Our Education Foundation

Updated: December 2022

Ocean Discovery Institute:
YOUNG LIVES TRANSFORMED THROUGH SCIENCE

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INTRODUCTION

THE PROBLEM

Founded in San Diego in 1999, Ocean Discovery Institute addresses a national crisis in science education – one particularly acute in underserved communities. The poor performance of American students in science keeps many young people from achieving their full potential, disengages entire communities, and leaves our nation without the workforce and decision makers it needs to meet tomorrow's challenges and sustain our position as world leaders in thought and innovation.

The primary community that Ocean Discovery engages, as of the current version of this document, is City Heights, an inland community of San Diego located approximately 10 miles from the Pacific coast. City Heights is rich in ethnic and racial diversity but poor in material wealth and resources. Thirty-four percent of its population of nearly 85,000 are foreign-born, many of whom are immigrants or refugees. Collectively, the population speaks more than 30 languages (Marcelli and Pastor, 2015; San Diego Association of Governments, 2015; United Way of San Diego, 2015). One of the poorest areas in San Diego County, the community is also burdened by poverty, with 43% living at 150% of the federal poverty level or below (Marcelli and Pastor, 2015) and over 94% of students eligible for federal free or reduced lunch programs (California Department of Education, 2016). More than one-third of the population have not graduated from high school (United Way of San Diego, 2015). High-quality public education for its approximate 21,000 youth (Marcelli and Pastor, 2015) is, generally, lacking in City Heights. Further, in spite of the high density of institutions of higher education and scientific industry in San Diego, the community experiences few opportunities for engagement in science, either inside or outside of the school classroom. Consequently, science and conservation are simply not a part of the fabric of life in this community.

OUR SOLUTION

Ocean Discovery operates on a single premise: by receiving high quality science learning opportunities, kids in poverty develop a passion for science and conservation, stay in school, go to college, become science leaders, and gain entry to high paying fields where they make a difference. Our unique seed-to-tree educational model supports young people throughout their development, engaging students early and staying with them through college and career. Our model provides science opportunities, mentoring, and growth mindset tools to build belief, achievement, and leadership in underserved young people from kid (our "seeds" – *children who are filled with potential but lack opportunity to understand how the world works and how they can make a difference*) to career (our "trees" – *individuals who have the education and experience to use science to make decisions, obtain a career, and make a difference*). We achieve this through provision of continuous, tuition-free science education across one school-shed – defined as the young people that feed into and through a single high school cluster. Our founding benchmark school-shed is the Herbert Hoover High School cluster in City Heights, which meets specific metrics determined as critical for implementation of our model, including racial diversity, size of the student population, the percentage of students qualifying for Federal free or reduced lunch, high school graduation rate, and academic proficiency scores. Our programs use ocean science as a platform to generate the "spark" that makes young people want to learn the principles of science, technology,

engineering, math, and conservation. We ensure all students have the tools to overcome adversity. Our students believe that a scientist is someone they can be. They achieve because of it and they become leaders who enter high-paying science and science-related fields and make a difference.

HISTORY OF THIS DOCUMENT

This document has arisen over time from a combination of many elements. First and foremost, it is informed by more than 20 years of hands-on experience teaching ocean science to young people, with the majority of that time concentrated in our target community of City Heights. This focus on a single community is strategic, and has provided Ocean Discovery with a depth of understanding of the strengths, challenges, and needs present in the community to which we respond in our educational programming. Further, it has allowed us to foster trusting relationships with teachers, school administrators, community members, and students – all of whom provide important feedback that, in turn, ensures our programming remains grounded in the community. Periodic review of other educational models as well as of educational and social research literature has ensured our approach is evidence-based. Internal assessment of our programming, both quantitative and qualitative, has allowed us to hone in on those components that produce positive results, as well as to test new ideas. Periodic external evaluation has provided new insights and unbiased assessments. Driven by feedback, evaluation, new sources of funding, creativity, and passion, our programming has undergone significant evolution – from the names and content of our educational programming to the graphics representing our educational model. This document represents the juxtaposition of these efforts, resulting in a solid framework from which to empower our youth and transform our community.

PURPOSE OF THIS DOCUMENT

Our Education Foundation provides a programmatic framework for the evolution of our programs and the design of associated educational activities. This framework ensures the integrity and effectiveness of our model while fostering creativity and enhancement by empowering each staff member to participate in curriculum design and communication. This document is used in a variety of ways.

- To communicate our approach to education, its theory, and its implementation;
- To ensure our programming, new and existing, is in alignment with our design principles;
- To provide a framework against which to both qualitatively and quantitatively evaluate our educational efforts; and
- To assist us in making decisions about potential programmatic partnerships.

Our Education Foundation is reviewed periodically and is informed by the results of our evaluation and organizational experiences.

COMPANION DOCUMENTS

This Education Foundation document is closely associated with several additional organizational documents.

- Education Foundation Executive Summary: an abbreviated version of our Educational Foundation and is intended for communicating to audiences a summary of our approach.

- Curriculum Design Framework: provides guidance on the development of curricula and associated lessons that meet our design principles.

  Educator Principles: a guiding document for the methodology and other educational best practices used by all Ocean Discovery instructors when directly engaging students.

- Education Foundation Alignment documents: these detail how the programs and/or curricula associated with our initiatives demonstrate the design principles explained in this document and provide a baseline against which to evaluate our programs.

- Comprehensive Evaluation Plan: provides information on our approach to evaluation of all of our programs and on our approach to evaluating the collective impacts our programs have on our students and the surrounding community.

ORGANIZATION OF THIS DOCUMENT

The next section, Our Educational Programming, first introduces the major components of our educational model and how they fit together. The philosophies underlying our approach to education are highlighted next, followed by an overview of each of our initiatives, their respective audiences, and their aims. Next, a detailed description of the components of our programming as well as an examination of how our design principles are expressed in each of our programs is provided. The Program Alignment section provides the templates for evaluating our programs with respect to our design principles. Finally, key definitions are included for clarity.

OUR EDUCATIONAL PROGRAMMING

ORGANIZATION OF OUR EDUCATIONAL MODEL

Eight primary components work together to form our Educational Model (Fig. 1).

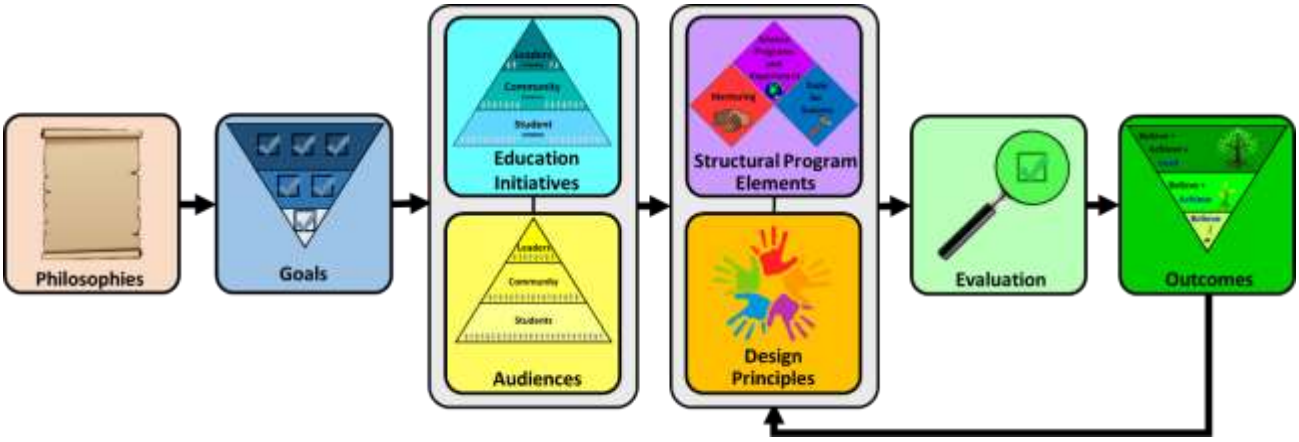

Fig. 1. Ocean Discovery Institute's Educational Model. Our educational model is infused with our philosophies. To address the goals and meet the intended outcomes of our programs, our model targets specific audiences in the community with strategic programming containing common structural program elements that are, respectively, tailored for each audience through the customized application of our design principles. Our programs undergo periodic evaluation efforts that assess progress toward intended outcomes. Our approach to our programs is refined as informed by evaluation to guide us in reaching our intended outcomes.

Our philosophies infuse our entire educational model. Our goals are informed by our deep knowledge of the community we serve as well as the challenges they face. We provide three progressively building program areas:

- In-School Programs
- Out-of-School Programs
- Leadership Programs

These program areas are informed by our philosophies as well as current educational and social research, serve as the foundation for all of our programming, and are designed to help us meet our goals. Programming within each area is comprised of three common structural program elements which provide cohesion among the programs:

- Science Opportunities
- Mentoring
- Growth Mindset Tools

Structural program elements are interpreted for each audience through our unique design principles, providing a customized experience. Evaluation is conducted to ensure our design principles are authentically implemented and that our programmatic goals are met. Lastly, when the goals for each of

the respective program areas have been met, the outcomes for our programming are considered to have been realized. As a result of our programming, our students will:

- BELIEVE that science is something they can do and a scientist is someone they can be.
- ACHIEVE positive academic performance in school as well as in their understanding of science and math content.
- LEAD in science and science-related careers to make a difference.

ELEMENTS OF OUR EDUCATIONAL MODEL

OUR PHILOSOPHIES

Three overarching and interconnected philosophies guide Ocean Discovery's approach to educational programming and help us fulfill our mission. These philosophies are woven throughout all of our programming.

- **We understand and serve the needs of our community.** A deep understanding of the community we serve, as well as longevity in the community, is necessary to promote real transformation. Our deep roots in City Heights give us unique insights into the significant and systemic educational, social, and economic challenges faced by the youth in the community and their families. We recognize that in order for our community to fulfill their potential for becoming science and conservation leaders, they must first have their fundamental needs met (Fig 2.)

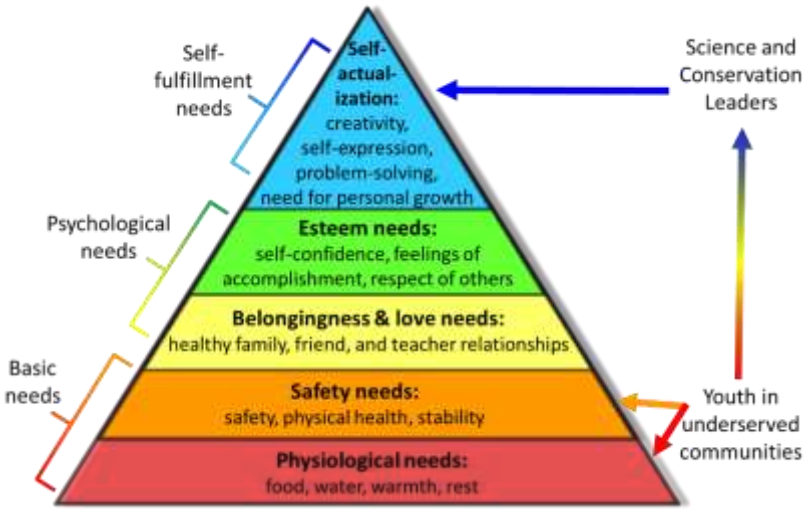

Fig. 2. Hierarchy of Needs in Underserved Communities. We recognize that in order for youth in our community to fulfill their potential as science and conservation leaders, they must first have their basic and psychological needs met. Our programs holistically address these fundamental needs. *Adapted from Maslow (1943).*

We also exist within the community we serve and are an integral part of the community, rather than an external presence. In San Diego, our state-of-the-art facility, the Living Lab, is located in the heart of City Heights, situated at the entrance of a city canyon, and is within one mile of the 11 public elementary schools, two public middle schools, and one public high school that constitute our school-shed. Thus, it serves as a focal point for all programming. Through our purposeful presence, we also recognize that, in spite of the challenges, our community possesses immense potential to spread their wings. We use these combined insights to build effective and holistic programs that meet the needs of our youth and empower them to transform their lives, their community, and our world.

- **Belief is the foundation for science achievement and leadership.**

  For individuals in our community and beyond, substantial inequities exist along the pipeline from birth to science and science-related careers. Belief provides the motivation to persist in the face of these barriers. It manifests itself in positive academic behaviors and performance, and, in turn, fuels students' perseverance along their educational and career pathway. Our programs are designed to address the many opportunity gaps in the educational pathway experienced by our community and build in students, first, a belief that science is something they can do and scientist is someone they can become. Furthermore, we maintain an unshakeable belief in our students' potential, and in turn they believe in themselves.

- **Our students study and steward the marine environment because it provides the ideal platform for discovery.** The ocean is the defining feature of our planet. Regionally, marine ecosystems, and their co-dependent terrestrial ecosystems, serve as significant features of our geography and provide immeasurable ecological, economic, social, and spiritual services upon which we are all profoundly reliant. Further, the ocean, in its marked immensity and subtle complexity, is an influential catalyst for exploration, discovery, and innovation. Yet, marine environments are threatened by human action and in coastal communities nationwide where the ocean is part of a cultural identity, entire groups of people are not accessing or stewarding this resource. By using the ocean as a platform for discovery, students can learn across all science disciplines and make an immediate impact on their environment. Just as biological diversity results in the most productive, sustainable, and resilient ecological communities, a culturally diverse science workforce is critical for the evolution of thought and innovation in the scientific community, and a broader understanding and utilization of science in the larger public, and contributes to a more just economy.

STRUCTURAL PROGRAM ELEMENTS

Structural Program Elements are unique educational components that have been identified as essential to building and retaining a robust pipeline of underrepresented young people in science. These Structural Program Elements provide a cohesive structure across our three program levels, and consist of Science Opportunities, Mentoring, and Growth Mindset Tools. Structural Program Elements are not necessarily mutually exclusive.

- **Science Opportunities** can take two forms. They can be formal, curriculum-based educational courses consisting of several connected science-related lessons and/or research activities that target a specific audience and that have specific goals aligned to one of our three program levels. Science opportunities can also exist external to our science program curricula and include one-time, opportunistic educational events with specific goals as well as more in-depth experiences such as research internships and teaching fellowships.

- **Mentoring** is broadly defined as the guidance of individuals at points during their educational pathway in the management of their own learning, education, and progression to and through careers with the goal of helping students to develop and maximize their understanding, abilities, and experiences, and ultimately, to lead using science to make a difference. It occurs at different levels of intensity among the initiatives, ranging from single interactions during a science program to peer-to-peer mentoring woven into science opportunities to long-term mentoring relationships.

- **Growth Mindset Tools** are a specific set of skills and practices that support learning, strong hearts and minds, and healthy bodies. We teach these tools in conjunction with a growth mindset practice so that students can overcome any challenges on their pathway to becoming a science leader. Our Programs

Our educational programs are structured with a “pyramid” approach, as described in more detail below. Our pyramid design demonstrates the number of students reached by a program tier, with an inverse correlation between the number of students reached and the intensity and impacts generated through participation. For example, the In-School Program, at the base of our pyramid, serves the most students at the lowest impact (including both number of hours of participation and projected student outcomes), while Leadership Program, at the top of our pyramid, serves the fewest students at the highest impact.

Figure 4. The pyramid approach to our educational programs, showing the number of students served by each program area and the scale of impacts generated through participation.

In-School Programs: Reaching 10,000 Students

Our most inclusive tier is our In-School Programs. By partnering with every school in the school-shed, our In-School Programs ensure that every student has the opportunity to believe that science is something they can do and a scientist is someone they can be.

Through three experiences each year, elementary school students 1) build community in their classroom, 2) explore a coastal watershed habitat, and 3) make a difference, both today and tomorrow, during a trip to the Living Lab. In middle school, students build their community's resiliency to climate change through experiences in their classrooms and at the Living Lab. At the high school level, students collect scientific data in coastal habitats and demonstrate that they are the science leaders our world needs.

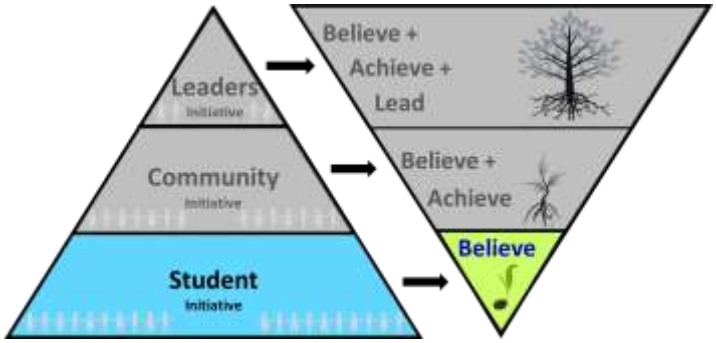

Fig. 4. Our Student Initiative builds belief among all students in the school-shed that science is something they can do and a scientist is someone they can be.

The In-School Programs build positive science belief so that our students believe that:

- they can recognize science;
- science is important;
- science, in its many forms, has relevance for their lives;
- they can do science;
- challenges can be opportunities to learn and grow, rather than permanent obstacles;
- a career in science is a possibility for them; and
- they can make a difference.

Out-of-School Programs: Reaching 1,000 Students

Our Out-of-School Programs is the middle tier of the pyramid. In partnership with families, this program area provides place-based science and conservation programming for K-8th grade students. Longer-term relationships with students and families promote attendance at multiple programs each year of a student's academic pathway. Programs are designed to provide students the opportunity to believe that science is something they can do while demonstrating they can achieve a positive academic performance and greater understanding of scientific concepts.

Out-of-School Programs embrace a wide variety of science programming rooted in areas of relevance to the community delivered through weeklong, after-school science camp experiences, monthly field trips that enable families to explore coastal environments, and weeklong summer camp. Curriculum themes change each academic year and summer, allowing each young person the opportunity to participate in unique programming twice a year from kindergarten to eighth grade. Students participate in year-round programs that support academic achievement. As part of our Out-of-School Programs, we also integrate large community events in order to generate a collective energy and sense of belonging.

Fig. 3. Our Community Initiative enriches our community and gives them reason to BELIEVE that science is a possibility for them and ACHIEVE academically.

Out-of-School Programs aim to break down barriers of perception toward science, to build community ownership of a place of science, and to, ultimately, permeate residents with a sense of belief that:

- they can recognize science;
- science is important;
- science, in its many forms, has relevance for their lives;
- they can do science;

- challenges can be opportunities to learn and grow, rather than permanent obstacles;
- a career in science is a possibility for them; and
- they can make a difference.

Through our Out-of-School Programs, our students also learn that they can ACHIEVE in science through:

- improved understanding of scientific concepts and the scientific process; and
- achievement of positive academic performance.

Leadership Programs: Reaching 100 Students

Our Leadership Program is our most intensive tier, and offers young people, who want to do more, the opportunity to do more, as they progress on their pathway from eighth grade through college and beyond. By pairing rigorous science programming and experiences with college and career support services, this initiative aims to develop young people into science leaders who make a difference in their community and our world.

This program builds upon the other tiers and uniquely also provides the practice of soft skills and practical tools for college and career. Peer-to-peer and professional-to-peer mentoring is a critical element of all Leadership Programs.

Fig. 5. Our Leaders Initiative grows leaders in science through participation in authentic research, development of practical work skills, and provision of critical tools, enabling our students to fulfill their potential, and to LEAD transformation in their community and our world.

Students are recruited as cohorts, so that through this shared experience they can build community and begin to build their network. Each year, a new cohort of 8th grade students begin on the Leadership Programs Pathway. We call these students “Ocean Leaders”. Once students become an Ocean Leader, they will continue their participation through college and beyond, leading participants to share the phrase, “Once an Ocean Leader, always an Ocean Leader”.

The Leadership Programs are comprised of (1) summer intensive science programs beginning in 8th Grade and throughout high school, (2) Academic Year coaching and mentoring programs throughout high school and during critical transitions from high school to college and college to career, and (3) year-round college and career connections offered throughout their pathway.

These programs build upon the goals of the tier below, Out-of-School Programs, so that students BELIEVE that:

- they can recognize science;
- science is important;
- science, in its many forms, has relevance for their lives;
- they can do science;
- challenges can be opportunities to learn and grow, rather than permanent obstacles;
- a career in science is a possibility for them; and
- they can make a difference.

and they can ACHIEVE in science through:

- improved understanding of scientific concepts and the scientific process; and
- achievement of positive academic performance.

Through our Leadership Programs, we also provide a foundation upon which our students are empowered to LEAD by:

- taking the necessary steps to pursue and obtain a career in science or science-related fields;
- taking opportunities to use science to make a difference; and
- participating as servant leaders and mentors.

Organization-wide Efforts and Impact *(in progress)*

- Language on how we affect change as an org vs. by program The concept of “An entire community transformed through science”
- Opportunity sharing with all students in the cluster, K-12
- Our organizational goals (e.g., all students obtaining college degrees, majoring in science and science related fields)
- Work we do that is org wide such as
    - Opportunity sharing
    - Attracting partners
    - Using our Living Lab for programs, events, mission-related efforts by other entities, and collaborative endeavors

OUR DESIGN PRINCIPLES

Our design principles are unique aspects of our programming that guide the development, implementation, and evolution of our programmatic activities within our initiatives. Table 1 highlights the design principles according to initiative in which they are expressed. The following section lists the design principles according to the type of structural program element they influence and defines each design principle and its rationale. It is important to recognize that our design principles, as presented in this document, represent the ideal state to which we strive in all of our programming. Periodic evaluation provides insight on the extent to which we achieve our design principles as well as opportunity to make necessary enhancements.

Table 1. Our Design Principles as Expressed in Our Programs

	Program Element	Design Principle	In-School Programs	Out-of-School Programs	Leadership Programs
Believe		Ocean Science Is Our Platform.	✓	✓	✓
		Our Programming Reflects Community Priorities.	✓	✓	✓
		We Share the "Spark".	✓	✓	✓
		Our Programming Is Hands-On.	✓	✓	✓
		Our Students Make a Difference.	✓	✓	✓
		Our Students Model Science Leaders.	✓	✓	✓
		Mentoring Plays an Important Role.	✓	✓	✓
		Our Educators Are Science Role Models.	✓	✓	✓
		Science Leaders Share Their Stories.	✓	✓	✓
		We Provide Coaching to Practice a Growth Mindset.	✓	✓	✓
		We Teach Tools to Support Strong Hearts and Minds	✓	✓	✓
		We Teach Tools to Support Healthy Bodies	✓	✓	✓
Achieve		Our Programming is Connected.	✓	✓	✓
		We Teach Tools to Support Learning		✓	✓
		Our Students Build Math Skills		✓	✓
		Our Students Achieve Academically		✓	✓
Lead		We Foster Social Awareness and Relationship Building Skills.			✓
		We Provide Practical Tools and Support for College and Career.			✓

Science Opportunities

- **Ocean Science Is Our Platform.** Focusing on the ocean as our platform is a natural channel for our educational programming for so many reasons. The ocean is a natural feature of our region, given San Diego's close proximity to the Pacific Ocean, and yet our community rarely

experiences the ocean directly due to a litany of barriers. Thus, our platform fills a gap our community experiences, and further, capitalizes on our inherent attraction to the sea. Additionally, ocean science provides an educational outlet for all STEM fields, as well as resulting opportunities to contribute to scientific knowledge. Lastly, in line with our focus on conservation, the ocean and its related ecosystems provide opportunities for stewardship of marine resources.

- **Our Programming Reflects Community Priorities.** Our community has identified three key priorities: 1) educational and economic opportunities, 2) family and fun, and 3) health and safety. To ensure our programming meets the needs of our community and stays relevant, we address these topics both directly and indirectly through our programming.

- **We Share the "Spark".** We believe that science that is new and exciting can capture the imagination of what is possible and promote lifelong exploration and learning. Several studies have suggested that interest in science declines starting between age 9-11 with quality of classroom science instruction possibly contributing to the decline (Osborne et al. 2003). Our programming captures and maintains the wonder of science exploration from early youth through adulthood by incorporating hands-on, novel activities that are taught by knowledgeable Science Educators. Whether the programs be sea star dissection, ROV engineering, or field discovery in Baja, Mexico, our programs share the "spark" of excitement with our students and generate the curiosity that makes them want to learn more.

- **Our Programming Is Hands-On.** Science is a process of active exploration and discovery. Studies show that youth learn best when they can actively learn about the world around them (Felder and Brent, 2009, Gormally et al. 2009; Freeman et al. 2014; Duran and Dökme, 2017). Further, active learning techniques promote scientific literacy skills as well as students' confidence in the process (Gormally et al. 2009; Duran and Dökme, 2017). Our students practice the scientific process by conducting experimental activities that require application of progressively more advanced knowledge and skill, utilizing correct scientific terminology, asking questions, recording observations and data in science notebooks, and critically assessing outcomes. To promote achievement, our programming incorporates inquiry-based instruction and tactile learning strategies that foster interest, develop necessary critical thinking skills, and solidify learning. We deliberately use strategies to reach all types of learners, including visual, auditory, reading/writing, and kinesthetic. Importantly, these techniques ensure success for students who are English Language Learners. Our community has abundant diversity, with over 30 languages spoken. To support comprehension of all our students and to ensure everyone can participate in our hands-on science programming, we focus on strategies for success including the use of multiple media to present content, students' physical demonstration of language comprehension, and group work (Clancy and Hruska, 2005).

- **Our Students Make a Difference.** The mindset of "if I understand how the world works, I can make a difference" is at the core of our educational approach. Our Science Discovery Process reflects this, placing Make a Difference at the center – where science discovery begins, ends,

and restarts again. To empower our community to make positive and informed environmental decisions in their communities, and apply these learnings to the world more broadly, conservation-oriented learning and activities are essential components woven throughout our initiatives. The confidence earned from building knowledge about our world and the critical thinking that is fostered during applied conservation activities provides a solid foundation for pursuit of post-secondary science and science-related education and careers.

- **Our Students Model Science Leaders.** Our programming integrates a focus on careers in science and science-related fields by incorporating a focus on professional scientific careers and activities in our Science Opportunities. We reinforce these themes with our students by encouraging them to act and think like the science leaders they are studying. We make this more explicit by calling our students "Science Leaders" and showing them that a person of any age can be a leader in science, and that the actions and responsibilities of a Science Leader change and evolve over the course of a person's journey from school to career, and that Science Leaders are people of any age who use science to make a difference in their community and our world. These leaders develop ideas that help solve problems facing our planet, improve human lives, and make our world a better place. Science Leaders study science or have careers in science and science-related fields.

- **Our Programming Is Connected.** To ensure our students understand how scientific concepts are related, the lessons within a given curriculum build on a specific ocean science theme and reinforce concepts learned previously. Techniques, such as the use of concept maps, help students visualize and conceptualize these connections. We also emphasize connectivity amongst our initiatives, so our students understand that the skills they learn and the understandings gained in one program are not independent of the avenues of science experienced in our other programs and that they can apply these skills beyond their program experience.

Mentoring

- **Mentoring Plays an Important Role.** Research has shown that mentoring from role models at different stages in their science and science-related careers has been associated with higher student performance and grades, and increased persistence in college and in science fields, particularly for members of high-need groups (Good et al., 2003; Myers et al., 2010; Stolle-McAllister et al., 2011; Wilson et al., 2012; Pfund et al., 2015). Young adults who had mentors as kids are: 55% more likely to be enrolled in college, more than twice as likely to say they held a leadership position in a club or sports team, and 78% more likely to volunteer regularly in their communities. Further, in a survey of young people who had mentors, 90% said they were interested in becoming mentors themselves, thus, facilitating this beneficial cycle (MENTOR, 2014). To help our students envision themselves in science, we incorporate mentors in our programming. Mentors range from our high school Ocean Leaders who mentor younger students, to Science Leaders. These individuals serve as mentors throughout the

continuum of mentoring from interacting with students during single classroom visits, to teaching classes, to participating as mentors in a formalized mentor relationship; represent the diversity in City Heights; and serve to help our youth model scientific and professional behavior and, ultimately, envision themselves in science.

- **Our Educators Are Science Models.** Like many underrepresented groups (Aschbacher et al. 2010), our community rarely experiences significant science engagement. Further, as only just over 15% of all bachelor degrees in science and science-related fields are issued to minorities, nationwide, and the science workforce is largely comprised of non-minorities (approximately 70% as of 2010; National Science Foundation, 2013), opportunities to see science modeled by scientists representative of the diversity in City Heights are rare. We recruit talented Science Educators who have degrees in the sciences, who represent the diversity in City Heights, and who also understand the challenges of, and the potential in, our community. Our educators share the "spark" with our community and demonstrate that science *is* for people like them.

- **Science Leaders Share Their Stories.** The term "Science Leaders" is also used to refer to students during programs, by means of encouraging them to act and think like the science leaders they are studying (as referenced in "Our Students Model Science Leaders", above). The other definition and use of the term "Science Leaders" refers to the adults who provide mentorship to our students and are described in more detail in this section.

- To a young person growing up in City Heights who is considering their future, the obstacles to achieving a college education, let alone a career in science and science-related fields, may seem insurmountable: lack of secure housing, familial instability, insufficient finances, family members without the knowledge or experience to help them navigate the college application process. To address this, we facilitate student interactions with Science Leaders into all programs. Story-telling by our Science Leaders, which includes discussion of their own college and career pathways, examples of how they overcame challenges, and how they found their own "Spark", helps to inject a sense of hope into our community – a belief that they, too, can participate in science.

  Science Leaders are individuals working in science and science-related fields who guide and inspire others by influencing knowledge with their thinking and ideas (Forbes 2014). Their work may involve creating new technologies, or doing scientific research and communicating and teaching that research to others. Their ideas tend to be well thought-through, supported by data and analysis, and logical. Science Leaders develop structure and frameworks that build knowledge about our world, help solve problems facing our communities and our planet, improve human lives, and make our world a better place. Science Leaders can come from a wide variety of science and science-related fields. A science or science-related career, as defined by the National Science Foundation (2015), is any position which is filled by a college graduate in a science or science-related field of study, including, but not limited to:

  - Computer and mathematical scientists

- Biological, agricultural, and environmental life scientists
- Physical scientists (e.g., physicists, chemists, geoscientists)
- Social scientists (e.g., psychologists, economists, sociologists)
- Engineers
- Postsecondary teachers in science and science-related fields
- Health care workers (e.g., physicians, audiologists, nurses)
- Science and science-related managers (e.g., engineering managers, natural and social science managers)
- Science and engineering precollege teachers (e.g., science teachers, math teachers)
- Technologists and technicians
- Other science and science-related occupations (e.g., actuaries, architects)

Growth Mindset Tools (*in progress*)

Growth Mindset is defined as the belief that your intelligence, abilities, and skills can be developed over time through dedication and hard work, and any challenge is an opportunity to grow. We believe having a Growth Mindset is a lifelong skill that all students should develop. To accomplish this, we provide coaching and teach growth mindset tools that enable students to see they can and will overcome challenges in their life, and we create an environment where they practice this regularly.

- **We Provide Coaching to Practice a Growth Mindset.**
  Students in Leadership Programs participate in weekly "Ocean Leader Coaching" at their school. Through coaching, students learn a 5-step process for achieving a growth mindset:
  1. Realizing what the challenge is and seeing it as an opportunity to grow.
  2. Knowing the Growth Mindset Tools that exist in their toolbox.
  3. Identifying the tool(s) to use to overcome the challenge.
  4. Implementing the tool(s).
  5. Reflecting on their success and growth.

  Additionally, all staff are prepared to engage students in coaching through informal interactions when opportunities arise during residential programming.

- **We Teach Tools to Support Learning, Including Communication Skills and *Know it! Own it!*:**
  Building good study habitats and practicing time management have a positive correlation with academic success in high school students (Fouche, 2017). Yet, students in our community who go on to attend college often experience a sense of shock at the difficulty of their higher education coursework. Commonly, the root cause of this is a lack of preparation in high school on how to process the new knowledge they are rapidly learning in class.
  - *Know it! Own it!:* To better prepare for the college learning environment, students use this series of tools to record new knowledge, organize it, identify and fill gaps in their new knowledge, and recall this knowledge to utilize in new circumstances.
    - *Know it!* includes the following tools:

        - Note-taking: Students learn to record main ideas and important facts from lectures using bullet points, summaries, and identifying key vocabulary.
        - Asking an "expert": Students learn how to use the internet to find credible sources and build confidence to take advantage of "office hours" when they can ask knowledgeable people (such as a teacher, professor, mentor, etc.) to help them fill their knowledge gaps.
        - Process reflection: Students process what was learned and experienced to build new connections to previous learning.
    - *Own it!* includes the following tools:
        - Study skills: Students develop skills which will allow them to take new knowledge, remember it, and begin to apply, analyze, and evaluate it.
        - Study time: Students practice how to set aside specific study time and use that time appropriately.
        - Process reflection: Students process what was learned and experienced to build new connections to previous learning using concept maps and individual thinking with pair and group share outs.
- *Communication Skills:* It is becoming increasingly important for science leaders to effectively communicate their knowledge to other scientists and the general public. Our students learn and practice presentation skills to be utilized during formal and informal presentations. For our students, building communication skills helps them not only share their science with others, but also gives them a critical tool that they can use in other aspects of their lives. Communication is an all-encompassing skill—including verbal, written, and body language—that empowers individuals to cooperate with others, resist inappropriate social pressure, negotiate conflict constructively, and seek and offer help when needed (CASEL, 2017).

- **We Teach Tools to Support Strong Hearts and Minds, Including Stress Reduction Techniques, Community Building, Self-Reflection, and Prioritization:** Young people face a variety of stressors as they develop cognitive, social, and emotional skills (McGorry et al., 2007). Their ability to navigate through challenges can affect their long-term prospects.
    - *Stress Reduction Techniques:* Students learn calming practices that can be utilized during times of stress. These evidence-based practices include stretching, deep breathing, yoga (in particular a body scan at the end of a session), and meditation.
    - *Community Building:* In a national landscape where only 1% of students of color from low income backgrounds are achieving science and science-related degrees, students at the early stages of this pathway need a community of support to push past all the barriers to access and gain entry into science careers. This community includes peers, program alumni, mentors, and staff who provide a safety-net for bourgeoning science leaders to fall back on when challenges arise and a network to access to pursue further opportunities. By offering students a safe, inclusive, and effective community in which they can take risks that no one in their family has done before, they are able to try out what it takes to become a science leader.
    - *Self-Reflection:* We incorporate guided self-reflection as students learn ways to actively explore and share thoughts and feelings in order to realize the impact of an experience. Participants are asked to reflect on various aspects of their educational

and personal experience (e.g., self-efficacy), which research shows can result in persistence and increase over time through self-reinforcing cycles of belief and behavior (Cohen et al., 2006; Oyserman et al., 2006; Wilson, 2006; Yeager and Walton, 2011). Self-reflection exercises can take various forms, such as discovering personal stories of compassion, humanity, and empathy to make a difference in the world.

- *Prioritization:* Students learn how to prioritize and then make decisions based on those priorities. With academics, sports, clubs, family, friends, and other competing obligations, students often lack understanding how decision-making can support with planning and reaching goals. Practice with how to prioritize in their daily lives helps students maintain progress and stay true to their commitments.

- **We Teach Tools to Support Healthy Bodies, Including Exercise, Nutrition, and Relaxation.** Ethnic minority and low socioeconomic status are both correlated with higher obesity rates in young people (Singh et al., 2008). Additionally, physical exercise and proper nutrition benefit not only physical health but also youth performance in school (Alex, 2015). Our students who adopt habits to improve their physical health now will see long-lasting benefits as they grow older.
  - *Exercise*: During residential programs, students experience many different types of physical activity in order to provide them with lifelong exercise options.
  - *Nutrition*: We introduce students to the science and data that shows the links between nutrition and overall well-being. Students learn best practices around healthy eating and nutrition during shared meals at residential programs. Nutrition tools are grounded in the USDA's "My Plate" dietary guidelines for food groups.
  - *Relaxation*: Especially after the COVID-19 pandemic, young people are dealing with escalating mental health challenges and require tools and mechanisms to aid in their self-care practices (Power et al., 2020). Students learn how to make choices related to their self-care and how to incorporate key components, including rest, fun, and connecting with family and friends.

DESIGN PRINCIPLE BENCHMARKS AND PROGRAM ALIGNMENT

We have created design principle benchmark matrices that holistically communicate how the design principles are demonstrated at the level of each initiative and represent the ideal state of how our design principles are exemplified. The matrices are organized by initiative and display the relevant design principles and the type of structural program element they reflect. Each matrix resides in the Manual document for each initiative.

These benchmarks function in several capacities. They:

- guide the creation of new programming;

- provide a detailed vision against which to evaluate existing programming within each initiative; and

- provide a framework against which to evaluate potential external programming provided by partners.

Programming, both existing and that in the design phase, and at any level (e.g., the track, program, curriculum, or lesson level) is then evaluated against these benchmarks in a program alignment process to ensure that the design principles are authentically met in the programming, and that, collectively, all programming is addressing the goals of the initiative. Evaluation of alignment of existing programs is conducted annually by program managers using these tools as a guide. A relevant program alignment form is also created for all new programming that is designed for any of the initiatives which is, then, integrated into regular program evaluation. The evaluation process results in identification and implementation of enhancements to our programming to ensure all relevant design principles are implemented and are achieving intended results. In the companion document, Program Evaluation Guide, the process and outcomes of our program alignment efforts are summarized in addition to the process used to identify progress toward meeting the goals of our programming.

Key Definitions

Achieve – The intended outcome of our Community and Leaders Initiatives, and symbolizes an increased understanding of science and math content and positive academic performance.

Believe – The intended outcome of all of our Initiatives, and symbolizes understanding of what science is and its relevance and sense of belonging within scientific endeavors.

Community Initiative – Our Community Initiative is our entry-level out-of-school initiative, and aims inspire students to ACHIEVE.

Conservation – The process of using scientific principles to steward our natural resources.

Design Principle – A unique component of our educational model and shapes programming in our initiatives. Design Principles may overlap the initiatives, but are not necessarily expressed identically. Science opportunities may be designed using many or all of the Design Principles for a given initiative.

Guiding Philosophies – The fundamental understandings upon which all of our programming is based.

In-School Programs – Cohesive programming that involves students and their teachers, typically within school-based instructional settings, to ensure every student in our school-shed is engaged in quality hands-on science, through which they believe that science is something they can do and a scientist is someone they can be. The In-School Program's goal is to inspire students to BELIEVE.

Lead – The intended outcome of our Leaders Initiative, and symbolizes envisioning oneself as a member of the community of science professionals, capacity to take the necessary steps to pursue and obtain a career in science and science-related fields, and ability to lead by using science to make a difference.

Leadership Programs – Intensive Science Programs and Experiences for a small cohort of high school and college students that take place during out of school hours and build essential science, research, analytical, and leadership skills through participation in authentic directed research and/or practical experiences such as internships and fellowships. The Leaders Initiative builds upon the goals of the Community Initiative and the Student Initiative and aims to generate the ability to LEAD, ACHIEVE and BELIEVE.

Mentoring – Broadly defined, the guidance of individuals at points during their educational pathway in the management of their own learning, education, and progression to and through careers with the goal of helping them to develop and maximize their understanding, abilities, and experiences, and ultimately, to lead using science to make a difference. Mentoring takes place at various levels of intensity in our programs, from sharing one's passion for science and conservation with students in the classroom to year-long intensive mentor-mentee relationships.

Reflection – The process of as actively exploring and sharing ones thoughts and feelings in order to realize the impact of an experience.

School-shed – The young people that feed into a particular high school cluster, e.g., the Hoover High School cluster, located in City Heights, San Diego, CA which consists of one high school, two middle schools, and 11 elementary schools.

Science Experience – Science Experiences exist external to our science program curricula and include one-time, opportunistic educational science events with specific goals aligned to one of our three initiatives as well as more in depth experiences such as research internships and teaching fellowships.

Science Program – Formal, curriculum-based educational courses consisting of several connected science-related lessons and/or activities that target a specific audience and that have specific goals aligned to one of our three initiatives. Each initiative has one to multiple programs.

Seed-to-Tree Model – Our life-cycle approach to education within which we provide services from early youth to career. Our youth – children filled with potential but lacking opportunity to understand how the world works and how they can make a difference – are represented by the seed in the model. These children live in a high poverty community and are less likely to receive a good education and fulfill their potential. The tree in the model represents individuals with the education and experience to use science in order to think critically, to obtain a career, and use science to make a difference in his/her community and world. These leaders connect their community to science and make a difference in the world by engaging in solving our scientific and environmental problems.

Social-Emotional Learning (SEL) – Social and emotional learning (SEL) is the process through which children and adults acquire and effectively apply the knowledge, attitudes, and skills necessary to understand and manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions.

Spark – The “wow” factor that can accompany experiencing something new and exciting. The “spark” can also be one’s passion for a given subject.

Science Educator – Individuals at Ocean Discovery Institute with a background in the sciences, who are trained in our curricula, and who engage in teaching our youth and our community about science through our Community, Student, and Leaders Initiatives.

STEM – Acronym for Science, Technology, Engineering, and Mathematics.

Science Leader – Individuals employed in the science, technology, engineering, mathematics and/or conservation field who participate in our programs by teaching classes, by helping in the classroom or in the field, and represent the diversity in City Heights. Science Leaders serve to help our youth, their families, and their neighbors envision themselves in science and range from recent college graduates to graduate students to established professionals. Our Science Educators are also considered Science Leaders. Science Leaders may also provide mentoring at various levels for students.

Structural Program Element – Unique educational components that provide a common structure for each of our initiatives. They are: Science Programs and Experiences, Mentoring, and Tools for Success.

Tools for Success – Skills that are fostered and/or resources that are available for students to help them overcome obstacles on their paths to science leadership. They include critical thinking skills and aspects of social-emotional learning fostered through our programming, guided reflection, and external resources such as college application workshops, and individual guidance through formal mentoring relationships.

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DOCUMENT HISTORY

Version 1

January - May, 2017 – development and refinement
June, 2017 – addition of summary goals in introduction
July, 2017 – 1) removed LI goal: by envisioning themselves as a member of the community of STEM professionals, as it is sufficiently covered in BELIEVE; 2) added benchmark column and removed programs level alignments

Version 2

August, 2017 – 1) refined design principles; 2) edited Leaders goal to include "take opps"; 3) added hierarchy of needs graphic and context; 3) expanded "programming is connected" design principle.
January, 2018 – Added / refined Discovery Fellow benchmarks.
March, 2018 – Edited NGSS design principle wording to demonstrate alignment with NGSS.
January, 2019 – Replaced program and organization-wide evaluation plans with a single, comprehensive evaluation plan reference

Version 3

June, 2021 – 1) refined design principles; 2) edited language on "Science Leaders" and "Science & Science-Related Fields throughout; 3) edited Benchmarks; 4) updated language on initiatives to reflect new directions.