

## ACTIVITIES AND PROGRAM MODEL

# E.E. Just Goes Digital during COVID-19

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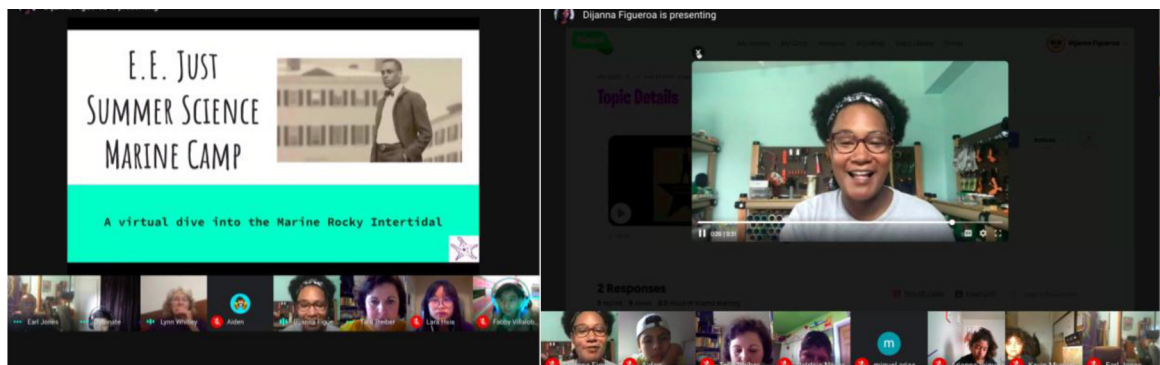
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The Bridge Builders Foundation's Ernest Everett Just (E.E. Just) Youth Science Program is designed to expose minority (Black/African American and Latinx) students to careers and academic pursuits in STEM in a hands-on and inquiry-based way. COVID-19, or the novel coronavirus, tried to put a rift in the Summer Marine Science Camp, but the Bridge Builders Foundation did a strategic pivot and engaged a group of partner marine educators to be creative and build a lesson plan and provide instruction to give participating students a hands-on and engaging experience in the digital realm. Using a variety of digital tools and hands-on activities, the educators provided students with a Summer Marine Science Camp experience right in their own homes. One of the hands-on activities even included shipping materials directly to students so they could be the model designers. Pre-Post survey results showed program success in students' interest and enthusiasm for the program, as well as their conceptual knowledge gain. As part of the data collection and analysis process, we calculated the 'learning gains' from the course. A learning gain shows the improvement between the pre-and post-learning assessment scores. Students showed a 41% normalized learning gain, above the 30% minimum significant gain.

**Keywords:** Diversity Equity and Inclusion (DEI); Underrepresented Minorities (URM); Virtual Learning during COVID-19; STEM Education; Marine Education; Intertidal Topic



**Caption:** Screenshots of the online Summer Marine Science Camp – Screenshots captured by Dieuwertje Kast.

For twenty years, the E.E. Just Youth Science Program has provided minority middle and high school students with high quality science education offerings. The program was created to help bridge the science achievement gap for Black/African American, Latinx, and other minority students. The program has evolved over the years and one of its key offerings is the Summer Marine Science Camp. Due to the novel coronavirus, the camp could not be offered in its usual in-person format. This article describes how the educators were able to alter and adapt the camp to a virtual format to ensure the program could continue in a safe way, while still engaging and supporting these traditionally underserved students.

## Program Description

*The Ernest E. Just Youth Science Program is designed to expose minority (Black/African American & Latinx) students to careers and academic pursuits in science, technology, engineering and math (STEM) in a manner that combines classroom instruction with field trips and fun projects and experiences. The program allows minority middle school students, ages 10-14, to explore the wonders and fascinations of a wide range of STEM topics. The program is dedicated to Dr. Ernest Everett Just, a pioneering African American biologist, who received international acclaim for work in marine biology. Marine science instruction is offered annually as a Summer Marine Science Camp. The Summer Marine Science Camp was the E.E. Just initial STEM offering, which eventually evolved to become a year-round STEM program including other disciplines. The Summer Marine Science Camp, however, continued to be the marquee element of the program. E.E. Just recruits students from the Los Angeles area and hires marine educators for their Summer Marine Science Camp to provide instruction, curriculum, development, and evaluation. One of E.E. Just's partners is the University of Southern California (USC) and the USC Wrigley Institute for Environmental Studies. This year (2020) the program's student participants were 70% African American/Black, 26% Latinx/Hispanic, and 4% biracial (African American and Latinx). The student participants were predominantly male at 78% with 22% female.*

Each year, the Bridge Builders Foundation (BBF), through its annual Ernest E. Just Summer Marine Science Camp contracts with USC to provide planning and instruction for a predominant portion of the Summer Marine Science Camp for middle school-aged youth of color. Created in 2000 out of the need to expose, inspire, and support African American and minority youth pursuits in STEM disciplines, The Bridge Builders Foundation started the Ernest E. Just program as a one-day event at Bolsa Chica Wetlands. The program expanded to a two-weekend event in 2004 (Bolsa Chica and Aquarium of the Pacific), and expanded again in 2006, when BBF contracted with USC for their three-day, two-night curriculum, instruction, residency, and use of the USC Wrigley Institute's Wrigley Marine Science Center on Catalina Island. On this trip, students explore the marine environment in the field by snorkeling, tide-pooling, kayaking, engaging in laboratory explorations, and meeting scientists who share their research expertise. The Summer Marine Science Camp further expanded in 2012 with classroom sessions and field experiences on the mainland held at the California Science Center with access to its Ecosystems Exhibit/Aquarium. The Summer Marine Science Camp evolved to three weekends with the mainland classroom portion at Los Angeles Southwest College (starting in 2014) and the field trip to Cabrillo Marine Aquarium in San Pedro the first weekend. The second weekend includes Bolsa Chica Wetlands and Aquarium of the Pacific visits, with the final weekend on Catalina Island, where students participate in the three-day field experience at the USC Wrigley Marine Science Center. The program rotates yearly with a themed set of content focused on marine habitats: Open Ocean/Pelagic with charismatic megafauna like sharks and fish, Rocky Shore, and Sandy Beach habitats introducing invertebrates and other shoreline/coastal organisms. The Summer Marine Science Camp usually serves 30-50 students per year, in third to ninth grade. This year, 27 students participated, though not all attended every day, which is typical of the program.

## Rocky Intertidal Gone Digital!

Just like the intertidal organisms adapt to life in the tide pools, the E.E. Just program adapted to the virtual environment necessitated by COVID-19. Instead of the two all-day in-person workshops during the first week of the program, we shifted to a two-hour class daily over the course of five days to make sure the students didn't suffer from Zoom fatigue. The program was split into two weeks: one week based on the mainland concepts and a second week based on the USC Wrigley Institute Catalina experience. The E.E. Just instructional team was effective in engaging the students using all of the various technology platforms. They transformed a very hands-on and inquiry-based learning environment into an engaging and interactive online learning experience in which the students were responsive in the digital realm. The instructors demonstrated the importance of thinking differently because all of the components of the virtual environment must be scaffolded and properly structured, which is very different from what happens naturally in the in-person classroom space. Students' attention was held by using different techniques and activities and by regularly switching modalities. Various learners were also accommodated by a wide range of activities. One of the common criticisms of online learning is it is often very stagnant and focused on listening; the instructional team consciously picked activities that required student action and creation. Kinesthetically inclined learners were accommodated by dancing and music components like the marine sound activity, which combined movement with snaps, clapping, and sounds. Traditional discussions were moved to chat or made possible by using tools like Padlet and Mentimeter (see details below). Students were also encouraged to share on their own time using Flipgrid video submissions. Creating engaging online

STEM lessons requires rethinking some of the standard teaching paradigms we all comfortably use, but it is possible with creative thinking and time.

## Learning Goals

Overall the camp works to increase student engagement in science, via marine science, and help them to see science as a possible career that is available to them in the future. Additionally, the camp hopes to increase student connection to the ocean, and help them to see how their individual actions can impact the ocean for better or worse. Specific learning goals for the program are outlined with the key activities in **Table 1** below.

**Table 1:** Scope and Sequence.

Week 1 – The Classroom Component		
	Activities	Learning Goals
Day 1	<ol style="list-style-type: none"> <li>1. Introduction to the program and Week 1 instructors</li> <li>2. Background Knowledge Assessment – Pre-Program Survey &amp; Virtual Chart of what students <b>Know</b>, <b>What</b> they want to know, and what they have <b>Learned</b> (KWL)</li> <li>3. Intro to the Rocky Intertidal Habitat – Video, Presentation + Student Drawing of Intertidal Diagram with Zones</li> <li>4. Key Vocabulary Exploration</li> <li>5. Marine Intertidal Sounds Activity to reinforce abiotic factor knowledge</li> <li>6. Intro to Intertidal Organisms – Critter Card Presentation</li> <li>7. Exit Ticket – Coolest Thing You Learned Flipgrid Video</li> </ol>	<p>Students will be able to explain:</p> <ul style="list-style-type: none"> <li>• There is a marine habitat known as the marine rocky intertidal</li> <li>• Wherever the marine rocky intertidal is found, it has some shared characteristics.</li> <li>• Because it has some shared characteristics, some kinds of animals are found here because they can handle or are adapted to those characteristics.</li> </ul> <p>Students will be able to:</p> <ul style="list-style-type: none"> <li>• Access the learning materials</li> <li>• Successfully participate in the program activities</li> <li>• Know who their instructors are and what the behavior expectations of the program are</li> <li>• Share what they have learned and demonstrate their learning through a variety of formats</li> </ul>
Day 2	<ol style="list-style-type: none"> <li>1. Welcome Back</li> <li>2. Intro to the Mid-Intertidal – Padlet, Presentation, and Student-Created Word Cloud</li> <li>3. Adaptations = Super Powers Presentation</li> <li>4. Animal Super Power Song/Poem Activity</li> <li>5. Closing</li> </ol>	<p>Students will be able to explain:</p> <ul style="list-style-type: none"> <li>• The rocky intertidal is divided into zones, one of them is known as the mid-intertidal</li> <li>• What an adaptation is</li> <li>• How animal adaptations help them to survive in a habitat</li> </ul> <p>Students will be able to:</p> <ul style="list-style-type: none"> <li>• Access the learning materials</li> <li>• Successfully participate in the program activities</li> <li>• Share what they have learned, and demonstrate their learning through a variety of formats</li> </ul>
Day 3	<ol style="list-style-type: none"> <li>1. Welcome Back</li> <li>2. Where is the Rocky Intertidal Found in Los Angeles County Presentation</li> <li>3. Intro to the Marine Phyla &amp; Phyla to Zonation Presentation</li> <li>4. Activity: Students connect Critter Cards from Monday to the Phyla and the Zone they would be found in</li> <li>5. Sea Star Virtual Dissection</li> <li>6. Exit Ticket – Best Part/Most Impactful Part of the Dissection Flipgrid</li> </ol>	<p>Students will be able to explain:</p> <ul style="list-style-type: none"> <li>• Where the rocky intertidal is found in LA County</li> <li>• The rocky intertidal is divided into zones, one of them is known as the lower intertidal</li> <li>• What a phylum is, and describe key marine invertebrate phyla</li> <li>• How animal adaptations help them to survive in a habitat</li> </ul> <p>Students will be able to:</p> <ul style="list-style-type: none"> <li>• Access the learning materials</li> <li>• Complete a virtual dissection</li> <li>• Successfully participate in the program activities</li> <li>• Share what they have learned, and demonstrate their learning through a variety of formats</li> </ul>

(Contd.)

### Week 1 – The Classroom Component

Activities	Learning Goals
Day 4 1. Welcome Back 2. Tide Pool Introduction – Video, Presentation and Student Connection of their Critter Cards from Monday 3. Make a Tide Pool Activity 4. Introduction to Friday's Activity – student Tide Pool Video Presentation 5. Closing	Students will be able to explain: <ul style="list-style-type: none"> <li>· What a tide pool is and where they are found in the rocky intertidal</li> <li>· How tidepools allow some intertidal organisms to thrive outside of the usual zone in which they are found</li> </ul> Students will be able to: <ul style="list-style-type: none"> <li>· Access the learning materials</li> <li>· Create a tide pool model</li> <li>· Successfully participate in the program activities</li> <li>· Share what they have learned and demonstrate their learning through a variety of formats</li> </ul>
Day 5 1. Welcome Back 2. Guest Speaker: Charnelle Wickliff, Drone Marine Biologist 3. Revisit KWL 4. Student Presentations 5. Intro to Next Week & Closing	Students will be able to explain: <ul style="list-style-type: none"> <li>· That marine science study takes many forms</li> <li>· That marine science is open to anyone who is passionate about it</li> <li>· Their tide pool creations, explaining them using vocabulary and learning from the entire week</li> </ul> Students will be able to: <ul style="list-style-type: none"> <li>· Access the learning materials</li> <li>· Ask question of a working scientist</li> <li>· Successfully participate in the program activities</li> <li>· Confidently and clearly share what they have learned and demonstrate their learning through a variety of formats</li> </ul>

### Week 2 – The Field Component

Day 1 1. Welcome to Week 2 and the Virtual Field Trip to USC Wrigley 2. Introduction to Week 2 Instructors 3. Revisit Invertebrate Phyla and Wrigley Marine Science Center Virtual Touch Tank Exploration – Video supplemented by Presentation 4. Activity – Create Animal Infographic Summarizing Today's Learning 5. Start Group Project – Create a PSA about Rocky Intertidal Importance 6. Exit Ticket – Coolest Thing You Learned Flipgrid Video	Students will be able to explain: <ul style="list-style-type: none"> <li>· Key features of marine intertidal organisms</li> <li>· How organisms are grouped by phylum</li> </ul> Students will be able to: <ul style="list-style-type: none"> <li>· Access the learning materials</li> <li>· Successfully participate in the program activities</li> <li>· Know who their instructors are and what are the behavior expectations of this week's program.</li> <li>· Identify some intertidal organisms by phylum</li> <li>· Share what they have learned, and demonstrate their learning through a variety of formats</li> </ul>
Day 2 1. Welcome Back 2. Plankton Prior Knowledge Assessment 3. Plankton Presentation 4. Group Work – Plankton Observation 5. PSA Group Project Work Time 6. Activity – Plankton Student Design and Creation 7. Exit Ticket – Coolest Thing You Learned About Plankton & Share your Plankton Creation Flipgrid Video	Students will be able to explain: <ul style="list-style-type: none"> <li>· What plankton are and what they look like</li> <li>· How many animals start their lives as a member of the plankton community</li> </ul> Students will be able to: <ul style="list-style-type: none"> <li>· Access the learning materials</li> <li>· Successfully participate in the program activities</li> <li>· Observe and draw microscopic plankton</li> <li>· Share what they have learned and demonstrate their learning through a variety of formats</li> </ul>

(Contd.)

### Week 2 – The Field Component

Activities	Learning Goals
Day 3 1. Welcome Back 2. Group Work – Decide on PSA Design Roles 3. Presentation – Food chains & Food webs 4. Presentation – Intertidal resources 5. Interview with a Marine Scientist Video: Monitoring the Intertidal 6. Create a Food Web Activity 7. Exit Ticket – Most Interesting Thing You Learned Flipgrid Video	Students will be able to explain: <ul style="list-style-type: none"> <li>• What a food chain is, what a food web is, how they are different, and how they are similar</li> <li>• Why the intertidal is an important ocean and coastal habitat</li> <li>• How resource availability impacts marine organisms</li> <li>• Some negative impacts on and some behaviors or actions to protect the intertidal</li> </ul> Students will be able to: <ul style="list-style-type: none"> <li>• Access the learning materials</li> <li>• Successfully participate in the program activities</li> <li>• Delineate responsibilities</li> <li>• Create a food web for an intertidal organism</li> <li>• Share what they have learned and demonstrate their learning through a variety of formats</li> </ul>
Day 4 1. Welcome Back 2. Rocky Intertidal Importance Revisit 3. Introduction to and Importance of Marine Protected Areas Presentation 4. Group Work – PSA Work Time	Students will be able to explain: <ul style="list-style-type: none"> <li>• Why the intertidal is an important ocean and coastal habitat</li> <li>• How resource availability impacts marine organisms</li> <li>• Some negative impacts on and some behaviors or actions to protect the intertidal</li> <li>• What a Marine Protected Area is and how they help protect the rocky intertidal and other ocean habitats</li> </ul> Students will be able to: <ul style="list-style-type: none"> <li>• Access the learning materials</li> <li>• Successfully participate in the program activities</li> <li>• Create a food web for an intertidal organism</li> <li>• Share what they have learned and demonstrate their learning through a variety of formats</li> </ul>
Day 5 1. Welcome Back 2. Group Work – Practice PSA 3. Student PSA Presentations 4. Student Post-Program Survey Assessment of Learning Gains 5. Guest Speaker on Marine Science Related Careers: Amber Brown 6. Program Wrap Up	Students will be able to explain: <ul style="list-style-type: none"> <li>• Why the intertidal is an important ocean and coastal habitat</li> <li>• How resource availability impacts marine organisms</li> <li>• Some negative impacts on and some behaviors or actions to protect the intertidal</li> <li>• What they have learning over the course of the two-week program</li> </ul> Students will be able to: <ul style="list-style-type: none"> <li>• Access the learning materials</li> <li>• Successfully participate in the program activities</li> <li>• Clearly and confidently present their PSA on the importance of the Rocky Intertidal</li> <li>• Ask questions of career speaker</li> <li>• Share what they have learned and demonstrate their learning through a variety of formats</li> </ul>

### Online Tools and Resources

To create an interactive and engaging learning environment in the digital space, many online tools and resources were used. The class was hosted within Google Classroom, and the sessions during week one were hosted on the Google Meet video conference platform. Students took their pre- and post-tests during the camp on a Google Forms survey.

**Flipgrid.** The Flipgrid platform was used to collect video responses from each of the students and increase student engagement. Flipgrid was used for exit tickets, homework, and even having students demonstrate their knowledge with varying activities. One of the activities on Flipgrid was to create an intertidal song demonstrated by rewriting lyrics to *Hamilton* and *The Fresh Prince of Bel-Air*. Flipgrid was a highly effective platform for the team because it included the framework of including not only a prompt, but also an

example video while also providing both grading and peer feedback opportunities. During week one, final presentations were conducted on Flipgrid and played during the synchronous session.

The screenshot shows a Flipgrid assignment page. At the top, the Flipgrid logo is on the left, and navigation links for Discussion, Discovery, Activity, Mixtapes, Shorts, and GridPals are in the center. On the right, there are links for Help and a user profile icon. Below the navigation, the breadcrumb trail reads 'Discussion > E.E. Just Marine Science Program > Intertidal Organism Song'. The main content area features the assignment title 'Intertidal Organism Song' with a play button icon, a 'Share' button, and an 'Actions' dropdown. Below the title, it shows '11 responses - 288 views - 3 comments - 2.6 hours of engagement'. A list of instructions is provided: 1. Research your organism, 2. Write down important facts, 3. Make your song, 4. Record and post on flipgrid. A 'Join Code: 2ccdc2cf' is also displayed. A video player shows a silhouette of a person on a star, with '17 views' indicated below it. At the bottom, a 'Responses (11)' section is visible, showing a table with columns for Actions, Name, Date, Comments, and Feedback. One response from 'Ivan A.' is shown, dated 'Aug 6, 2020', with '7 views' and an 'Active' status.

**Caption:** Intertidal Organism Song Assignment on Flipgrid. Screenshot by Dijanna Figueroa.

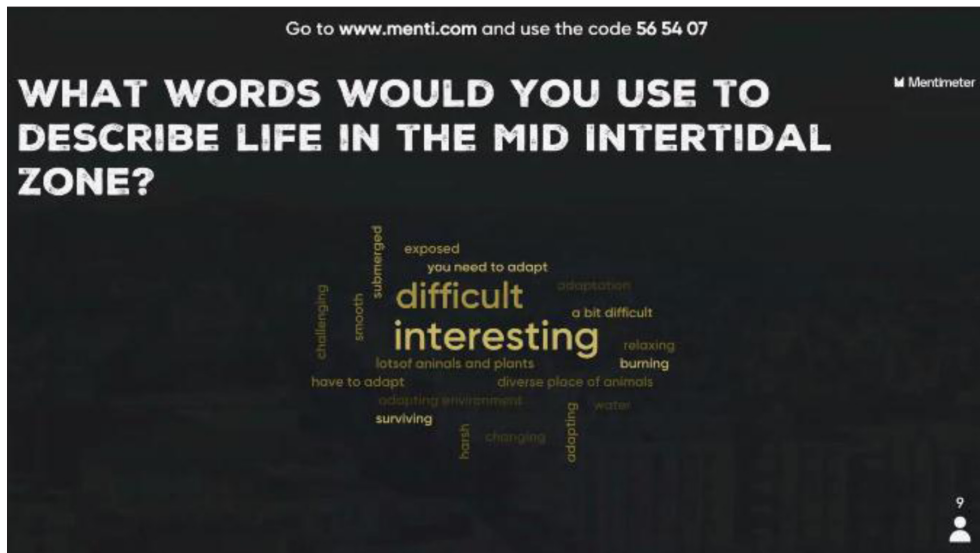
**Padlet.** Another tech resource utilized frequently with this age group was Padlet. Padlet is a multimodal tech platform that allows for a wide variety of student responses. Each of the teachers created their own Padlet to facilitate discussions with students. The teachers created the main static questions at the top of the Padlet and students responded with text, photos, video, or audio recordings. We also utilized it as a digital notebook and we displayed their responses live as they were updated.

The screenshot shows a Padlet board titled 'E.E. Just Marine Science Camp 2020' with the subtitle 'We want to get to know you better.' The board is organized into five columns, each with a question and several student responses. The questions and responses are as follows:

- Column 1: How many years have you participated in the E. E. Just Marine Science Camp?**
  - Kevin: 0
  - First year
  - Amar Dinnon: This Is My First Year
  - This is my first year
- Column 2: What/Where is the mid intertidal zone?**
  - Maybe a different intertidal zone?
  - Maybe the zone that is the sunlight zone and maybe coral reefs and different type of fish-ariana
  - Alex: Since it is titled "mid" intertidal, I believe it is in the middle
  - Francisco: Mid intertidal zone is near the
- Column 3: What is Natural History?**
  - The way history is told like a oragin
  - Francisco: Natural history is history that has to do with nature
  - Alex: Natural history had to do with learning the origins of natural resources and organisms
  - The examination of animals and plants
- Column 4: List some animals and "plants" you may find in the intertidal zone:**
  - Purple sea urchin, sea slug and all I can think is a star fish
  - Hermit crab mussel goose barnicles chiton limpet Acorn barnicles sea star
  - Francisco: barnicles starfish mussels
  - sponges
- Column 5: What is your favorite "Super Power"? Why?**
  - Flying: you never have to deal with traffic
  - Intelligence with infinite intelligence u can give urself speed or end world hunger
  - Francisco: Flying would be a great super power because you can go anywhere.
  - to stop time or be fast

**Caption:** A demonstration of how Padlet was used to facilitate discussions. Screenshot by Dijanna Figueroa.

**Mentimeter.com.** We used a Mentimeter to demonstrate a live interactive response on both mobile and computer device platforms. We included discussion questions and used students' answers to create word clouds for instantaneous assessment of their understanding of concepts and to build group definitions.



**Caption:** A demonstration of how a Mentimeter was used as an assessment tool for prior knowledge. Screenshot by: Dijanna Figueroa.

### **Hands-On STEM Component**

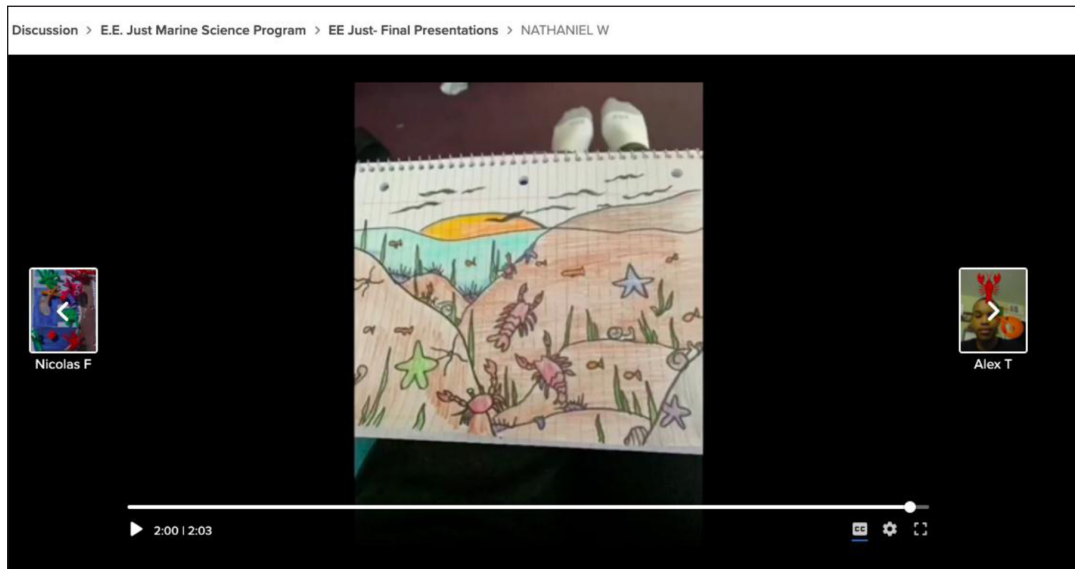


**Caption:** Worksheet observation and labelling of the Aboral Surface of the Sea Star Model for the dissection. Photo by Tara Treiber.

**Sea Star Experiment.** The sea star dissection was the most time-intensive component of our teaching, but it also yielded the strongest learning impacts. Students were mailed a paper model of a purple ochre sea star with each of the major organ systems created as a different layer (for example: the reproductive system, the neurological system, the digestive system, etc.). Using a Google Slides presentation to scaffold the dissection, students were introduced to sea stars as a vital member of the intertidal community, and then directed to examine and draw first the oral and then the aboral surfaces. They could choose between drawing their observations free-hand and using a provided worksheet with basic shapes for those who needed that support. Next, students were asked to “cut” the sea star open, by cutting through the tape that was used to hold the paper layers closed, and examine the organ systems layer by layer. The Google Slides showed photos and videos of the actual features on live or actual dissected sea stars that were referenced as they went through the dissection. Key vocabulary was also highlighted and defined in the presentation. Students were then asked to reflect upon and summarize their favorite part of the dissection experience and learning of the day using Flipgrid. This project required the creation of the dissection worksheets and sea star models (which included illustration of the ochre star layer by layer, printing and copying the pieces, cutting them out, assembling the pieces into the sea star), mailing the sea stars and worksheets (stuffing envelopes and

addressing and stamping them), developing the the scaffolding Google Slides, leading the dissection, and reviewing the student reflection Flipgrid videos.

**Tide Pool Maker Project.** Not only were the paper sea star dissection materials sent home, but also craft materials were sent for the tide pool maker project. Students were able to make a tide pool environment however they wanted to. They could craft it, build it from natural materials in the backyard, use materials from around their homes, and even draw it. “I liked making the tide pool models with the mollusks, crabs, and sea stars (echinoderms)” said E.E. Just student Liberty Figueroa. The image below includes an example of a drawing as well as thumbnail images of crafted tide pool products the students created.



**Caption:** A screenshot of Nathaniel W.'s tide pool drawing, which he filmed as a timelapse. Screenshot by Dieuwertje Kast.

## Guest Scientist



**Caption:** A drone ocean scientist in action! Photos by Charnelle Wickliff.

During the last day of the first week, the instructors invited graduate student Charnelle Wickliff to come in as a guest scientist and interact with the E.E. Just students. Wickliff is a graduate student from the Moss Landing Marine Laboratory and a USC Wrigley Fellow who is studying rhodolith beds on Santa Catalina Island. She talked about what rhodoliths are, specifically calcifying red coralline algae that are unattached, and how they cluster together to form beds. According to literature, these beds may be an important nursery ground for many invertebrate species in the local rocky habitat. She uses a Phantom 4 drone to monitor these beds, checking for seasonal variations and mooring disturbances. A first-generation college student, she is originally from Long Beach, California, where her interest in marine science began with multiple



trips to the Cabrillo Beach Aquarium in San Pedro and Bolsa Chica Wetlands near Huntington Beach (local opportunities for the E.E. Just students, too). We ended her talk with an open session for students, allowing them to ask questions relevant to their own experience and curiosity, and Wickliff's answers allowed them to see a pathway into the sciences for each of them.

## Catalina Component



**Caption:** Wrigley Institute Educator Lorraine Sadler discusses the touch tank at USC's Catalina Island campus. Screenshot by Julie Brown.

During the second week, the program shifted gears to best mirror the students' usual Catalina Island Field Experience in the digital realm. The program switched instructors to those affiliated with the USC Wrigley Marine Field Site: Lorraine Sadler, Meghan Macgregor, Natalie Foote, Linda Chilton (provided guidance), Lynn Whitley, Lara Hsia. The second week was also two hours daily over the course of five days. It started with a virtual touch tank tour, where students met living occupants of the touch tank with pre-recorded videos and ended with presentations on Flipgrid from all the students. Each day's content is itemized below.

### Day One: A Deeper Dive into the Creatures of the Intertidal

**LET'S EXPLORE THE TOUCH TANK TOGETHER**

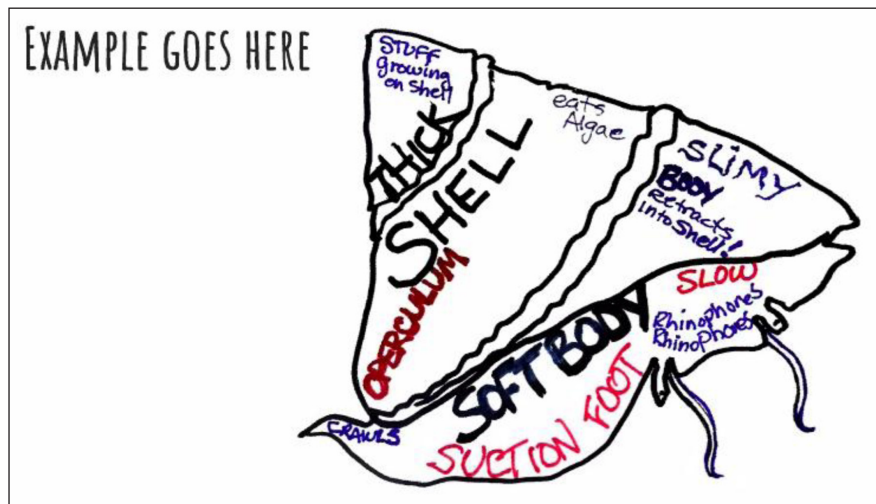


- Make a chart and record
- Watch video
- Behavior observations of animal groupings – what do you notice, what do you wonder

**Caption:** A screenshot of the touch tank Google Slides activity. Screenshot by Dieuwertje Kast.

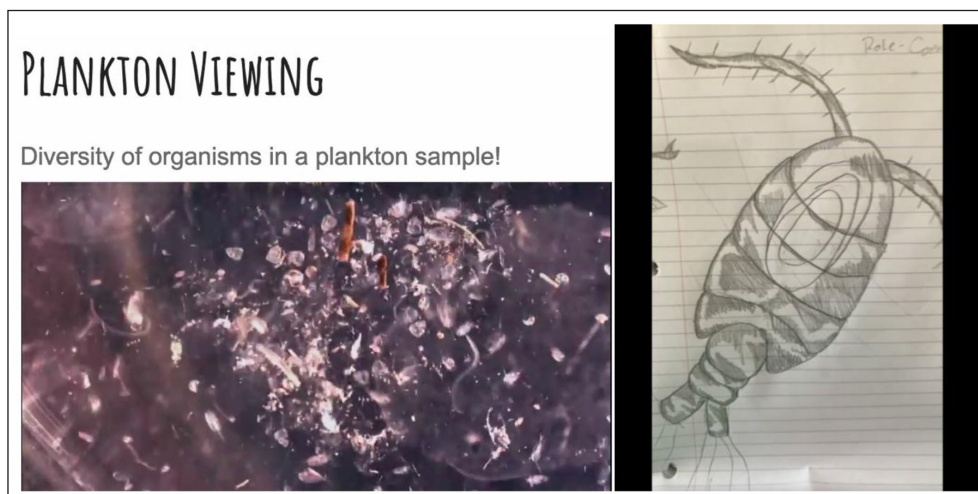
One of the highlights of the Catalina trip is visiting the resident touch tank of live oceanic creatures such as crabs, sea stars, urchins, and anemones at USC's campus on Catalina Island. During the field excursion students are able to see these creatures and sometimes hold or feed them in person. This experience was digitized by doing a touch tank tour virtually with professional-quality waterproof cameras that recorded video from inside the tank. The students then observed the creatures in the touch tank and created questions about the organism behaviors. Instructors connected what they were seeing in the videos to the previous week's exploration of the intertidal and extended the scientific learning by organizing the organism

exploration by phylum. To summarize and reflect on the learning, students drew a 2D model or created a 3D model of a touch tank creature that they learned about as an exit ticket/homework. This included a typographic drawing as seen below.



**Caption:** Screenshot of the typographic drawing created by Lorraine Sadler, screenshot by Dieuwertje Kast.

## Day Two: Intertidal Lifecycles and Food Webs – Meet the Plankton



**Caption Left 11:** Screenshot of the plankton viewing lesson plan by Dieuwertje Kast.

**Caption Right 11:** Nathaniel created a copepod drawing for his plankton model. Photo by Dieuwertje Kast.

To open the day and connect with students' prior knowledge, students were asked to share what they know about plankton on a Padlet. During a regular Catalina field site excursion, students would collect plankton with plankton nets during the day and nighttime and do a comparative microscope analysis of each plankton population. To replicate the plankton experience in the virtual realm, these samples were placed under the microscope and converted to videos that the students watched and worked to assess population differences between various times of the day and locations. Afterwards, students created plankton models (drawn or with craft materials) based on the plankton they saw. Students were given access to a [Spark Adobe document](#) about plankton to dive deeper into the topic on their own time.

## Day Three: Making Connections – Food Webs and Resources in the Intertidal

The day began with a short instructor-led lesson on the difference between food chains and food webs. After the lesson, students created their own food webs or food chains using rocky intertidal organisms that they have been exploring. Students then explored the food and nutrient resources of the intertidal using an animated video created through a partnership between USC Wrigley and USC Cinema School's Division of Animation

and Digital Arts program. Additionally, the video introduced the idea of scientists collaborating with the media and artists to increase their communication reach. To close out the day, guest intertidal scientist Jessie Alstadt talked to the students about her intertidal monitoring work and tied back to their food webs.

### Day Four: How Does the Intertidal Connect to ME? Impacts, Benefits, and Sustainability in the Intertidal

Sometimes students wonder why we should care about a habitat or concept presented in scientific learning if its connection to them is not provided. For this day, students explored the importance of the rocky intertidal through a [presentation](#) by USC Wrigley educator and researcher Meghan MacGregor on Marine Protected Areas, the benefits of the habitat, and how it connects to students even if they live far from the coast. Students were challenged to create a public service announcement (PSA) using Flipgrid on why they should protect the rocky intertidal.

### Day Five: Bringing it All Together

This day was a culmination of the two weeks of learning. Students presented their Intertidal Protection PSAs. One of the students named Merari created a PSA warning the public not to take the animals from the tide pool because they will die.

One of the goals of the program is to encourage minority students to see careers in science as a possibility. Because of this, the program has been increasing the number of presentations by people of color in science-related careers. The camp closed out with a presentation by Amber Brown, program administrator for the Tyler Prize for Environmental Achievement. She talked about her experience as a non-scientist who does outreach and raises funds for scientists' work. Students were also introduced to a few [black scientists and other possible science role models](#) that they might want to explore in the future. Finally, students completed a Post-Program Survey so we could assess their learning gains over the course of the two weeks.

### Data Section

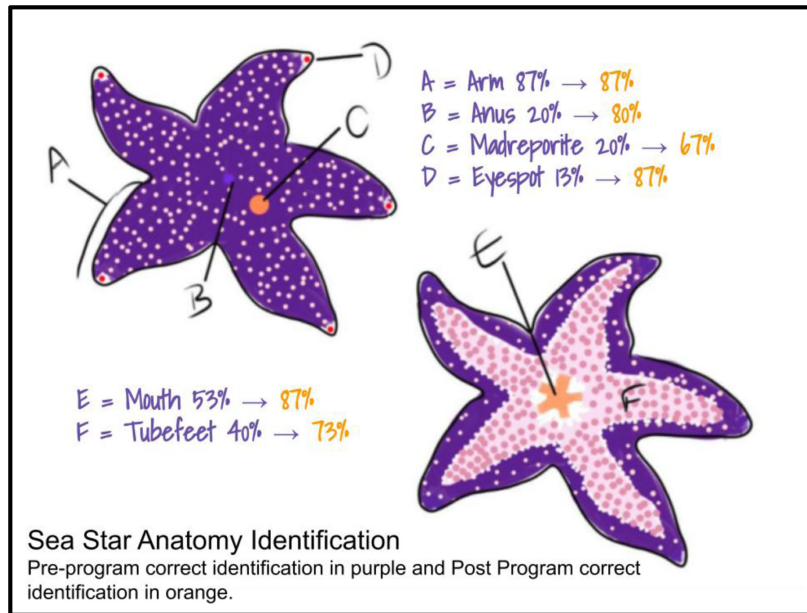
Students who participated in the two-week digital camp had their learning gains documented by their responses to a Pre-Program Survey that was administered on the first day of the program and a Post-Program Survey that was administered on the last day of the program. The Google Forms questionnaire featured both content-related questions and questions about the impact of the program on their lives.

Responses to one of the questions were catalogued with a word cloud as seen below. The answers shifted between the pre- to post-surveys, and we saw a decrease in the “I don’t know” or “the ocean doesn’t impact my life” answers and an increase in more specific responses based on what they learned.

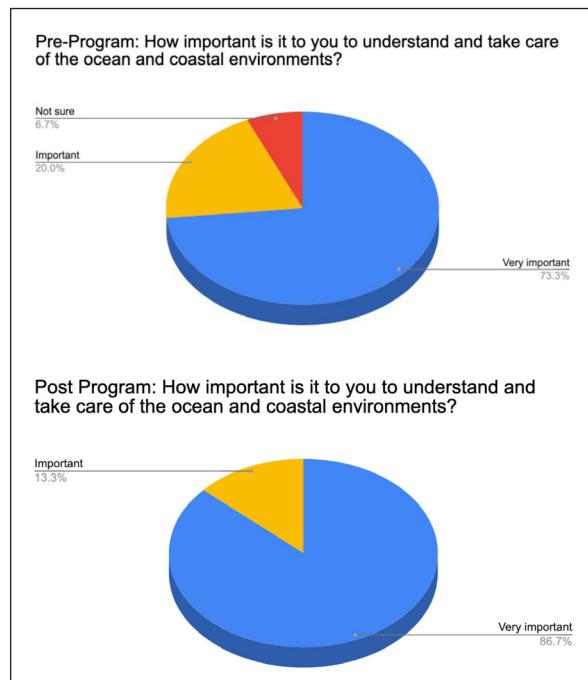


**Caption:** Pre- and post-survey word cloud for the “How does the ocean impact your life?” question. Word clouds created by Dieuwertje Kast.

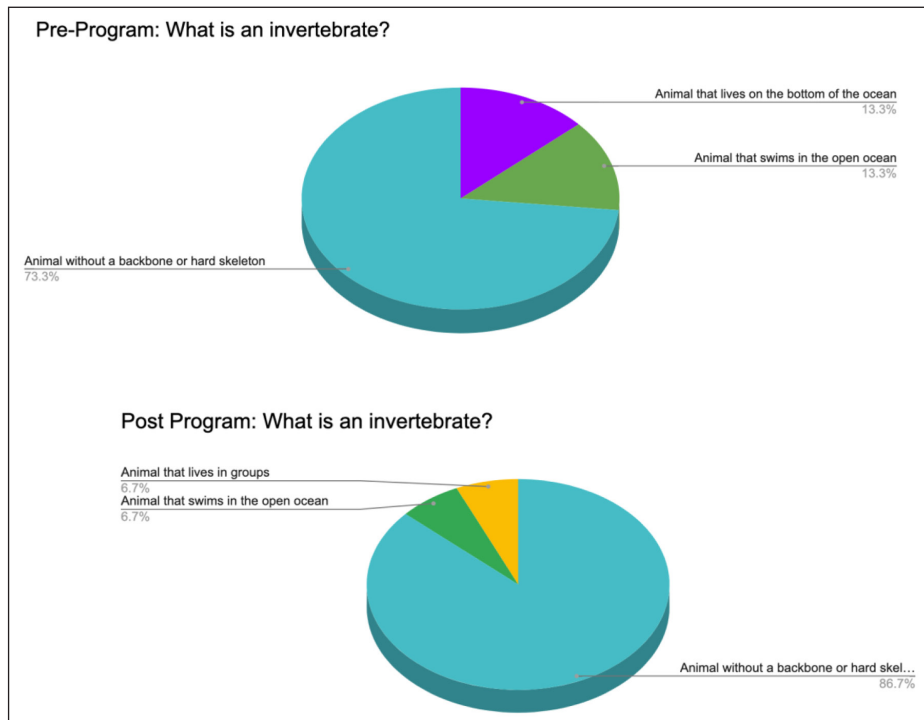
**Sea Star Anatomy Identification Infographic:** Students were asked to correctly identify sea star parts on the Pre- and Post-Program Survey, using the same imagery that was used in the Sea Star Dissection Activity. There were huge gains in correct identification of all parts except the Sea Star Arms, as students came to the program with a high level of correct identification skills. Infographic by Tara Treiber.



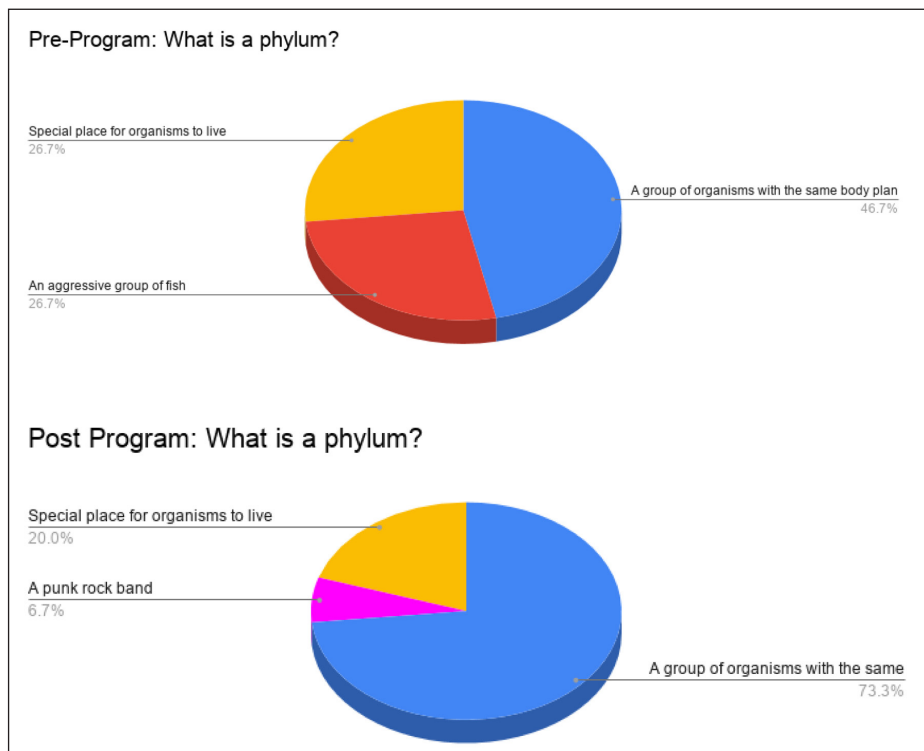
**Chart Comparison 1:** Student perspective changes about the importance of ocean stewardship and understanding from Pre-Program and Post Program Surveys. Students chose from: Very important (blue), Important (yellow), Not sure (red), Not important (N/A), and Not important at all (N/A). By the end of the program all students agreed that understanding and caring for the ocean and coastal environments is very important. Charts created by Tara Treiber.



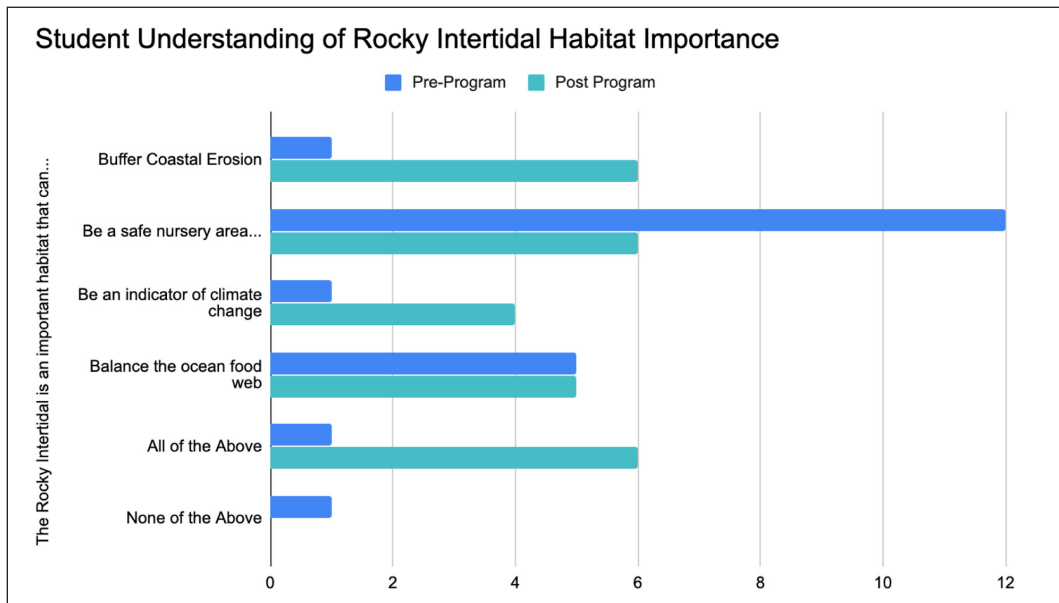
**Chart Comparison 2:** Student knowledge change for defining an invertebrate. Students chose from: Animal without a backbone or hard skeleton (teal), Animal that lives on the bottom of the ocean (purple), Animal that swims in the open ocean (green), Animal that lives in groups (yellow), and Tiny floating organisms (N/A). Student capacity to successfully define an invertebrate increased from 73.3% of students before the program to 86.7% after the program, a 13.4% increase. Charts created by Tara Treiber.



**Chart Comparison 3:** Student knowledge change for defining a phylum. Students chose from: Special place for organisms to live (yellow), A group of organisms with the same body plan (blue), An aggressive group of fish (red), A type of oyster (N/A), and A punk rock band (pink). Student capacity to successfully define a phylum increased from 46.7% of students before the program to 73.3% of students after the program, a 26.6% increase. Charts created by Tara Treiber.



**Chart Comparison 4:** Student understanding of the importance of the rocky intertidal habitat change over the program. Students chose from: Buffer coastal erosion, Be a safe nursery area for young organisms – allowing them to get big enough to survive in the open ocean or other ocean habitats, Be an indicator of climate change, Balance the ocean food web, All of the Above, and None of the Above. Student understanding increased in all categories except the ocean food web. Chart created by Tara Treiber.



The other interesting gains we saw between the Pre-Program and Post-Program Survey were a 20% increase in students saying they liked or really like science and a 23% increase in students saying that they like marine biology. Learning gains can be assessed in a variety of ways, but E.E. Just has been using the normalized gain method as proposed by Richard Hake as a way to evaluate the effectiveness of the program (1998). This year's normalized learning gain showed a 41% increase between the Pre- and Post-Program Survey responses. We also assessed the success of the class using various qualitative methods like attendance and the majority of students stayed throughout the day (attendance wise) for the voluntary program. However, with the shifts in themes and content, it was difficult to do a longitudinal study over the previous years of E.E. Just programs.

### Challenges

There were a lot of unprecedented challenges with the transition to the virtual sphere. The first hurdle was regarding student access to technology including devices like Chromebooks, laptops, and ipads and internet connectivity. In combination with the school district, which provided the bulk of the devices that students used, the program delivered devices and hotspots to those who did not have access to either of those.

On the first day, the onboarding process took a lot of unexpected time, including entering the digital classroom and getting started, which was comparable to the regular in-person onboarding process. We had to figure out the parent versus child accounts when students logged into the class and keep track of them for attendance. Some of the email addresses did not have real names in the Google Meet classroom, but we fixed this problem during the second week when we transitioned to Zoom. To resolve some of these challenges, we had a designated person who was responsible for connecting parent to child accounts.

Background noise and echoing audio presented another challenge. Siblings who were joining us from the same household on various devices would cause audio reverberation between their devices. Additionally, not all of the students were cognizant of the background noises coming from their homes, which would drown out the instructors who were speaking. Some of the instructors and students would get unstable internet warnings and those resulted in frozen screens and garbled speech. There were issues with battery power and the need for quick access to chargers. We ran into some issues using communal platforms like Google Docs, where some of the students would accidentally delete responses, so we tried to use things like Padlet where that wouldn't happen.

### Recommended Changes for Next Virtual Experience

This session of the E.E. Just camp was a major trial run for the instructors trying out various engaging platforms within the digital space.

- Adult to Child Ratios
  - There was an average ratio of two adults to one student, but there were a lot of adults who didn't have an active role. The basic Google Meet version didn't allow breakout rooms, so we had a lot of adults with no significant role besides serving as observers. We transitioned to

Zoom in the second week, which eliminated part of this problem. In the future, we plan to engage the additional adults with a more structured and scaffolded active role.

- We recommend:
  - Being clear about guidelines and expectations of students participating digitally in the class.
    - Make sure students know that the public chat is not private and to not be discussing non-class related items on it.
  - Utilizing digital puzzles and escape room type strategies for motivating assessments and exit tickets.
  - Increasing the sharing time for students and increasing the time they had to work on their activities and designs.
  - Allow extra time for prep time ahead of class. With the extreme structuring and scaffolding of the virtual environment, prep time took a lot longer.

## Ethics and Consent

The program collects media release forms for all participating students and parental consent for use of students' images and voices, which we utilized digitally throughout the various online platforms.

## Acknowledgement

Programs like this couldn't function without an amazing village of people supporting all aspects of the program. The program is sponsored and organized by the Bridge Builders Foundation, a Los Angeles area group whose goal is to stem the tide of academic underachievement and career underrepresentation, which characterize minorities in our society through core programs that focus on youth mentoring and tutoring, scholarship support, and STEM (science, technology, engineering, and math) education. James Breedlove is the current president of the Bridge Builders Foundation and has been instrumental in making the program happen from a program management and fundraising perspective. Earl Jones, program manager of the E.E. Just program, manages and organizes the logistics of the program including parent sign-ups, administrative paperwork, and material acquisition and distribution, and acquires program funding. He also calculated and described the learning gain process mentioned in the data section. E.E. Just volunteers in our Zoom breakout rooms were: Milton Coleman, Darren Starks, and Drake Dillard, as well as two Bridge Builder Foundation scholarship recipients currently in college: Henry Arinze and Diamond Boxley. Over the years many Bridge Builders Foundation members have volunteered in a variety of capacities that have made the program possible, as well. Of notable mention for the many years and level of involvement include Will "Big Will" Dillard, and Bernard Jefferson, Jr.

In summer 2020, Lara Hsia, a UC Davis student in Evolution, Ecology, and Biodiversity helped orchestrate many components of the online E.E. Just course and researched activities for the program development. This semester we featured two live guest speakers that we would like to acknowledge, as well: Amber Brown and Charnelle Wickliff. This course was built on partnerships including relationships with Centers for Ocean Science Education Excellence (COSEE)-WEST, the USC Wrigley Institute for Environmental Studies, USC Sea Grant, and Cabrillo Marine Aquarium.

We would also like to honor instructors and additional volunteers for the course in current and previous years who have been a part of shaping and leading the program to its current format, including Dena Deck, Ellen Maisen, Charlene Gus, Renee Klein, Linda Chilton, Gwen Noda, and Kurt Holland.

## Funding Information

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## Competing Interests

The authors have no competing interests to declare.

## Author Contribution

- Dr. Dieuwertje "DJ" Kast – Dr. Kast is the lead author of this journal article and an instructor for the course who designed the tide pool maker activity.

- Tara Treiber – Treiber was one of the educators who coordinated, developed, and taught the curriculum for the program and helped manage its digital structure; created, distributed, and led the sea star dissection; and is the second author of this journal article.
- Dr. Dijanna Figueroa – Dr. Figueroa is a co-author of this article and an instructor for the E.E. Just course who designed the Flipgrid prompts and had students create intertidal songs that they shared with the group.
- Lynn Whitley – Whitley is a co-author of this article and an instructor for the E.E. Just course. She collaborated and designed the second week of the E.E. Just Marine Science Camp: the Catalina Wrigley Marine Science Center virtual field experience component.

## Author Information

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**Dr. Dijanna Figueroa** – Dr. Dijanna Figueroa has made a career of exploring the mysteries of the deep. She was featured in James Cameron’s documentary *Aliens of the Deep*, which follows Cameron and NASA scientists as they explore some of the deepest parts of the ocean and learn about the unique life forms that inhabit those spaces. She has participated in hundreds of deep-sea dives using various deep submergence vehicles. Currently, she works at the intersection of science, education, and entertainment. She is a science and nature consultant for various film and media production companies and serves as the director of Education and Playful Learning for the Two Bit Circus Foundation. She’s spent more than two decades teaching STEAM to grades K–8 in the greater Los Angeles area, formerly served as global director of the MUSE School National Geographic Society’s Green STEAM program, and has advisory roles with many STEM/STEAM nonprofits. She was recently featured on MTV’s *Women Crush Wednesdays* Women in STEM series as a female science “rock star.” She teaches middle school science at St. Matthew’s Parish School in Pacific Palisades, California and runs programs that teach students how to fly drones, scuba dive, and build underwater robots. If that isn’t enough, Dr. Figueroa is the director of the Lucas Scholars STEM Program, a community based social justice and equity program designed to engage young people in science, engineering, design, and art. She has a bachelor’s degree in marine biology from UCLA and holds a Ph.D. in marine science from UC Santa Barbara. She is committed to making science, technology, art, engineering, math, and music accessible to all people. She joined the faculty of the E.E. Just Marine Science Camp in 2019. Additionally, as one of a few black women in deep sea marine science, she was honored to have had the opportunity to mentor and share her experiences with young aspiring scientists and explorers of color. She is also a co-chair for the NMEA Expanded Audiences committee. ORCID ID: 0000-0001-7113-1663

**Lynn Whitley, M.A.** – Lynn Whitley directs pre-college programs for the Wrigley Institute for Environmental Studies at University of Southern California in Los Angeles. She has more than twenty years of experience presenting ocean science and STEM opportunities to students and educators. As co-director for Centers for Ocean Science Education Excellence (COSEE)-West, she worked with scientists and education partners to enhance learning and networking between science educators and research scientists and has developed and



implemented numerous marine science programs. Much of her career focuses on connecting students to the natural world and supporting educational opportunities for students of color. Whitley believes strongly in the mission of the Bridge Builders Foundation and its E.E. Just Program. She has worked with the E.E. Just Program since 2011 creating the “mainland” component of the E.E. Just Marine Science Camp and designing, teaching, and facilitating its field experience component at Wrigley Marine Science Center (WMSC) on Catalina Island. For the 2020 project, she helped the team develop the mainland portion of the program; designed and facilitated its WMSC Catalina week; and analyzed data collected in student surveys before and after the program. She is past president of the National Marine Educators Association and currently chairs its Membership Committee. ORCID ID: 0000-0001-5311-6865

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