



SALTWATER CLASSROOM

OCEAN EDUCATION THROUGH
GLOBAL COLLABORATION

A Portfolio Presentation by
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SALTWATER CLASSROOM

AT A GLANCE:

Saltwater Classroom is an **innovative approach** to **environmental education** that harnesses the power of our technologically connected world to spur an **ethic of global ocean stewardship** in today's youth.

*Focused on building **cross-cultural relationships** rooted in a shared passion for the marine environment, Saltwater Classroom will bridge cultural differences to create a universe of young students with a **deeper appreciation and heightened responsibility for our planet's oceans.***



HOW?

Saltwater Classroom will work in two ways to instill in young generations an **ethic of ocean stewardship**:

1. Week-long marine science and conservation **workshops in elementary classrooms**, centered around hands-on experiments and field-work missions
2. A **mobile phone/iPad application** allowing Saltwater Classroom students globally to connect, build cross-cultural relationships, share marine discoveries, and ultimately **forge a passion for the ocean** that extends beyond whatever differences may set us apart.

WHY?

Our planet's oceans are facing a number of potentially devastating threats, ranging from ocean acidification and habitat loss to overfishing and plastic pollution. Now, more than ever, we must come together as global citizens, and drive sustainable change for our oceans. **This starts with education.**

And that's where Saltwater Classroom comes in.

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SALTWATER CLASSROOM

IN DEPTH:

Introduction

No matter what country, region, or city one calls home, we are all connected by the ocean. Whether it is through deep cultural ties, geographic location, economic dependence, or something as fundamental as the air we breathe, the ocean unites us unlike anything else. Despite this, our oceans find themselves in a state of distress, facing a barrage of threats as a result of carelessness on the behalf of humankind.

Issues like habitat loss and ocean acidification are endangering our planet's oceans with little action being taken to combat them. Around the world, entire species are disappearing, coral reefs are dying, beaches are being polluted, and what is being done? How are we simply letting this happen?

It could be said that the vast inaction towards the pressing ocean issues stems from an overall sense of apathy towards the ocean. Despite our dependence on them, the oceans are relegated to the back burner, so to speak, often cast aside as 'out of sight, out of mind'. However, with the undeniable importance of the oceans to our communities, economies, and ultimately our species' survival, as well as the severity and immediacy of the issues confronting them, these issues are of paramount importance. To overcome these challenges, we must change the way in which we see the oceans, how we value them, and consequently, the actions we take to

protect them. Inarguably, the first step in this paradigm shift is education. And that is where Saltwater Classroom comes in.

Saltwater Classroom will connect young students in coastal cities across the globe by igniting a passion for our oceans through education. By building relationships across oceans, countries, and cultures, Saltwater Classroom will foster a new generation of ocean stewards. Through the transformative power of education, Saltwater Classroom will spur a new wave of ocean education in today's youth, instilling not only an appreciation for the oceans and the life they support, but creating a sense of responsibility to one's environment and a heightened awareness of the specific consequences of one's actions.

Our Approach

At it's core, Saltwater Classroom is a two-pronged approach that works first through weeklong workshops in elementary school classrooms, and secondly, through a mobile phone/iPad application that connects participants around the world, continuing the education and fostering a global network of ocean stewards.

PART 1: *Saltwater Workshops*

Week-long marine science and conservation **workshops in elementary classrooms**, centered around hands-on experiments and field-work missions

PART 2: *Saltwater Application*

A **mobile phone/iPad application** allowing Saltwater Classroom students globally to connect, build cross-cultural relationships, share marine discoveries, and build a universe of young ocean stewards

PART ONE:

Saltwater Workshops

Overview

The first component of Saltwater Classroom consists of week-long workshops in elementary school classrooms around the world, designed with a hands-on curriculum focused on marine science and ocean conservation. The program is geared towards 5th grade students and will incorporate lessons, field excursions, conservation missions, and a culminating showcase presentation by the students.

The curriculum has been based off a college education in Marine Biology and shaped by observational research in 5th grade classrooms in Boston, Massachusetts and Viña del Mar, Chile. Flexible and easily adapted, the curriculum can be altered for classrooms with various requirements, content expectations, and logistic limitations.

Monday	Tuesday	Wednesday	Thursday	Friday
Welcome to Saltwater Classroom! <u>Lesson: Our Blue Planet</u>	Field Excursion to the Intertidal Zone	<u>Lesson: An Ocean in Trouble</u> Conservation Mission: Beach Clean-up	Intro to the App! <u>Lesson: Species, Species, Species</u>	Saltwater Showcase!

Figure 1. Lesson Outline

Schedule

Day 1: Monday

Welcome to Saltwater Classroom!

- About
- What's going to happen!
- Global network

Lesson: Our Blue Planet

- Today's oceans
- History of the oceans
- Types of ocean environments
 - open ocean, littoral, benthic
- Coastal environments
 - lead in for field excursion #1

Day 2: Tuesday

Field Excursion #1: The Intertidal Zone

Day 3: Wednesday

Lesson: An Ocean in Trouble

- Issues facing our oceans
- Marine pollution

Conservation Mission #1: Beach Clean-Up

Day 4: Thursday

Introduction to the Collaborative Application

- Make account and “Scientist Bio”

Lesson: Species, Species, Species

- Ecosystems
- Trophic cascade
- Make a food web
- Species profile

Day 5: Friday

- Final work on species profiles

Saltwater Showcase (parents invited to attend)

(Lesson plans available in Appendix A)



School Research

Escuela Paul Harris

Viña del Mar, Chile

Students at Escuela Paul Harris come from the neighboring community, a lower income area of Viña del Mar. Classroom size ranged from 25-30 students. Classroom activities centered around interactive games with vocabulary, call and response, and frequent testing/quizzing. Student interest level was on average low, with some students paying no attention and few exhibiting diligence with tasks and responses. Energy of the classroom was very high with loud, boisterous activity and lots of movement. Students would respond well to activity, games, and other interactive, hands-on methods. Technology in classroom consisted of an overhead projector, television, teachers laptop computer. Wi-fi connection available but not strong.

Joyce Kilmer K-8 Elementary

West Roxbury, Massachusetts

Kilmer Elementary is a branch of the Boston Public School system and serves the neighborhood of West Roxbury. Class size was 22 students. Overall students exhibited high level of interest and participation. Particular lesson plan focused on ecosystems with students making observations and claims about the terrariums they had built. Students worked individually first, then in small groups, then reported to whole class. The children enjoyed sharing and were eager to do so. Videos were used as a tool and were well received by the students. Technology in classroom consisted of overhead projector, desktop computer, and laptop computer. Wi-fi connection was reliable.

PART TWO:

Saltwater Application

Overview

The second component of Saltwater Classroom is a mobile phone or tablet application that builds upon the workshop and allows Saltwater Classroom participants around the world to connect with one another. The collaborative application will make it possible for students across the globe to connect, build cross-cultural relationships, share marine discoveries, and ultimately forge a passion for the ocean that extends beyond whatever differences may set students apart.

Application Structure

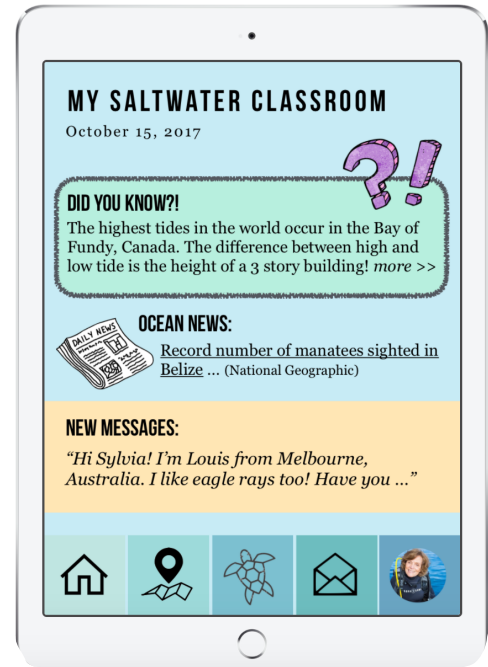
Students will make a “Scientist Bio” profile page that will show their first name and last name initial, a photograph, their location, and their favorite marine animal. Students can form “Partnerships” with other students and there will be a page showing a list of their connections with name and location. There will also be a “Global Network” page that features a world map as a visual of their connections. There will be a “Message Board” page where students can send short messages to one another. Students will upload “Species Profiles” to the application that will include information about a certain species including a description, its habitat range, conservation status, a photograph, and other pertinent information. A page will exist where

each student's species profiles will appear. Additionally, there will be a "Homepage" screen that will showcase a fun fact of the day, any recent messages from other students, and ocean news.

There will be incentives for students to be engaged with the application in the form of "Badges" on their "Scientist Bios". Examples of these badges include "Global Scientist", awarded when a student forms partnerships with other students in five different countries. Another example of a badge would be "Master Ecologist", given when a student completes ten species profiles.

The application would be free and available to download from Apple's AppStore or Android's Marketplace but would require a unique code to register. This ensures that only participants in the Saltwater Classroom workshop will be able to access the application.

(Application Mock-Ups available in Appendix D)



Examples of Homepage and Message Board, respectively



SALTWATER CLASSROOM

Rationale

WHY THE OCEAN?

"We need to respect the oceans and take care of them as if our lives depended on it. Because they do."

-Sylvia Earle

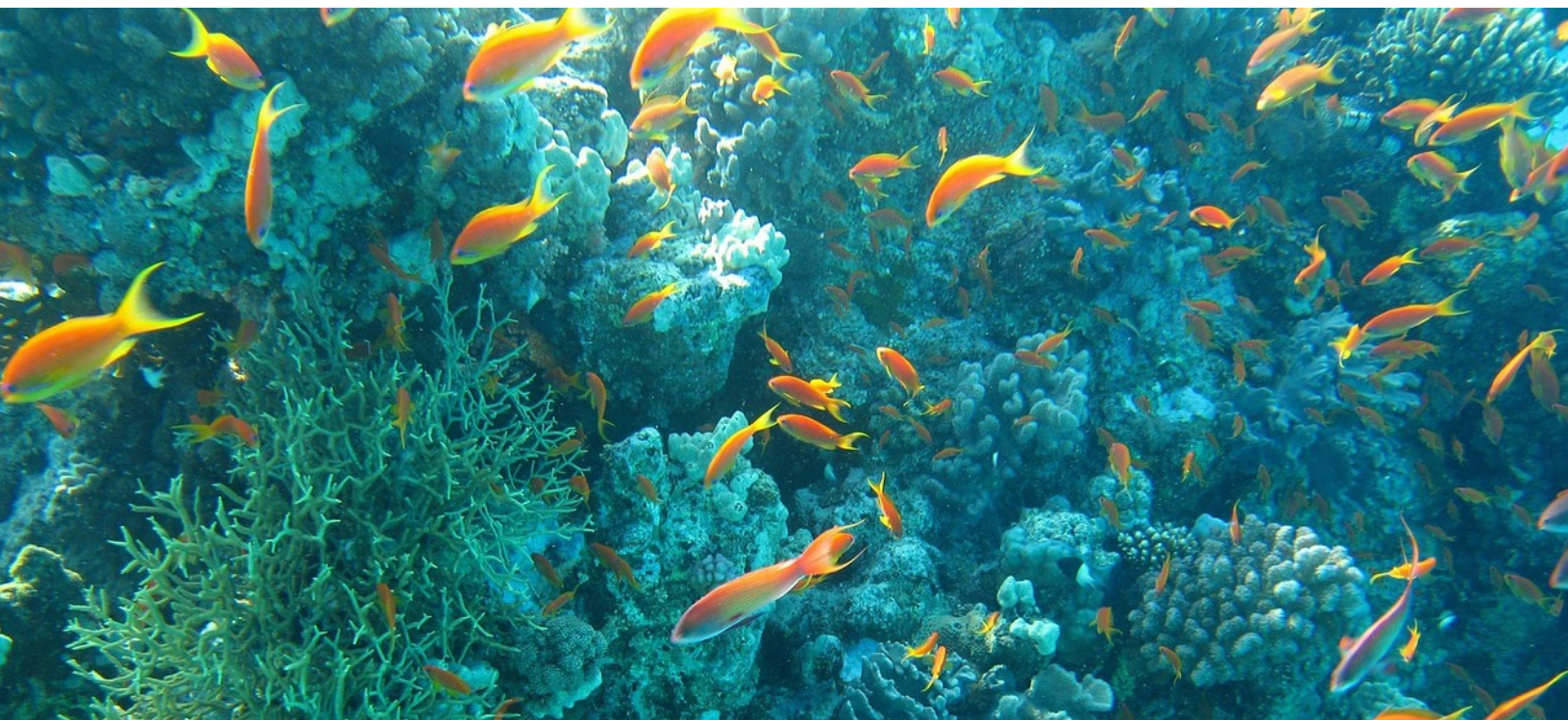
In every dimension of human life, the ocean plays a vital role. To begin with, the ocean and its processes are solely responsible for making the Earth a habitable place for humankind. Covering nearly three quarters of the globe, the oceans and the life they support generate over half of the world's oxygen supply and absorb nearly 30 percent of the carbon dioxide ("Oceanic Institute", "National Geographic"). Oceans play a critical role in climate stability, nutrient cycling, food production, and coastal protection. Simply put, life as we know it on planet Earth, would not exist without healthy oceans.

As if this fundamental dependence was not enough, society and our global economies are heavily dependent on the ocean and its resources. The livelihoods of over 3 billion people worldwide are directly tied to marine and coastal biodiversity ("Oceans & Seas"). Nearly half the global population relies on the ocean as their primary source of protein (WWF). Estimated to generate between three and six trillion dollars in economic activity annually, the ocean moves over 90 percent of global trade by marine transport and drives coastal tourism, one of the largest market segments in the world economy (International Maritime Organization; Honey et. al 2007). The ocean is the source of several breakthrough discoveries in sectors such as pharmaceuticals and has the key to solve many future challenges in

agriculture and healthcare. Over 40 percent of the world's population lives within 100 kilometers of the coast, many in rapidly-growing coastal cities (United Nations).

This human activity has put an enormous amount of stress on the ocean environment, an amount that we can only begin to quantify. Due to excessive harvesting, over 30 percent of the world's fish stocks are classified as overexploited with many more on the path towards it ("State of World Fisheries"). Marine pollution has reached unprecedented levels with a staggering average of 13,000 pieces of plastic litter present on every square kilometer of ocean (UNEP). Human activity has even altered the very chemistry of the ocean with increased atmospheric carbon dioxide changing the pH, throwing off the delicate balance and leading to the devastating phenomenon of ocean acidification. These issues and many more leave the ocean in a precarious position with devastating consequences looming large.

With our growing dependency on the services provided by the ocean and its increased vulnerability, the way in which we respond to these challenges will ultimately dictate the future sustainability of our species. Addressing these ocean issues is of utmost importance if we hope to protect our economies, our homes, our food sources, our planet's respiratory system, and the world's single largest ecosystem.



WHY EDUCATION?

*“If you are thinking a year ahead, plant a seed.
If you are thinking a decade ahead, plant a tree.
If you are thinking a century ahead, educate the people.”
-Chinese poem*

When face-to-face with the pressing challenges confronting our oceans, environmental education has a unique power to conquer these immense problems by changing the way in which society thinks and treats the environment. Environmental education inspires individuals to make changes towards a sustainable future by equipping them with the tools necessary to make informed decisions about their surroundings, actions, and impact.

Defined by the United States Environmental Protection Agency as “a process that allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment,” environmental education first emerged in the 1960s as a response to the threatening environmental crises facing the United States at that time (EPA.gov). Since its onset, environmental education has remained a relevant aspect of both education and environmental efforts. With the monumental challenges facing society due to anthropogenic climate change, environmental education is of paramount importance, now more than ever.

The Environmental Protection Agency identifies the key components of Environmental Education as the following:

- *Awareness and sensitivity to the environment and environmental challenges*
- *Knowledge and understanding of the environment and environmental challenges*
- *Attitudes of concern for the environment and motivation to improve or maintain environmental quality*
- *Skills to identify and help resolve environmental challenges*
- *Participation in activities that lead to the resolution of environmental challenges (EPA.gov)*

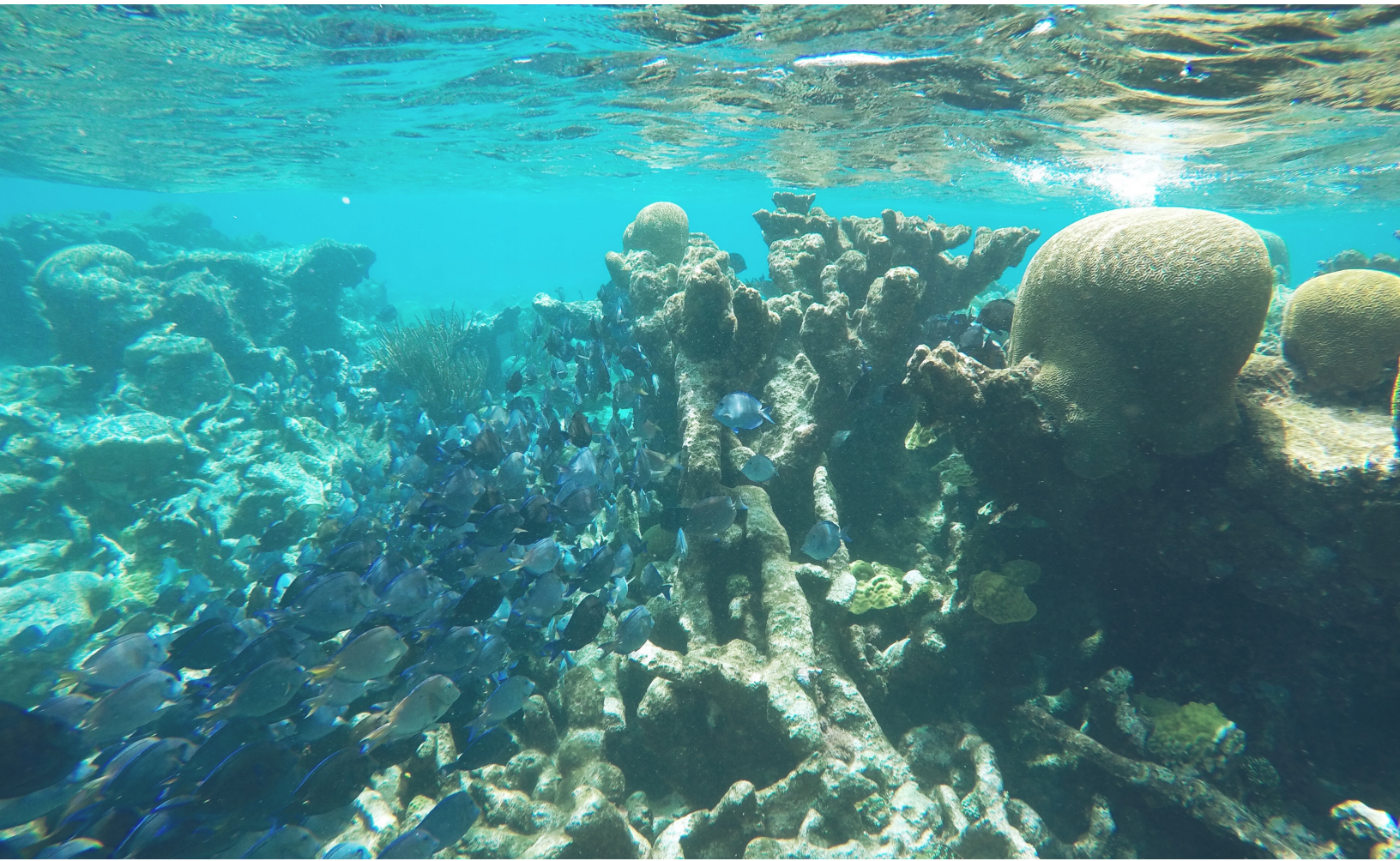
These central tenets ensure that individuals will have the ability to: first, think critically when addressing environmental situations; secondly, make informed decisions about those situations; and lastly, possess the capacity to act, both individually and collectively, in a manner that not only sustains, but hopefully enhances, the natural environment. Environmental education is interdisciplinary and centers around values, attitudes, ethics, and actions. For decades, Australia has succinctly described environmental education as education “in, about, and for” the environment.

As aforementioned, the need for environmental education is more important in today’s world than ever before. Especially in regard to the marine environment, the looming sustainability challenges threaten not only our homes and our food supply, but the very ecosystems and ecosystems services that make the Earth a habitable place for humankind. As such, it is imperative that all of society, not just the conscientious few, adapt and learn how to address present sustainability concerns and take action to ensure the prevention of future challenges.

Undoubtedly, environmental education plays a critical role in this.

There are countless studies that have shown that the understanding of environmental issues that environmental education facilitates leads to “pro-environmental” behavior (Littledyke 2008). This is due to the apparent fact that learning about the environment leads to individuals who not only value, but feel concern for the natural environment, and consequently possess a desire to protect it. Environmental education, therefore, can pave the way for solutions to many of the environmental problems facing our society.

Environmental education is particularly relevant for ocean issues because of the inherent obscurity of the ocean. Much of ocean life exists out of reach below the surface and is inaccessible to the vast majority of people. Education about the ocean and the marine environment can familiarize students with life below the surface and open their eyes to the importance of the ocean.



WHY CHILDREN?

*“The world is not left to us by our parents,
It is lent to us by our children.”*

-African proverb

It is no question that environmental education is important for citizens of all ages, however, focusing on children provides singular advantages. It is widely believed that children are important agents of social change in society. Children, of course, represent the future for our civilization. They will grow and come to be the citizens and consumers whose attitudes and outlooks will lead to decisions that will impact the environment. Within this, is an opportunity for environmental education to spur the development of a generation that seeks not to harm the environment, but one that aspires to treat the environment and its resources with respect.

There have been many studies that have shown that environmental education is most effective when focused on children. A study done by Wells and Lekies (2006) found that children’s interactions with “wild” nature before the age of eleven were more likely to lead to behaviors and attitudes in adulthood that benefited the environment. Liefländer et. al found in their 2012 study that younger students, aged from ten to eleven were significantly more receptive to environmental education compared to older counterparts.

In addition to the sheer efficacy of environmental education with children, there are other benefits for children, primarily the healthy development that interactions with the natural world spurs. Children grow healthier, wiser, and more

content when they are more connected throughout their childhood to the natural environment (NAAEE.org). These benefits are long-lasting and significant and will positively impact their future well-being, as well as the contributions they will make to society as adults. Studies have shown that the average American spends more than 90% of their time indoors. For children, this leads to the development of baseless fears and feelings of dislike towards natural objects (Bixler et. al 1994). This results in the risk for children never developing positive attitudes and feelings toward the natural environment. When endeavoring to solve the mounting environmental issues facing our society, these feelings of apathy lead to inaction and further environmental exploitation and degradation.

Environmental education and time spent in the natural environment have a direct correlation to the development of positive feelings towards nature. For children in touch with it, the natural world is a source of wonder, joy, and awe. Experiences with nature nurture this connection and provide the basis for a future rooted in an appreciation for the environment and dedicated to its prosperity. Rachel Carson, a biologist and leader of the environmental movement in the 1960s, articulated the importance of environmental education and its power to inspire children in her book “The Sense of Wonder”. Carson states that “if a child is to keep alive his inborn sense of wonder, he needs the companionship of at least one adult who can share it, rediscovering with him the joy, excitement, and mystery of the world we live in” (Carson, 45). Environmental education rooted in hands-on experiences in the natural world has the potential to provide students with the important connection to the natural world, nurturing their sense of wonder, and developing an ethic of stewardship for the environment.

Saltwater Classroom is dedicated to this hands-on experience with nature. Through the field excursions and conservation missions, participants have the opportunity to engage with the marine environment and form connections with the

sea. Whether it is a tidal expedition focused on field science or a beach clean-up, these interactions will expose students to the ocean and lay the foundation for a strong connection with it.

Environmental education fosters healthy development and nurtures a child's sense of wonder, but the impact of environmental education with children does not stop there. Rather, the impacts extend beyond the children themselves, affecting other members of society. Not only are the children more concerned, informed, and competent agents of change, but they have the potential to bring about change by influencing peers, family members, and the wider community. Research studies have shown the significant power of children to shape the values of their parents and exert strong peer group influence (Knafo and Galansky, 2008; Lee, 2008). Educational strategies focused on children, therefore, have a wider impact and added value through the production of a ripple effect, changing the knowledge, attitudes, and behaviors of various adults around them.

Environmental education geared towards giving individuals the tools to explore environmental issues, engage in problem solving, and take positive steps to improve the environment has the power to significantly impact our environmental condition by changing the lives of children, the face of the future.



WHY GLOBAL?

“The environmental crisis is a global problem, and only global action will resolve it.”

-Barry Commoner

As previously mentioned, the ocean connects us all, regardless of what country, region, or city one calls home. Through cultural connections, geographic location, economic dependence, or simply the air we breathe, the ocean brings us together unlike anything else. The ocean, in many ways, is our planet's greatest global unifier. As such, the issues facing the ocean are equally as global. In order to effectively address these environmental issues, we must recognize the existence and importance of the global context in which they take place.

By nature, environmental threats, particularly those related to the ocean, are diffuse, indirect, and not confined by borders. As a result, these challenges are vastly complex and require the involvement of stakeholders around the world. Environmental issues such as sea level rise and resource depletion, call for global cooperation and coordination and the way in which the international community answers this call, will profoundly impact the future for humankind.

In many ways, several of the obstacles preventing solutions to today's pressing environmental issues are cultural. Perceived barriers have made it nearly impossible for sustainable strategies to take hold and permeate deep-seeded cultural beliefs. However, the global nature of these challenges poses an opportunity for people around the world to unite as global citizens to address them. With the unprecedented scale and potentially devastating consequences of these

threats, it is imperative that we seize this opportunity and overcome whatever may set us apart. Embracing the global nature of these challenges will provide the pathway for us to move forward towards a global sustainable future.

Global cooperation is a primary of goal of Saltwater Classroom. This is achieved through the connections and partnerships forged through the collaborative application connecting students around the world. Saltwater Classroom seeks to harness the power of today's technologically connected world to create a network of young students united in a shared passion for the marine environment. Through connections made around the world, young students will be able to bridge divides and come together through a common appreciation for the ocean and the life it supports.

Through the collaborative application, students can not only continue to be engaged with the educational material, but build upon it through interactions with other students. The application will allow students in Boston, Massachusetts, for example, to connect with students on the other side of the world in Melbourne, Australia about a common favorite species or an interesting similarity between their hometown beaches. These connections will not only reflect the global action required to address these challenges, but help to create a generation of young people that see themselves as global citizens, unencumbered by geographic and cultural differences.

In addition to the global aspect of the collaborative application, the global nature of the ocean and the issues facing it will be a focus of the weeklong Saltwater Workshops as well. Both the activities and lessons will aim to give students an understanding of the global scale of the challenges. Additionally, insight will be drawn on the relationship between local actions and conditions elsewhere in the world. For example, through the beach clean-up conservation mission, students will explore the issue of marine debris and plastic pollution, emphasizing the

consequences of a local action, like littering, and the global impact that it has due to the interconnectedness of the ocean and the power of ocean currents.

For the ocean, the global nature of the challenges facing it and their impacts speak not only to their monumental significance, but their immense complexity. However, uniting over these issues can lead to the promotion of global cooperation, solving many of the social problems plaguing our global society. For young students, this global cooperation begins with shared appreciation and shared passion. Saltwater Classroom makes it possible for students around the world to connect with one another, build cross-cultural relationships, share marine discoveries, and ultimately forge a passion for the ocean that extends beyond whatever differences may set us apart.



SALTWATER CLASSROOM

CONCLUSION:

Saltwater Classroom is an innovative approach to environmental education that harnesses the power of our technologically connected world to spur an ethic of global ocean stewardship in today's youth. Through the weeklong Saltwater Workshops and the education curriculum centered around hands-on learning with interactive lessons, field excursions, and conservation missions, Saltwater Classroom will work to instill in young students a passion for the ocean that translates into respect, awareness, and ultimately, a desire to protect it.

The education is continued and strengthened through Saltwater Classroom's collaborative mobile phone/iPad application. This aspect of Saltwater Classroom emphasizes the global nature of these challenges and aims to build a global network of young students connected by a shared passion for the marine environment. Focused on building cross-cultural relationships, Saltwater Classroom will bridge divides to create a universe of young students with a heightened responsibility to our planet's oceans and an elevated awareness of their actions.

The revitalized global stewardship ethic that Saltwater Classroom creates will result in a generation that can be the voice for our oceans, advocating and demanding positive, sustainable change.

*"In the end we will conserve only what we love;
we will love only what we understand;
and we will understand only what we are taught."*

-Baba Dioum



Lesson: Our Blue Planet

Objectives

- Rudimentary understanding of the formation of the oceans
- Understanding of today's oceans
- Ability to identify planet's oceans on map
- Ability to identify and describe various ocean environments
- Ability to describe coastal environments

Lesson Outline

1. History of the Oceans

Activity: How old is the Earth?

The question is posed. All students raise hands and are instructed to lower them when they think the correct age is stated. Instructor begins: "1000 years old?", "5000 years old?", "1 million years old?", "50 million years old?", "1 billion years old?", "4 billion years old?", "Age of Earth = 4.6 billion years old!"

Lesson: Formation of Planet Earth as we know it

- Formation of Protoearth, an early, "rough draft" version of Earth
- Formation of our atmosphere
- Formation of our oceans
- Beginning of life in the ocean

2. Today's Oceans

Lesson: Our home, the Blue Planet

- Oceans dominate surface of Earth
- One interconnected ocean
- Four principal and one additional oceans: Pacific, Atlantic, Indian, Arctic, Southern
- Characteristics and locations of each ocean

Game: Pin the Ocean on the Earth

Large blank map is hung up and students are given one of 5 labels for an ocean. Students first look at the map and see where the ocean should go, they are then blindfolded, spun around, and try to put the ocean label in the correct location. After all students go, we look and see if anyone did it correctly.

3. Types of Ocean Environments

Lesson: Ocean Habitats

- Arctic
- Coral reef
- Deep sea
- Kelp forest
- Mangrove
- Open ocean

4. Coastal Environments

Activity: Let's think about the coast!

Students will be shown an image of the coast and be asked if they've ever been here before. Students are invited to share their experiences. Students are then asked to hypothesize what might make these environments a hard place to live.

Lesson: Why are coastal environments unique?

- The Tides
- Types of coastal environments:
 - Sandy beaches
 - Rocky shores
 - Mangroves and salt marshes

Introduction to Field Excursion #1

- The Intertidal zone
- Organisms of the intertidal
- Scientific protocol
- Materials and methods
- Vocabulary



Lesson: An Ocean in Trouble

Objectives

- Understand the issues facing the ocean
- Describe the impacts of issues including:
 - Ocean acidification
 - Habitat degradation and loss
 - Overfishing
 - Sea level rise
 - Marine debris
- Begin to understand the global context

Lesson Outline

1. The Ocean Needs our Help

Question: What kind of issues are facing the oceans?

Students will be asked if they can brainstorm any issues that are facing the oceans related to human activity.

Activity: Global Warming and Sea Level Rise

Introduction:

Where does ice exist in the ocean?

Is there ice on land and in the water?

As temperatures rise, what happens to these ice masses?

Do sea and land ice lead to sea level rise?

Experiment:

Materials:

- Lab notebook
- Plastic containers
- Sculpting clay
- Ice
- Water
- Ruler

Procedure:

1. Frame the question:
2. Form a hypothesis:
3. Place clay on one side of both boxes, resembling land coming out of the ocean
4. Place six ice cubes on “land” in first box, six cubes in “ocean” in second
5. Pour water into both boxes at an equal level, ensuring cubes are off the bottom of the box
6. Measure water depth at 20 minute intervals and record data
7. Graph data on bar graph

Discussion:

In groups first, students will discuss the results they observed. Students will then hypothesize about the implications of melting sea and land ice on global sea level.

Conclusion:

In their lab notebooks, students write conclusion about what happened and why.

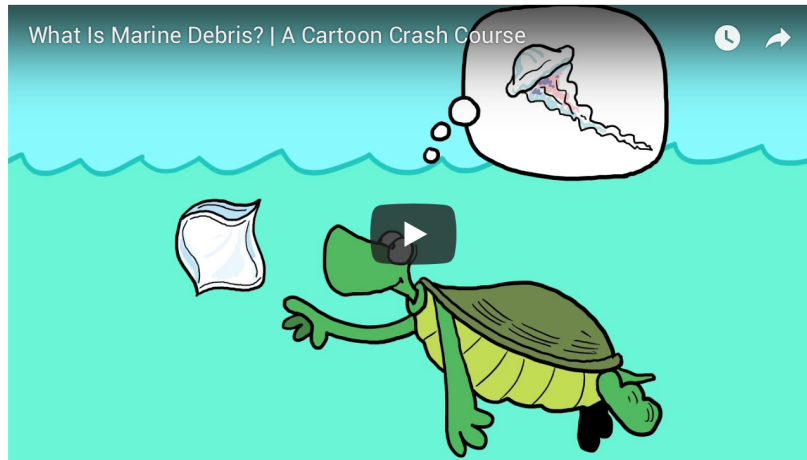
2. Other Ocean Issues

- Overfishing
- Habitat Loss
- Coral Bleaching

3. Marine Debris: A Plastic Ocean

Questions: *How does plastic get into the ocean? What types of plastic get into the ocean? What kind of problems does plastic in the ocean present?*

Video: "What is Marine Debris? A Cartoon Crash Course"



Lesson:

- Plastic Origins: Litter, fishing, shipping, waste
- Kinds of plastic in the ocean: Macro and micro plastics
- Issues caused by ocean plastic: Entanglement, ingestion, accumulation

Activity:

Conservation Mission: Beach Clean-Up



Field Excursion: The Intertidal Zone

Objective:

This Saltwater Classroom Field Excursion takes students to the Intertidal Zone and introduces them to the methods and materials that ecological scientists use to collect data about species and their habitats.

Procedure:

In small groups, students will sample species *abundance* and *distribution* by using the *quadrat* sampling method. Each group will conduct two quadrat samples, one closer to the *high tide* line and one closer to *low tide*. For each quadrat sample, students will begin by placing their quadrat in a tide pool or on a rock. First, students will measure the temperature of the air and the water. For species sampling, students will use two methods, depending on whether the species is *mobile* or *sessile*. For mobile species, students will use their field guides to count the organisms. For sessile species, students will estimate *percent cover*. Data is recorded in the data sheet and will be analyzed and graphed when back in the classroom.

Materials:

- Quadrat
- Field guide
- Thermometer
- Lab notebook with data sheet

About the Intertidal Zone

The Intertidal Zone is the area of shoreline that is located between the high and low tide levels. Over the course of a day, the area changes from being submerged underwater to fully exposed to the air. This creates many challenges for the organisms that live in this area. As a result, the organisms that live here have adapted various strategies to make this tricky spot a viable home.

Many organisms live in the Intertidal Zone, including mobile and sessile species. Mobile species are animals that are able to move freely by themselves, including species like

crabs and starfish. Sessile species, species that do not move, also exist in these ecosystems. They include various types of seaweed and algae.

The variability in the Intertidal Zone due to the movement of tides, presents many challenges for the organisms living here. One of the major challenges is the drastic changes in temperature, salinity, oxygen levels, and pH that occur. Additionally, at low tide, when species are exposed to air, they experience *desiccation*. Both high tide and low tide present threats in terms of predation. At low tide, species may be subject to predators like seabirds or rodents. High tide could mean the presence of predators including large crabs or fish. In addition, the Intertidal Zone is always subject to waves which pose their own set of challenges. Powerful waves can transport organisms from one place to another or damage parts of an organisms body.

For organisms living in the intertidal, these challenges certainly make the area a difficult place to live. But for scientists, the intertidal zone and the challenges it presents for organisms make it a very interesting study subject!

Vocabulary:

Intertidal: the area of shoreline that is covered by water at high tide and exposed to air at low tide

Tide: the alternate rising and falling of the sea due to the gravitational pull of the moon and the sun

Quadrat: a frame used to sample an area

Sessile: an immobile species

Mobile: a species that is able to move

Desiccation: the drying out of an organism due to air exposure



Conservation Mission: Beach Clean-Up

Objective:

Marine debris poses a serious threat to our oceans. Through this Conservation Mission, students will participate in a Beach Clean-Up. Students will collect debris, analyze the contents, and hypothesize the origins. Discussion will include the negative consequences of marine debris and ways to reduce it. Students will understand the formation of microplastics and the process of bioaccumulation.

Background:

Marine debris is a problem of massive scale and one with disastrous impacts. Ranging from plastic bottles to sunken ships, discarded fishing gear or a windswept sun hat, NOAA defines marine debris as “any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment” ([NOAA.gov](https://www.noaa.gov)).

For marine life, marine debris poses many serious threats including entanglement and ingestion. Because of the movement in the ocean, plastics continually break down into smaller and smaller pieces, eventually becoming “microplastics”. These tiny pieces of plastic accumulate as fish ingest them and threaten not only ocean health, but the health of humans who eat seafood.

The problem of marine debris is universal, occurring in every ocean on Earth. But despite the enormous scale and severity of the problem, marine debris is preventable. Beach clean-ups, like this Conservation Mission, are important steps in reducing the amount of plastic and other debris that ends up in the ocean.

Procedure:

Part one: Beach Clean-Up

Students will use thick rubber gloves to pick up debris on beach and put it into trash bags. After collection period, students will analyze the composition of the collected debris and sort debris made of different materials including plastic, paper, wood, metal, cloth, and

glass. Students will count items in each material category and log the data into their lab notebooks. Students will hypothesize the source of the material.

Part two: Microplastics

Students will use microscopes to examine sand and microplastics. The exercise will lead students to understand the process of plastic breaking down gradually over time and becoming very small. Students will form connections with how this microplastic can be ingested by small marine organisms.

Conclusion:

Students will summarize the procedure and the results from the beach clean-up, including an analysis of the debris composition and ideas for its origins. Students will make a pie chart of the composition of the marine debris found. Based on what they experienced, students will brainstorm negative consequences of marine debris. Students will include a description of how plastics in the ocean break down into microplastics and how these tiny particles pose a threat for marine organisms.

Materials:

- Thick rubber gloves
- Trash bags
- Microscope
- Lab notebooks

Vocabulary:

Marine debris: any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment

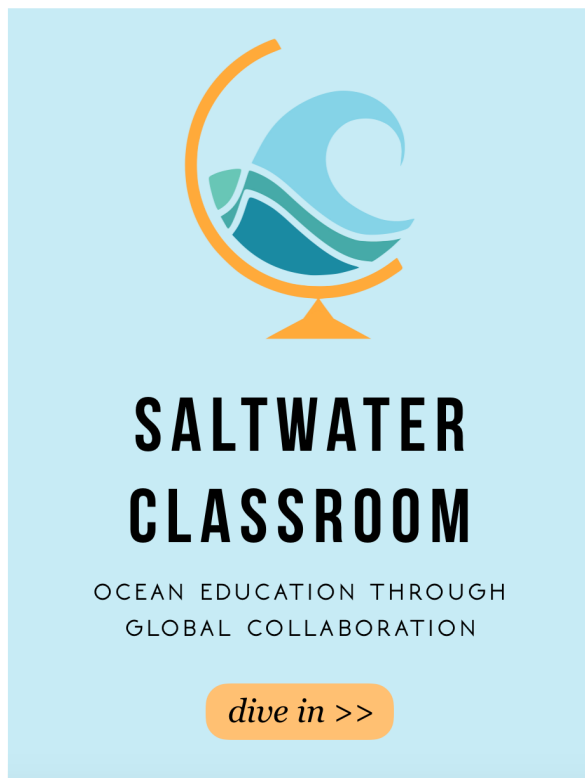
Entanglement: the process by which marine organisms, particularly marine mammals, are caught in marine debris

Ingestion: the process of marine organisms swallowing marine debris

Accumulation: the process of marine debris, mainly microplastics, becoming concentrated in an organism

Microplastic: extremely small pieces of plastic debris in the environment resulting from the disposal and breakdown of marine debris

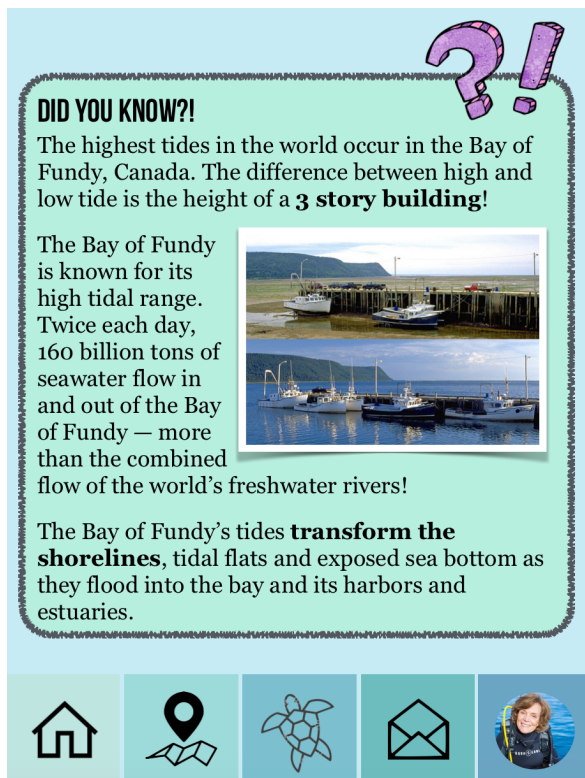
APPENDIX D: APPLICATION MOCK-UPS



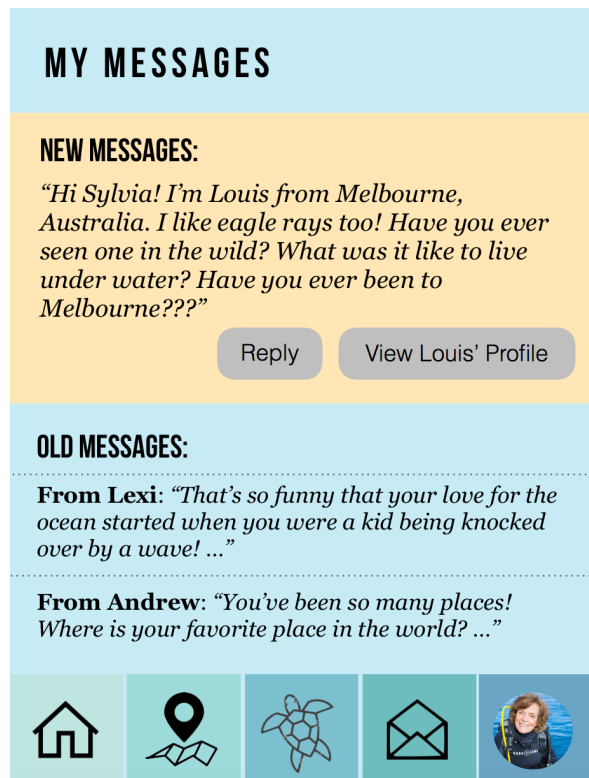
1. Welcome page



2. Homepage



3. Zoom-in of "Did You Know?!"



4. Message Board

APPENDIX D: APPLICATION MOCK-UPS



SYLVIA EARLE

Hi! I'm Sylvia! I'm an ocean explorer and marine biologist for National Geographic. I've lived underwater!

WHERE IN THE WORLD?
Berkeley, California
United States

SYLVIA'S PROFILES:





5. Profile page



LOUIS COPOLOV

Hi! My name is Louis. I love to surf and swim in the ocean. My favorite ocean animal is a dugong.

WHERE IN THE WORLD?
Melbourne, Victoria
Australia

LOUIS' PROFILES:





6. Profile page

MY SPECIES PROFILES



LIONFISH

Pterois volitans



SPOTTED EAGLE RAY

Aetobatus narinari



SERGEANT MAJOR


Abudefduf saxatilis



MAKE A NEW PROFILE



7. List of Species Profiles



LION FISH

Pterois volitans






Identification: Lionfish have distinctive brown or maroon, and white stripes covering their head and body. They have fleshy tentacles on their face and spines along their fins.

Native range: South Pacific and Indian Oceans

Non-native range: Southeastern United States coast, Caribbean

Conservation: Lionfish are an invasive species in the US and Caribbean coastal waters. They have the potential to harm reef ecosystems because they are top predators that compete for food and space with overfished native stocks.

FUN FACT: Lion fish are also known as: zebra-fish, firefish, turkeyfish, and butterfly-cod!



8. Lionfish profile

REFERENCES

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