaborative, cross-disciplinary program that matches exploration needs with assets, enables technology demonstrations, and trains and inspires the next generation of explorers.

OER is the only federal organization dedicated to exploration of the deep sea and it conducts telepresence-enabled mapping and exploration using the NOAA Ship *Okeanos Explorer* and remotely operated vehicle *Deep Discoverer*, collecting high-resolution mapping data and video, oceanographic measurements, and biological, geological, and water samples.

The program seeks continuous input from a broader community through regional and national level discussions and actively works toward making its rapid output data even more accessible and nimble. OER is calling for a more robust national program.

"It's about getting the broad community together to explore this relatively unexplored place."

"One day, we'll have millions of robots of all shapes and sizes, working alongside humans to explore the ocean."

ANTONELLA WILBY

Pushing the limits of ocean exploration through robotics

Imagine developing a swarm of underwater robots with the goal of scaling up the ability to create ultra-high resolution large-scale maps of coral environments as a tool for understanding coral reef resilience in the face of ongoing problems like pollution, ocean acidification, and climate change.

Wilby's collaborative effort with Scripps Institution of Oceanography is called the 100 Island Challenge and has the goal of creating such maps for 100 different islands across the world as a tool for understanding reef resilience. She is also working on building more robust algorithms around low-cost vehicles in order to make the technology more accessible to researchers working in the marine space, and more accessible to ecologists working in remote areas, or who do not have the support of really large research vessels.

When robots get out of the water in the future, scientists may be handed data that they can use to draw conclusions through annotation of data using machine learning in real time.

"The goal isn't to replace humans -- it is to augment the human capacity to do science in the field through advanced robotics."

"When you think about building things at scale, it's a very different calculus, and the cost comes down dramatically."

ALLAN ADAMS

Increasing access to unknown ocean domains by building technologies at scale

Much of the core domains of ocean exploration are unobtainable due to the cost of technologies available for use.

Adams is focused on radically decreasing the costs of tools used to explore and sense in the ocean through two ideas: (1) commodity electronics and manufacturing at scale can dramatically bring down the cost of technologies, and (2) the four decimal place accuracy that can drive up cost is not needed for many efforts of current concern. This allows for economies in design.

With this premise, Adams' team is creating low-cost, low-power sensors and high-end cameras for ocean exploration, and with designs and codes available open-source. To understand the bulk of the ocean where most of life lives, there is a need to radically decrease the cost of the tools used to explore and sense.

"Designing for manufacturing at scale will dramatically change what's possible."

"Citizen Science is a form of mass collaboration to advance scientific research, ... which existed long before science became professionalized."

ELIZABETH TYSON

Legal and administrative barriers influence the practice of Citizen Science

Citizen science addresses societal needs, encourages hands-on STEM education, and advances scientific research at scales and costs that were previously not imaginable, especially for the ocean.

Foundational documents are publicly available that cover legal and administrative gray areas that were being encountered by academics and government practitioners, and creating barriers. These reports address intellectual property rights of researchers and volunteers who participate in projects; review U.S. laws that invite the public into discourse about making decisions about the environment; and describe legal issues affecting federal agencies that prevent or slow down leveraging citizen science practice.

A new initiative called Earth Challenge 2020 also addresses a well-known issue in citizen science, silo-data collection, the lack of global coordination. Eighty percent of the work is actually the collating of it and making it accessible. This global initiative has been designed in part with this challenge in mind. The goal is one billion data points by one million citizen scientists on the 50th anniversary of Earth Day in April 2020.

"Citizen science addresses and advances scientific research."

RELATED EXPERIENCES

"Literally anyone can be involved in ocean exploration, no matter what skills they possess. There is a role for any and every skill set."
-- Rachel Kahn

CONNECT —

INTRODUCTION

"How can we bring together everyone to be an explorer, and a steward of the ocean?"-- Danielle Wood

CONTENTS

Connecting people to the ocean and to each other

The final theme, CONNECT, emphasizes the critical importance of finding a way of connecting people with the tradition, ecology, and community that surrounds them in order to foster a culture of stewardship on our blue planet.

Margarita Mora embodies the deep connection between people and place. As Director of Partnerships at Nia Tero, she focuses on how to support indigenous communities who, for centuries, have served as guardians to their native lands. How can we recognize, partner, and support these communities and their culture to continue to control and protect their marine ecosystems? And how can we amplify the voices of indigenous communities to ensure lasting protection?

Mark Pierce is the Senior Student Engagement Programs Director a City Year, as well as a City Year Americorps alumni. The City Year program aims to close the gap in high-need schools through additional support for the academic and emotional wellbeing of students, as well as providing out-of-school programming to enrich students' educational experience. How can programs like City Year be used to connect students to the water around them and foster a culture of exploration?

Tierney Thys is a biologist, filmmaker, Research Assistant at the California Academy of Sciences, and National Geographic Explorer. Recently, she has focused on connecting populations that are deprived of nature, including urban communities and incarcerated individuals, to their surrounding environment. How can we connect what we know about human behavior to improve mental health and create stronger campaigns for environmental protection?

Madeleine Foote works as the manager of the National Geographic's Open Explorer. The Open Explorer platform originated in the OpenROV community, and is now being used to empower and connect the broader public with deep dives into how day-to-day science and exploration is conducted. How can we leverage these platforms to inspire a new generation of ocean explorers?

Captain Hammerhead| The Deep

SPEAKERS

Margarita Mora
Nia Tero

Mark Pierce
City Year

Tierney Thys, PhD
California Academy of Sciences and National Geographic

Madeleine Foote
Open Explorer, National Geographic

MODERATOR

Danielle Wood, PhD
MIT Media Lab

"What kind of ancestor will I be? What kind of ancestors will we collectively be?"

MARGARITA MORA

We must support the guardianship of indigenous communities to protect our planet's biodiversity.

Not only do indigenous communities hold the highest concentration of culture, but they also are protectors of much of biodiversity left on Earth. Unfortunately, these same communities have been manipulated throughout the centuries, with Mora highlighting the importance of local land control for indiginous communities to sustain their culture and local ecosystems.

Island communities in the Pacific control about 10% of the Earth's surface and are home to a rich but threatened marine ecosystem that includes more than half the annual tuna catch. These communities need recognition, support, and partnership to continue their work in protecting the future inheritance of their children.

"If we have the capacity to start thinking about well-being, not in terms of what we take, but thinking about what we can leave behind, maybe we will be able to manage the identity crisis that we have as a society, and face some of the most pressing environmental challenges of the century."

"The goal of CityYear volunteers is to be that additional set of eyes, ears, and heart in the classroom, to be there for a student, and to create opportunities."

MARK PIERCE

Enrichment opportunities to connect middle and high school students with ocean exploration

How can we inspire the next generation of ocean explorers through engaging enrichment programming?

Pierce is passionate about his job at City Year, which could be because he served in classrooms for City Year and has seen firsthand the results of their work. A significant component of the program is in-classroom help, which allows for a more meaningful experience in the classroom that has both academic and socio-emotional benefits to students.

But what excites Pierce most is the possibilities to expand enrichment programs offered after school. These programs can provide curricula and experiences that are not part of the state requirements, but give the students a chance to learn something new and improve their likeliness to graduate high school. In particular, getting students in the Boston area to build and deploy their own LEGO underwater robots with the support of MIT is a unique opportunity to allow students to take a peek into otherwise inaccessible aquatic world around them.

"How we can get opportunities into our classroom, for students who live just, in many cases, a mile or less from the ocean, but don't necessarily get to explore it?"

"We need to be able to wayfind, without leaving the blue and the green, and our humanity, and our sanity behind."

TIERNEY THYS

Leveraging neuroscience to improve mental health and environmental protection

We can use the neuroscience of how humans respond to nature to strengthen connections to the environment.

Thys is no stranger to science communication, as a biologist who is also a filmmaker and has created video content aimed at all ages. As a researcher, she has the privilege of receiving all of the physical benefits to exploring within nature and recognizes how rare that is within our increasingly urbanized society. In response, Thys researches ways of improving mental wellbeing for incarcerated populations by integrating rooms that provide inmates some of the benefits of the outdoors, which has been shown to reduce discipline referrals and increase wellbeing.

Thys is also working with researchers at Stanford University to understand how human brains respond to some of the most popular images that National Geographic posts on Instagram. She hopes to connect our understanding of what our brains are drawn toward to the design process of environmental protection campaigns for more engagement.

"As we careen into being a fully urban species, we need to be able to not only navigate our way into this fast-moving future, but also figure out how to navigate the dark waters of our cerebral seas."

"How do we create an accessible way for the public to dive deep into topics that they care about?"

MADELEINE FOOTE

Digital field notebooks on ocean research can inspire a new generation of explorers

Can we design a modern-day field notebook that will create a path for new explorers to follow?

As the manager of the Open Explorer platform, Foote wanted to find a way to connect communities to not only scientific discoveries, but the often years-long journey that it takes to get to that result. Open Explorer allows for a place to quite literally deep dive into ocean research that is happening in real time, before papers get published and species get named.

Foote hopes that the platform can be one that allows for better storytelling within scientific communities, especially communities that have not yet had the capacity to explore their ocean homes. Toward this end, OpenROV, the founding technology platform for Open Explorer, will be giving away one thousand remotely operated vehicles to communities all over the world, with Open Explorer providing a hope for more communication, collaboration, and discovery.

"Our goal in was to get people excited about exploring, and then documenting what they were doing...and expand the community of people who can do ocean exploration in a really literal, profound, immediate way."

CES RELATED EXPERIENCES

"I learned that it matters what you are passionate about, what you dare yourself to do, and who you connect and cooperate with."
-- Anna Madlener

Experiences	Page

TOWARD AN OPEN OCEAN

Nainoa Thompson said the movement is the ultimate voyage. That movement is here today in this room. And there are an incredible number of reasons to be optimistic.

What we've started here...feels like something new. As Alan Leonardi said in his opening remarks yesterday, and has been the theme throughout both of these days, this gathering is about opening ocean exploration up to everyone. New ideas, new approaches, new voices, and ancient voices joining into the conversation together.

We do not have time -- this planet does not have time -- to continue doing things the way we've always done them. We need to accelerate how we're learning about the ocean and how we're communicating and engaging the entire planet in the conversation. And to do that, we need to do things differently.

In her lightning talk, Leigh Marsh said "we've never turned on that instrument at that depth, why would we do it today? But we did," and they discovered something new. We need to keep doing the unexpected, pushing ourselves to do things that break the cycles of how we've always done things.

We've seen some fantastic examples of how to do things differently -- from LEGO and comedy to knitting and volunteerism -- and by bringing all of these ideas together, collectively, we'll make a difference.

No one organization, no one person, can navigate the solution to these challenges alone. It's the connection of everyone in this room and beyond that will help get us there.

MIT Media Lab is about convening disparate groups, harnessing their power, and deploying results, and I am stoked that we had the opportunity to host this event to explore these new ideas over the last two days.

I hope that all the connections made here can help us find this new path forward to a discovered, open ocean.

Katy Croff Bell, PhD
Chair, All Hands on Deck
Director, Open Ocean Initiative, MIT Media Lab
Fellow, National Geographic Society

ACKNOWLEDGEMENTS

Sponsors

Collaborators

Executive Committee

Katy Croff Bell, Chair
David McKinnie
Jenni Chow, Event Coordinator
Alexis Hope, Creative Director
Adrienne Copeland
Michael Bove
Dan Novy
Devora Najjar
Avery Normandin
Emily Salvador

Advisory Board

Diva Amon
Peter Girguis
Joi Ito
JJ Jackson
Ayana Elizabeth Johnson
Fabien Laurier
Alan Leonardi
Dominique Rissolo
Kristen Sarri
Jerry Schubel
Jyotika I. Virmani
Kaitlin Yarnall

Event Team

Jessica Sousa
Emily Pereira
Laura Seretta
Nina Wishnok
Janine Liberty
Chia Evers
Jimmy Day
Will Glesnes
James Frost
Jeffrey Kelly
Bill Lombardi
Danielle Killick
Russ Dougan
Sargent Media Productions
Jonathan Tadiello
Via Lago
Human Design

Workshop Leads

LEGO Wayfinders
Katherine McConachie, Avery Normandin, Harm van Beek, John Paris, Rachel Hwang

AquaGames
NovySan

Transmedia Storytelling
Dan Fields, Cory Rouse, Emily Salvador, Philipp Schmidt

Shared Exploration Beyond the Screen
Catherine Havasi

Designing the Future Aquarium Experience
Yihyun Lim, Scott Penman, Billy Spitzer

Ocean in Transformation
Markus Reymann, John Palmesino

My Deep Sea, My Backyard
Diva Amon, Randi Rotjan, Alan Turchik, Brennan Phillips, Alexis Hope, Rafa Anta

Designing A Pop-Up Discovery Lab
Devora Najjar, Teja Jammalamadaka, Neil Gemmel

Designing Telepresence Across Scales
Brian RC Kennedy, Mike Bove

Crowdcomputing and Data Across Scales
Neil Gaikwad, Max Vilgalys, Becca Browder, Jeremy Stroming, Ben Woodward

Demonstration Leads

Big Ocean, Big Data
Kakani Katija, Ben Woodward, Katy Croff Bell, Alexis Hope

Boston Intertidal
Avery Normandin, Devora Najjar

Micronauts
Jeffrey Marlow, Ben Bray, Keith Ellenbogen, Raquel Fornasaro, Caroline Rozendo, Craig McLean

My Deep Sea, My Backyard
Randi Rotjan, Diva Amon, Alan Turchik, Brian Kennedy, Alexis Hope, Brennan Phillips, Katy Croff Bell

Ocean Cultures
Devora Najjar, Avery Normandin

Project Prometheus
Allan Adams, Jake Bernstein, Corey Jaskolski, Kenny Broad

Wheels of Poseidon
Dan Oran, Rachel Smith

100 Island Challenge
Stuart Sandin, Jennifer Smith, Brian Zgliczynski, Clinton Edwards, Nicole Pedersen, Chris Sullivan, Hugh Runyan, Falko Kuester, Vid Petrovic, Dominique Rissolo, Eric Lo, Christopher McFarland

Rapporteurs

Diva Amon
Joanne Flanders
Allison Fundis
Susan Haynes
Catalina Martinez
Allison Miller
Logan Mock-Bunting
Amanda Netburn
Nicole Raineault
Randi Rotjan
Katie Wagner
Carlie Wiener
Samantha Wishnak

Artists

Sarah Caudle
Whitney Cornforth
Lori Hepner
Jessica Orfe
Lauren Salm
Hansi Singh
Adam Swanson
Lizzy Taber
Rebecca Welti

Rapporteurs

Allison Alexander
Brendon Dempsey
Nicolle Fagan
Ben Haskell
Mark Henderson
Pamela Kunick-Cohen
Scott O'Connell
Anne-Marie Runfola
Steven Wendland
Jane Wolfson

Boston Ocean Day

Allison Alexander
Brendon Dempsey
Nicolle Fagan
Ben Haskell
Mark Henderson
Pamela Kunick-Cohen
Scott O'Connell
Anne-Marie Runfola
Steven Wendland
Jane Wolfson

Ocean Discovery Fellows

Sulaiman AlSibani
Mariana Andrade
Tassia Biazon
Tyler Carrier
Regina Easley
Zoleka Filander
Alexis Garretson
Beverly Goodman
Anna Guasco
Lori Hepner
Jovita Ho
Esther Howard
Carmen Hoyt
Jinnapat Indrapiromkul
Beno Juarez
Simone Kilgore
Luis Lara
Lizmar Luna
Ning Ma
Anna Madlener
Leigh Marsh
Leah Meth
Nadia Meyers
Samuel Mitchell
Beatriz Naranjo
Kaitlin Noyes
Jeremy Raguain
Glorianne Rivera Santiago
Nadiah Rosli
Rebecca Rutstein
Harpreet Sareen
Kyle Sorenson
Shanee Stopnitzky
Clarisse Sullivan
Satya Sullivan
Sheena Talma
Andrew Thaler
Ernst van der Poll
Alexis Weinnig
Geneviève Yehounmè

"This conference was simply amazing. Thank you for planning such a transformative event. From the participants, to the venue, to the catering, everything was well planned and inspiring."
-- Regina Easley

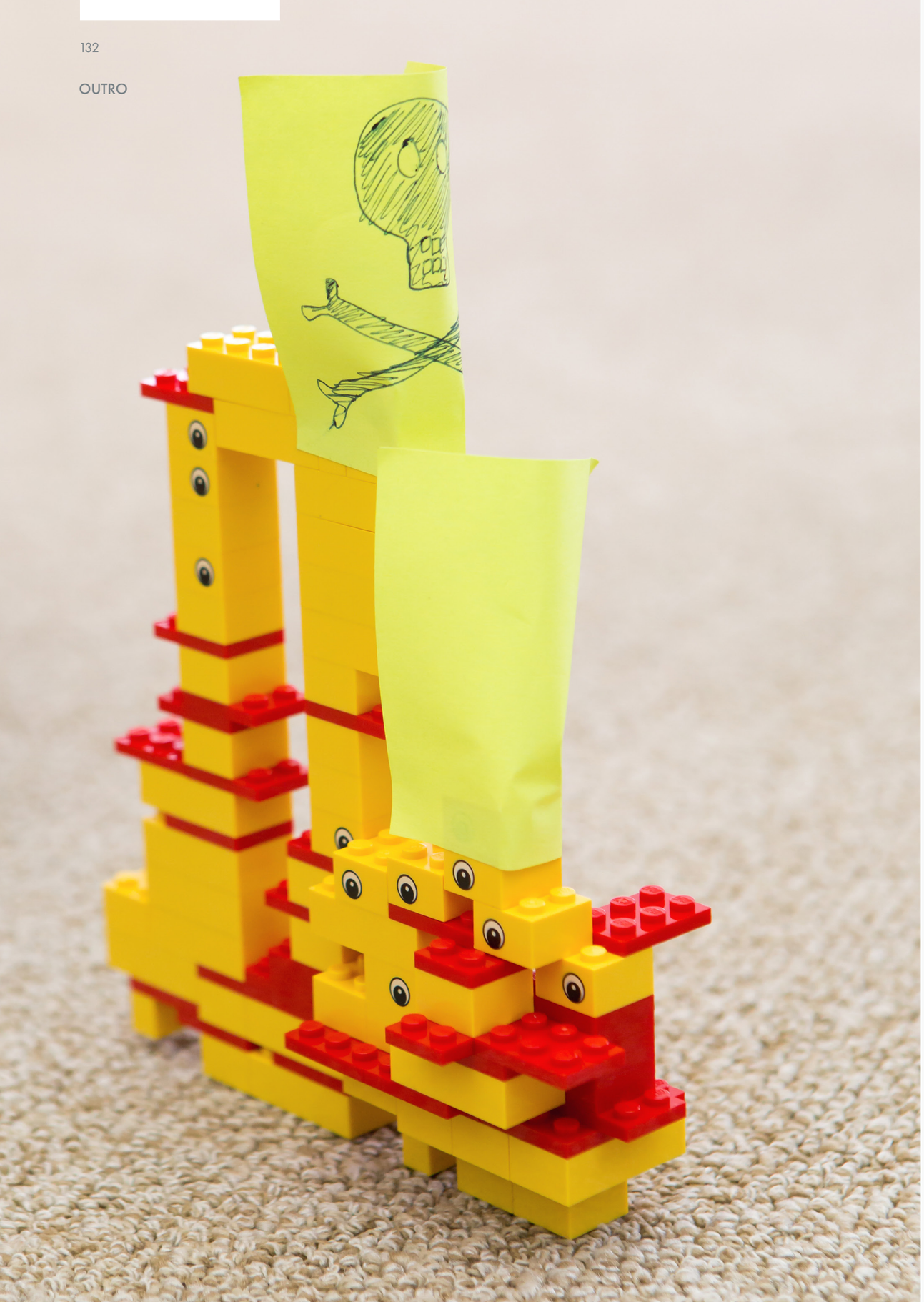


PHOTO CREDITS

NOAA Office of Ocean Exploration & Research: Pages 72, 84, 86, 105
Futuro Brilliantes: Cover, Pages 5, 23
Human Design: Pages 26, 95, 99
Ryder Redfield: Page 13
Rafael Anta: Page 15
Kaitlin Noyes: Page 16
Matteo Cerioli: Page 18
Ben Haskell: Page 19
Patrick Flanagan: Page 19
Meredith Brindley: Page 20
Julie Silverman: Page 21
Jonatha Giddens: Page 21
Jovita Ho: Page 22
Thrasher Photo: Page 22
Elizabeth Taber: Page 23
Ella Al-Shamahi: Page 41
Devora Najjar: Page 71
Lauren Salm: Page 77
Samuel Mitchell: Page 88
Mike Giles: Page 90
Jonathan Tadiello: All others

AGENDA November 8, 2018

8:00AM — **Registration & Breakfast**

8:45AM — **Welcome**
Katy Croff Bell, MIT Media Lab
Alan Leonardi, NOAA Office of Ocean Exploration & Research

9:00AM — **Keynote Address**
Neil Jacobs, National Oceanic & Atmospheric Administration

9:15AM — **PLAY | Sparking curiosity in the ocean through games and recreation**
Andre Fountain, Aspen Institute Sports & Society Program
Reece Pacheco, World Surf League Pure
Samantha Chiappetti, Lego Education
Maria Redin, Two Bit Circus
Jenni Chow, MIT Media Lab (Moderator)

10:15AM — **Break**

10:30AM — **IMAGINE | Imagining a bright, optimistic futue for the ocean**
Steven Wendland, Technicolor
Ella Al-Shamahi, UC London & National Geographic Explorer
Steven Gould, Science Fiction Writer
Ayana Elizabeth Johnson, Ocean Collectiv (Moderator)

11:15AM — **IMMERSE| Bringing people to the ocean and the ocean to people**
Sven Lindblad, Lindblad Expeditions
Vikki Spruill, New England Aquarium
Carlos Toro, Steer Digital
Dan fields, Walt Disney Imagineering
Emily Salvador, MIT Media Lab (Moderator)

12:00PM — **Artist-at-Sea Program Update**
Carlie Wiener, Schmidt Ocean Institute

12:10PM — **Lunch & Artist-at-Sea Exhibit**

1:00PM — **Lightning Talks**

1:30PM — **Choose Your Own Adventure**

1:45PM — **Workshops 1A**
LEGO Wayfinders
AquaGames
Transmedia Storytelling (Concurrent Online Workshop)
Shared Exploration Beyond The Screen
Designing The Future Aquarium Experience

3:15PM — **Break & Switch**

3:30PM — **Workshops 1B**
LEGO Wayfinders
AquaGames
Transmedia Storytelling
Shared Exploration Beyond The Screen
Designing The Future Aquarium Experience

5:00PM — **Reconvene**

5:15PM — **Workshop Report-outs**

6:00PM — **Exploration Updates**
Dominique Rissolo, UC San Diego
David McKinnie, NOAA Office Of Ocean Exploration & Research

6:30PM — **Reception & Artist-at-Sea Exhibit**

AGENDA *November 9, 2018*

8:00AM — **Breakfast**

8:45AM — **Welcome**
Joi Ito, MIT Media Lab

9:00AM — **Keynote Address**
Nainoa Thompson, Polynesian Voyaging Society

9:30AM — **CREATE | Building connections and engagement through the arts**
Daniel Kohn, Kohn Workshop
Hansi Singh, Hansigurumi & University Of Victoria
Geoff Shelton, Hank Films/OK Go Sandbox
Whitney Cornforth, MIT Glass Lab
Alexis Hope, MIT Media Lab (Moderator)

10:15AM — **Lightning Talks**

10:45AM — **Break**

11:00AM — **EXPLORE | Empowering a global community of ocean explorers**
Alan Leonardi, NOAA Office Of Ocean Exploration & Research
Antonella Wilby, UC San Diego & National Geographic Explorer
Allan Adams, MIT Future Oceans Lab
Elizabeth Tyson, National Geographic Fellow
Diva Amon, Natural History Museum (Moderator)

11:45AM — **CONNECT | Connecting people to the ocean and to each other**
Margarita Mora, Nia Tero
Mark Pierce, City Year
Tierney Thys, California Academy Of Sciences & National Geographic Explorer
Madeleine Foote, National Geographic Partners
Danielle Wood, MIT Media Lab (Moderator)

12:30PM — **Here be Dragons Update**
Katy Croff Bell, MIT Media Lab

12:40PM — **Lunch & Demos**
Big Ocean, Big Data
Connected Coral
My Deep Sea, My Backyard
Project Prometheus
Boston Intertidal
Micronauts
Ocean Cultures
Wheels Of Poseidon

1:30PM — **Workshops 2A**
Ocean In Transformation
My Deep Sea, My Backyard
Designing A Pop-Up Discovery Lab
Telepresence Across Scales
Seafloor To Satellites

3:00PM — **Break & Switch**

3:15PM — **Workshops 2B**
Ocean In Transformation
My Deep Sea, My Backyard
Designing A Pop-Up Discovery Lab
Telepresence Across Scales
Seafloor To Satellites

4:45PM — **Reconvene**

5:00PM — **Workshop Report-outs**

5:45PM — **Closing Remarks**
David McKinnie, NOAA Office Of Ocean Exploration & Research
Katy Croff Bell, MIT Media Lab

6:30PM — **Reception at MIT Museum**

PARTICIPANTS

A

David Abel
Boston Globe

Mark Adam
Cape Cod National Seashore

Allan Adams
Massachusetts Institute of Technology

Ella Al-Shamahi
University College London & National Geographic Explorer

Allison Alexander
National Marine Sanctuary Foundation

Sulaiman AlSibani
Oman

Diva Amon
Natural History Museum, London

Darlene Anderson
Independent

Mariana Andrade
University of Sao Paulo

Rafael Anta
Inter-American Development Bank

Pau Anta
Washington International School

B

Mary Baghdady
US Navy & University of Hawai'i at Manoa

Doug Bailey
National Geographic Society

Lizbeth Barrios De La Torre
MIT Media Lab

MIT Media Lab
Organization here

Jonathan Becker
Walt Disney Imagineering

Stanton Belford
Martin Methodist College

Katy Croff Bell
MIT Media Lab & National Geographic Explorer

Jonathan Berger
Stanford University

Jacob Bernstein
Massachusetts Institute of Technology

Tassia Biazon
University of Sao Paulo

Holly Bik
University of California Riverside

Michael Bove
MIT Media Lab

Phil Bresnahan
Scripps Institution of Oceanography, UC San Diego

Annie Brett
Stanford University & World Economic Forum

Meredith Brindley
The George Washington University

Becca Browder
Massachusetts Institute of Technology

Colleen Brown
University of North Carolina

C

João Canário
University of Lisbon

Kat Cantner
American Geosciences Institute

Dominic Cardoso
BBC

Michelle Carnevale
11th Hour Racing

Tyler Carrier
University of North Carolina Charlotte

Olivia Carson
Sharon High School

Laura Castañón
Northeastern University

Bob Chen
University of Massachusetts Boston

Samantha Chiappetti
LEGO Education

Rubez Chong
MIT Media Lab

Jenni Chow
MIT Media Lab

Chrys Chryssostomidis
MIT Sea Grant

Tamar Cohen
NASA Ames Research Center

Mary Cole
Piers Park Sailing Center

Cady Coleman
NASA (Retired)

Pedro Colon-Hernandez
MIT Media Lab

Beckett Colson
MIT/WHOI Joint Program

Michael Conathan
Aspen High Seas Initiative

Adrienne Copeland
NOAA Office of Ocean Exploration & Research

Whitney Cornforth
Massachusetts Institute of Technology

Emily Crum
NOAA Office of Ocean Exploration & Research

Antonio Cunha
MIT Portugal

D

Ari Daniel
NOVA

Bianca Datta
MIT Media Lab

Kellie Davis
Connect Ocean

Alex DeCiccio
University of Rhode Island

Jeffery DelViscio
Knight Science Journalism Fellow

Jacqueline Dixon
University of South Florida

Fernanda Dobal
Royal College of Art & Imperial College London

Jeff Donze
Esri

E

Regina Easley
National Institute of Standards and Technology

Kelli Edwards
Savannah State University Alumni

Keith Ellenbogen
MIT Sea Grant

Chia Evers
MIT Media Lab

F

Nicolle Fagan
New England Aquarium

Jason Fahy
Naval War College

Dan Fields
Walt Disney Imagineering

Zoleka Filander
Nelson Mandela University

Margaux Filippi
MIT/WHOI Joint Program

Aria Finkelstein
MIT/WHOI Joint Program

Jody Fisher
Northeastern University

Brittany Flaherty
Massachusetts Institute of Technology

Patrick Flanagan
Ollie

Joanne Flanders
NOAA Office of Ocean Exploration & Research

Madeleine Foote
National Geographic Partners

Raquel Fornasaro
Independent

Beth Foster
National Geographic Society

Andre Fountain
Aspen Institute Project Play

Mara Freilich
MIT/WHOI Joint Program

James Frost
MIT Media Lab

Allison Fundis
Ocean Exploration Trust

G

Neil Gaikwad
MIT Media Lab

Sarah Gaines
University of Rhode Island

Alexis Garretson
Brigham Young University

Scott Gass
SeaWorld Parks & Entertainment

Kasey Gaylord-Opalewski
EarthEcho International

Chris German
Woods Hole Oceanographic Institution

Briana Gibbs
University of Miami

Jonatha Giddens
National Geographic Fellow & NOAA

Aimee Gillespie
Massachusetts Institute of Technology

Peter Girguis
Harvard University

Kristina Gjerde
IUCN, Middlebury Institute of International Studies

Ethan Gold
Ocean Exploration Trust

Whitney Goodell
National Geographic Fellow

Beverly Goodman
University of Haifa

Steven Gould
Independent

Arnaud Grignard
MIT Media Lab

Anna Guasco
Independent

Rachel Guillory
Ocean Conservancy

H

Adam Haar Horowitz
MIT Media Lab

Rachel Hale
University of Southampton

Leila Hamdan
University of Southern Mississippi

Marah Hard
Future of Fish

Adam Haar Horowitz
MIT Media Lab

Rachel Hale
University of Southampton

Leila Hamdan
University of Southern Mississippi

Marah Hardt
Future of Fish

Joshua Harskam
Territorial Agency

Doug Hart
Massachusetts Institute of Technology

Ben Haskell
Stellwagen Bank National Marine Sanctuary

Catherine Havasi
MIT Media Lab

Graham Hawkes
HAWX Open Ocean

Susan Haynes
NOAA Office of Ocean Exploration & Research

Tom Henry
MIT

Lori Hepner
Penn State University

Reed Herne
Human Design

Angela Hewitson
Northwest Maritime Center

Tara Hicks Johnson
University of New Hampshire

Jovita Ho
Independent

Alexis Hope
MIT Media Lab

Alex Hornstein
Looking Glass Factory

Esther Howard
South African National Parks

Carmen Hoyt
Duke University

Julie Huber
Woods Hole Oceanographic Institution

Cameron Hume
Ocean Exploration Advisory Board

Rachel Hwang
Wellesley College

I

Jinnapat Indrapiromkul
Cisco Systems

Joi Ito
MIT Media Lab

J

Jason Jaacks
University of Rhode Island

Neil Jacobs
National Oceanic & Atmospheric Administration

Jules Jaffe
Scripps Institution of Oceanography

Julie Jakoboski
MIT/WHOI Joint Program

Teja Jammalamadaka
MIT Media Lab

Junsu Jang
MIT Media Lab

Ayana Elizabeth Johnson
Ocean Collectiv

Benito Juarez
Fab Lab

K

Alexandra Kahn
MIT Media Lab

Rachel Kahn
MIT/WHOI Joint Program

Lehua Kamalu
Polynesian Voyaging Society

Sebastian Kamau
MIT Media Lab

Cy Keener
University of Maryland

Brian Kennedy
Boston University

Simone R. Kilgore
Savannah State University & 88Vintage

Matthew King
NOAA Office of Ocean Exploration & Research

Martin Klein
Martin Klein Consultants

Louisa Koch
NOAA Education

Daniel Kohn
KohnWorkshop

Jimmy Kralj
Office of U.S. Senator Brian Schatz

John Kreider
NOAA Ocean Exploration Advisory Board

Pam Kunick-Cohen
Technicolor

Tom Kwasnitschka
GEOMAR Helmholtz Centre for Ocean Research

L

Luis E. Lara
Chilean Geological Survey

Eden Leonard
World Ocean School

Alan Leonardi
NOAA Office of Ocean Exploration & Research

Jacob Levenson
Bureau of Ocean Energy Management

Janine Liberty
MIT Media Lab

Miles Lifson
MIT Media Lab

Yihyun Lim,
MIT Design Lab

Sven Lindblad
Lindblad Expeditions

Sabrina Liu
Massachusetts Institute of Technology

Leah Lovgren
MIT Portugal

Megan Lubetkin
University of Rhode Island

Lizmar Luna,
Genaro Cautiño Vázquez School

Rafael Luna
Naui Diving Instructor

Nina Lutz
MIT Media Lab

M

Juliann Ma
Juilliard, The New School, Stanford University

Ning Ma
Pennsylvania State University

Hannah MacDonald
National Marine Sanctuary Foundation

Roderick MacLeod
Online Participant

Anna Madlener
KTH Royal Institute of Technology

Marissa Marcoux
MIT Media Lab

Jeffrey Marlow
Harvard University

Leigh Marsh
Oceansturn & University of Southampton

Catalina Martinez
NOAA Office of Ocean Exploration & Research

Arwa Mboya
MIT Media Lab

Katherine McConachie
MIT Media Lab

Todd McGuire
11th Hour Racing

David McKinnie
NOAA Office of Ocean Exploration & Research

Craig McLean
MIT/WHOI Joint Program

Leah Meth
California Environmental Associates

Nadia Meyers
Healing H2Os & Savannah State University

Ilona Miko
Providence CityArts

Allison Miller
Schmidt Ocean Institute

Samuel Mitchell
University of Hawai'i at Manoa

Ankkit Modi
Online Participant

Logan Mock-Bunting
Schmidt Ocean Institute

Margarita Mora
Nia Tero & MIT Media Lab

Prathima Muniyappa
MIT Media Lab

N

Devora Najjar
MIT Media Lab

Beatriz Naranjo-Elizondo
URÉKE Aquatics and Universidad de Costa Rica

James Neilan
Tethys Oceanix LLC

Amanda Netburn
National Oceanic & Atmospheric Administration

Dava Newman
Massachusetts Institute of Technology

Avery Normandin
MIT Media Lab

Dan Novy
MIT Media Lab

Kaitlin Noyes
Bermuda Institute of Ocean Sciences

O

Heather Olins
Boston College

Tess Olson
MIT

Dan Oran
MIT Media Lab

Ufuoma Ovienmhada
MIT Media Lab

P

Reece Pacheco
World Surf League, PURE

John Palmesino
Territorial Agency

John Paris
Massachusetts Institute of Technology

Mary Lide Parker
ML Parker Media

Katie Pearl
PearlDamour Theater Company

Marcus Pearson
Adventure Scientists

Clay Pell
U.S. Coast Guard

Aramael Pena-Alcantara,
Massachusetts Institute of Technology

Scott Penman
MIT Design Lab

Emily Pereira
MIT Media Lab

Eduardo Pereira
University of Minho

Jessica Perelman
University of Hawai'i at Manoa

Colleen Peters
University of Rhode Island

Brennan Phillips
University of Rhode Island

Hannah Piecuch
MIT Libraries

Mark Pierce
City Year Boston

Jeremy Pochman
11th Hour Racing

Susan Poulton
Door 44 Digital

Charles Powell
National Oceanic &
Atmospheric Administration

Christian Prothmann
Massachusetts Institute
of Technology

R

Maria Radjenovic
Territorial Agency

Jeremy Raguain
Seychelles Islands Foundation

Nicole Raineault
Ocean Exploration Trust

Minoo Rathnasabapathy
MIT Media Lab

James Rawsthorne
NOAA Office of Ocean
Exploration & Research

Henriette Recny
City Year Boston

Maria Redin
Two Bit Circus

Rasiqra Revulva
Wolsak and Wynn, Gap Riot
Press, Slice Records

Markus Reymann
TBA21–Academy

Pedro Reynolds-Cuéllar
MIT Media Lab

Bob Richards
Stockbridge Jr/Sr High School

John Richardson
Massachusetts Institute
of Technology

Dominique Rissolo
University of California
San Diego

Glorianne Rivera Santiago
University of Miami

Stephen Rodan
Massachusetts Institute
of Technology

Tyler Rohr
MIT/WHOI Joint Program

Katarina Rolf
Woodrow Wilson Academy
of Teaching and Learning

Ann-Sofi Rönnskog
Territorial Agency

Nadiah Rosli
Freelance Journalist

Randi Rotjan
Boston University

Jean-Pierre Rouja
LookBermuda

Cory Rouse
Walt Disney Imagineering

Caroline Rozendo
MIT Media Lab

Rebecca Rutstein
Independent

S

Monica Sack
SXSW

Emily Salvador
MIT Media Lab

Katherine Sammler
California State University
Maritime Academy

Casey Sapp
VRTUL

Harpreet Sareen
Parsons School of Design

Antonio Sarmento
Atlantic International
Research Centre

Deepak Sathyanarayan
Aptima, Inc.

Tim Savas
MIT Media Lab

Mariah Savoie
Massachusetts Institute
of Technology

Philipp Schmidt
MIT Media Lab

Maximilian Schob
Territorial Agency

Jerry Schubel
Aquarium of the Pacific

Jessica Seevers
11th Hour Racing

Sunanda Sharma
MIT Media Lab

Geoff Shelton
Hank Films & OK Go
Sandbox

Julie Silverman
Summit 2 Shore Consulting

Todd Simmons
New York University

Ryan Sims
NASA

Victoria Sindorf
University of Hawai'i
at Manoa

Hansi Singh
University of Victoria

Adam Skarke
Mississippi State University

Kyle Sorenson
Song Writer

Jess Sousa
MIT Media Lab

Fran Spector Atkins
SpectorDance

Gualtiero Spiro Jaeger
MIT/WHOI Joint Program

Billy Spitzer
New England Aquarium

Vikki Spruill
New England Aquarium

Elizabeth Stephenson
New England Aquarium

Javier Stober
MIT Media Lab

Shanee Stopnitzky
The institute for Emergence

Ashton Strait
MIT Media Lab

Jeremy Stroming
Massachusetts Institute
of Technology

Wanda Strukus
Hanover Conservatory

Satya Sullivan
Savannah College of
Art and Design

Clarisse Sullivan
University of Hawai'i
at Manoa

Sarah Cameron Sunde
Works on Water +
Purchase College

T

Lizzy Taber
Arizona State University

Sheena Talma
Rhodes University & South
African Ministry of Environment

Mike Tarkanian
Massachusetts Institute
of Technology

Jeffrey Tedmori
MIT Sloan

Ravi Tejwani
MIT Media Lab

Andrew Thaler
Blackbeard Biologic;
University of Maryland

Nainoa Thompson
Polynesian Voyaging Society

Michael Thompson
National Marine Sancturies

Tierney Thys
California Academy of Science

Jessica Todd
Massachusetts Institute
of Technology

Carlos Toro
Steer Digital

Gui Trotti
Trotti and Associates

Alan Turchik
National Geographic Society

Elizabeth Tyson
National Geographic Fellow

Eleni Maria Tzavellou Gavala
Territorial Agency

U

Carole Urbano
MIT Museum

V

Harm van Beek
The Incredible Machine

Ernst van der Poll
Connect Ocean

Daniel Van Otterdijk
DP World

Max Vilgalys
Massachusetts Institute
of Technology

Robert Vincent
MIT Sea Grant

W

Katie Wagner
NOAA Office of Ocean
Exploration & Research

Amanda Waite
ANGARI Foundation

Timothy Weaver
University of Denver

Alexis Weinnig
Temple University

John Weiss
Human Design

Steven Wendland
Technicolor

Zachariah Whalen
Boston Sea Rovers

James Whitacre
University of Massachusetts

Carlie Wiener
Schmidt Ocean Institute

Antonella Wilby
University of California
San Diego

Samantha Wishnak
Ocean Exploration Trust

Alexandra Witten
University of Rhode Island

Danielle Wood
MIT Media Lab

Benjamin Woodward
CVision AI

X

Charlene Xia
MIT Media Lab

Y

Geneviève Yehounmè
Green Keeper Africa

Karen Romano Young
Independent

ALL HANDS ON DECK