

OUR EDUCATION FOUNDATION

Version 4: July 2021

Ocean Discovery Institute:
YOUNG LIVES TRANSFORMED THROUGH SCIENCE

TABLE OF CONTENTS

TABLE OF CONTENTS	2
INTRODUCTION	3
THE PROBLEM	3
OUR SOLUTION.....	3
HISTORY OF THIS DOCUMENT	4
PURPOSE OF THIS DOCUMENT	4
COMPANION DOCUMENTS	5
ORGANIZATION OF THIS DOCUMENT.....	5
OUR EDUCATIONAL PROGRAMMING.....	5
ORGANIZATION OF OUR EDUCATIONAL MODEL.....	5
ELEMENTS OF OUR EDUCATIONAL MODEL	7
<i>Our Philosophies</i>	7
<i>Structural Program Elements</i>	8
<i>Our Initiatives</i>	10
<i>Our Design Principles</i>	14
DESIGN PRINCIPLE BENCHMARKS AND PROGRAM ALIGNMENT.....	21
INTRODUCTION	ERROR! BOOKMARK NOT DEFINED.
COMMUNITY INITIATIVE DESIGN PRINCIPLE BENCHMARKS	ERROR! BOOKMARK NOT DEFINED.
STUDENT INITIATIVE DESIGN PRINCIPLE BENCHMARKS	ERROR! BOOKMARK NOT DEFINED.
LEADERS INITIATIVE DESIGN PRINCIPLE BENCHMARKS: OCEAN LEADERS.....	ERROR! BOOKMARK NOT DEFINED.
LEADERS INITIATIVE DESIGN PRINCIPLE BENCHMARKS: DISCOVERY FELLOWS ..	ERROR! BOOKMARK NOT DEFINED.
KEY DEFINITIONS	22
REFERENCES CITED	25
DOCUMENT HISTORY	29

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 and experiences, mentoring, and tools for success 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 15 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 initiatives 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 initiatives 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).

OUR EDUCATION FOUNDATION

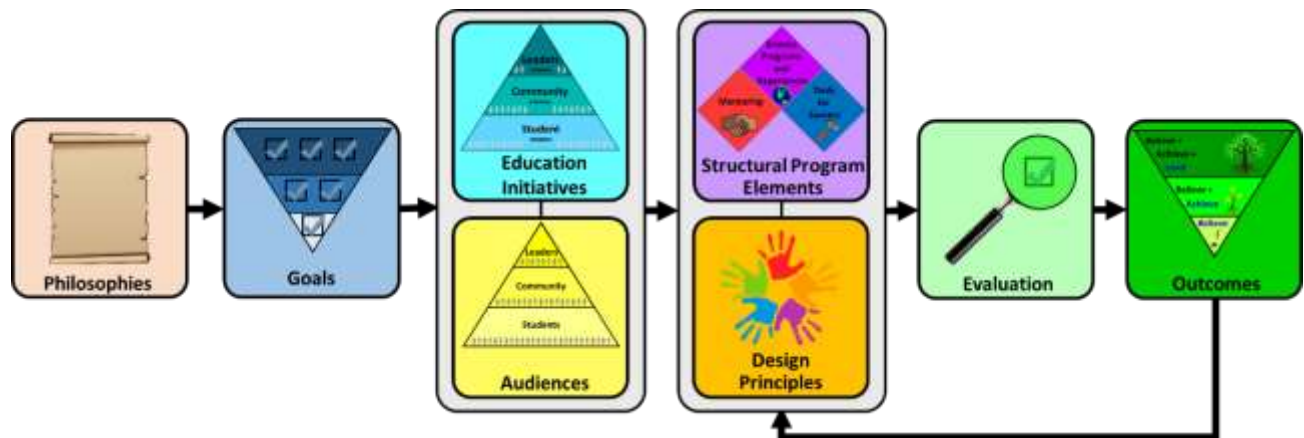


Fig. 1. Ocean Discovery Institute's Educational Model. Our educational model is infused with our philosophies. To address the goals and meet the intended outcomes of our educational initiatives, our education initiatives target specific audiences in the community with strategic programming containing 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 initiatives:

- Student Initiative
- Community Initiative
- Leaders Initiative

These initiatives 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 initiative is comprised of three common structural program elements which provide cohesion among the initiatives:

- Science Opportunities
- Mentoring
- Tools for Success

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 initiatives 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 initiatives, and consist of Science Opportunities, Mentoring, and Tools for Success. 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 initiatives. 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.
- **Tools for Success** are skills that are fostered and/or resources that are available for students to help them overcome obstacles on their paths to science and environmental leadership. Equipping student participants with the tools to overcome barriers is essential if individuals from high poverty and underrepresented backgrounds are to attain access to these fields. How these are provided vary by initiative and strategies include building essential skills such as critical thinking skills and guided reflection through our programming, individual coaching, and external resources such as college application workshops, financial aid assistance, and opportunities for individual guidance through formal mentoring relationships.

OUR INITIATIVES

Our educational initiatives are structured with a “pyramid” approach, as described in more detail below. Our pyramid design demonstrates the number of students reached by an initiative, with an inverse correlation between the number of students reached and the intensity and impacts generated through participation. For example, the Student Initiative, 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 the Leaders Initiative, at the top of our pyramid, serves the fewest students at the highest impact.

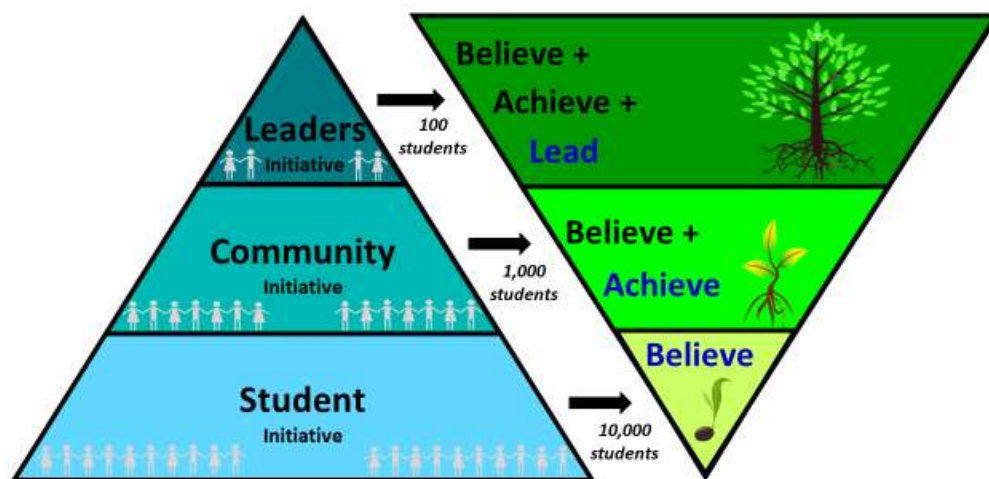


Figure 4. The pyramid approach to our educational initiatives, showing the number of students served by each initiative and the scale of impacts generated through participation.

Student Initiative: Reaching 10,000 Students

Our most inclusive tier is our Student Initiative. By partnering with every school in the school-shed, our Student Initiative programming ensures 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 (in pilot phase as of 2021) students dialogue with scientists and program alumni about pursuing science and becoming a leader who makes a difference in the face of systemic barriers.



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 Student Initiative builds positive science beliefs 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.

Community Initiative: Reaching 1,000 Students

The Community Initiative is in the middle tier of the pyramid. In partnership with families, this initiative 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.

The Community Initiative embraces a wide variety of science programming rooted in areas of relevance to the community delivered through weeklong 'camp' experiences and monthly field trips that enable families to explore coastal environments. 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 Community Initiative, we also integrate large community events in order to generate a collective energy and sense of belonging.

Community level programming aims 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;



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

- 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 Community Initiative programming, 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.

Leaders Initiative: Reaching 100 Students

Our Leaders Initiative 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 initiative builds upon other initiatives 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 Leaders Initiative programs. The Leaders Initiative offers two tracks: 1) Ocean Leaders, which provides programs and opportunities that build research experience and 2) Discovery Fellows, which focuses on professional expediciencies in science- and conservation careers. An individual can participate in one or both tracks.



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.

Ocean Leaders

Each year, a new cohort of 8th grade students are recruited to be part of the Ocean Leaders program. Over the course of 4+ years, participants will build their research experience through intensive summer programs:

- In the 8th grade program, students learn and understand the basics of the Science Discovery Process.
- In the 9th grade program, students gain first-hand experience with field research methods.



OUR EDUCATION FOUNDATION

- In the 10th grade program, students have an authentic field research experience.
- In the 11th grade program, students translate these skills to a lab setting, gaining new expertise and comfort.

During the school year, Ocean Leaders participate in regular science programming, coaching, mentoring, and practice in their tools for success.

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”.

Discovery Fellows

Through fellowships for high school students, college students, and college graduates, individuals gain professional work experience at Ocean Discovery Institute. Working in these job settings, young people take an important exploratory step along their pathway and develop skills needed to compete in the marketplace. Fellowships may range from a single term to multiyear commitments.

Both Ocean Leaders and Discovery Fellows are paired with support services integrated into their experience that equip students to graduate from college and attain a successful career. These supports are provided through:

- *Workshops*: Through subject-specific sessions, students build practical knowledge and soft skills.
- *Mentoring*: Participants receive robust mentoring through critical transition periods into college and career.
- *Opportunity sharing*: Students learn of and are encouraged to participate in college and career opportunities provided outside of Ocean Discovery (e.g., internships, tutoring, workshops).
- *Virtual resources*: Students have access to resource-rich online portals, which include instructional webinars and links to other resources, that are specifically built to support the transition from college to career.
- *Cohort model*: Students are recruited as cohorts, so that through this shared experience they can build community and begin to build their network.

Ocean Leaders, additionally, receive:

- science curriculum and authentic research opportunities that are provided within the programs, giving students the opportunity to build their skills over time.
- coaching that comprehensively supports each individual’s well-being and connects each to specialized resources, as needed.

These programs build upon the goals of the Community Initiative 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 Leaders Initiative, 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.

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 Initiatives

	Program Element	Design Principle	Student Initiative	Community Initiative	Leaders Initiative
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.			
		Mentoring Plays an Important Role.			
		Our Educators Are Science Role Models.			
		Science Leaders Share Their Stories.			
		Our Students Model Scientists.			
		We Build a Community of Support.			
		Our Students Practice Decision-making and Responsible Behaviors.			
		We Encourage Reflection.			
Achieve		Our Programming is Connected.			
		We Foster Self-Awareness and Self-Management.			
		We Foster Critical Thinking Skills.			
		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 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.
- **Our Students Model Scientists.** 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 scientists 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.

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.** 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 initiatives. 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 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)

Tools for Success

- **We Build a Community of Support.** 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 of support includes their cohort of peers, older alumni of the program, mentors, and staff. Collectively, this community of support provides a safety-net for burgeoning scientists to fall back on when challenges arise and a network to access to pursue further opportunities. We fortify against self-doubt and a lack of social and cultural capital through regular activities such as community building, opportunities to have new experiences and learn new skills in a comfortable environment, and a culture of coaching and mentoring to support growth and learning. 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 scientist.
- **We Encourage Reflection.** To encourage and build positive mindsets toward science and support students in developing a belief that they can do science and become a scientist, we incorporate guided reflection into all of our programs. We define “Reflection” as actively exploring and sharing ones 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). Reflection is present in our programs through both *self-reflection* (discovering personal stories of compassion, humanity, and empathy to make a difference in the world) as well as *process reflection* (engaging in a practice that allows for connection of learning to prior knowledge, understanding the connection of concepts, and applying them to real world examples).
- **Our Students Practice Critical Thinking and Responsible Decision-making.** To be a science leader, critical thinking and responsible decision-making are part of everyday life. The ability to think critically is as equally necessary for effective and informed decision-making skills in daily life and as it is in the sciences. These skills must be fostered, however, for individuals to fulfill their potential. Research suggests that even the critical thinking abilities of young children can benefit from instruction (Kennedy et al. 1991). Through audience-appropriate instructional techniques, we help to build these skills, so that each “seedling” can grow to

become the tree they are meant to be. Responsible decision-making ranges from constructive choices about personal behavior and social interactions, to the realistic evaluation of consequences of various actions, to a consideration of the well-being of oneself and others (CASEL, 2017). To support program participants in practicing decision-making, each initiative features real-life decision-making scenarios where participants gain practice in this critical skill.

- **We Foster Self-Awareness and Self-Management.** To be the first in your family to attend college is a big responsibility, and many of our students who hold this title can attest to how especially difficult the transition from high school to college is, and later from college to career. Many report feeling alone with a lack of preparation. Having the ability to pulse-check one's personal needs and barriers is essential for navigating the challenging waters of being underprepared for higher education. In addition, the ability to self-regulate has been shown to be a leading factor in predicting future college success (Lapan, 2004). Programs intentionally guide students towards the ability to deliberately integrate fun and healthy activities into their lives such as hiking, snorkeling, yoga, and meditation. Through goal setting activities, student coaching, consistent use of SEL language and practices across initiatives, and lessons focused on growth mindset and investigating the self, program participants develop a self-efficacy where they can recognize their strengths, productively work on their challenges, and have a self-discipline and motivation to accomplish their goals. Through college and career exploration activities, nutrition-oriented and physically active program components, meditation and mindfulness practices, and community action meetings, participants equip themselves with the self-management skills and techniques that are necessary to succeed as science leaders.
- **We Foster Social Awareness and Relationship Building Skills.** To be a science leader takes an acute understanding of our world and the challenges we face, as well as the ability to work with others to develop innovative solutions. By fostering skills related to perspective-taking and relationship-building, participants can bring a social lens and skills to their chosen careers, important qualities in leadership. Communication is also 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 foster these skills through collaborative group activities and projects; formal presentation practice; lessons and practice with code switching—the modifying of one's behavior, appearance, etc., to adapt to different sociocultural norms; curricula that include social perspectives and topics relevant to the lives of our community; and reflections that take into account an individual's role within a group or community.
- **We Provide Practical Tools and Support for College and Career.** Transitions are uncharted territory for underrepresented students; many gaps remain to be filled as students navigate the move from high school to college and from college to career. Through workshops, virtual resources, one-on-one mentoring during transition periods, and a focus on social-emotional learning featured in the Leaders Initiative, we address these gaps so that students are

prepared to take on the challenges of their new contexts and thrive as competitive career-seekers by the end of their educational pathway.

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.

Initiative – A group of cohesive educational opportunities that have shared goals for a targeted audience. Ocean Discovery has three initiatives: Student, Community, and Leaders.

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.

Leaders Initiative – 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.



OUR EDUCATION FOUNDATION

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.



OUR EDUCATION FOUNDATION

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.

Student Initiative – 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 Student Initiative builds upon the goals of the Community Initiative and aims to inspire students to BELIEVE.

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.

REFERENCES CITED

- Aschbacher, P. R., E. Li, and E. J. Roth. 2010. Is science me? High school students' identities, participation and aspirations in science, engineering, and medicine. *Journal of Research in Science Teaching* 47(5):564-582.
- American Diploma Project (ADP). 2004. Do graduation tests measure up? A closer look at state high school exit exams. Achieve, Inc. Retrieved from <http://www.achieve.org/dstore.nsf>
- Aronson, J., C. B. Fried, and C. Good. 2002. Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology* 38(2):113-125.
- California Department of Education. 2016. Unduplicated student poverty – free or reduced price meals data 2015-16 [Data file]. Retrieved from <http://www.cde.ca.gov/ds/sd/sd/filessp.asp>
- California Invasive Species Advisory Council. 2011. The California Invasive Species List. Retrieved from <http://www.iscc.ca.gov/docs/californiainvasivespecieslist.pdf>
- Christidou, V. 2011. Interest, attitudes and images related to science: Combining students' voices with the voices of school science, teachers, and popular science. *International Journal of Environmental & Science Education* 6(2): 141-159.
- Clancy, M. E. and Hruska, B. L. 2005. Developing language objectives for English language learners in physical education lessons. *Journal of Physical Education, Recreation & Dance* 76(4): 30-35.
- Cohen, G. L., J. Garcia, N. Apfel, and A. Master. 2006. Reducing the racial achievement gap: A social - psychological intervention. *Science* 313(5791):1307-1310.
- Collaborative for Academic, Social, and Emotional Learning. 2017. What is SEL? Retrieved from <http://www.casel.org/what-is-sel/>
- Duran, M., and I. Dökme. 2016. The effect of the inquiry-based learning approach on student's critical-thinking skills. *Eurasia Journal of Mathematics, Science & Technology Education* 12(12):2887-2908.
- Dwight, R. H., J. S. Caplan, M. V. Brinks, S. N. Catlin, G. Buescher, and J. C. Semenza. 2011. Influence of variable precipitation on coastal water quality in southern California. *Water Environment Research* 83(12):2121-2130.
- Felder, R. M., and Brent, R. 2009. Active learning: An introduction. *American Society for Quality Higher Education Brief* 2(4):August.

- Flores, K. L., G. S. Matkin, M. E. Burbach, C. E. Quinn, and H. Harding. 2012. Deficient critical thinking skills among college graduates: Implications for leadership. *Educational Philosophy and Theory* 44(2): 212-230.
- Freeman, S., S. L. Eddy, M. McDonough, M. K. Smith, N. Okoroafor, H. Jordt, and M. P. Wenderoth. 2014. Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences* 111(23):8410-8415.
- Good, C., J. Aronson, and M. Inzlicht. 2003. Improving adolescents' standardized test performance: An intervention to reduce the effects of stereotype threat. *Journal of Applied Developmental Psychology* 24(6):645-662.
- Gormally, C., P. Brickman, B. Hallar, and N. Armstrong. 2009. Effects of inquiry-based learning on students' science literacy skills and confidence. *International Journal for the Scholarship of Teaching and Learning* 3(2):16 doi.org/10.20429/ijsoatl.2009.030216
- Hanak, E., and G. Moreno. 2012. California coastal management with a changing climate. *Climatic Change* 111(1):45-73.
- Hulleman, C. S. and J. M. Harackiewicz. 2009. Promoting interest and performance in high school science classes. *Science* 326(5958):1410-1412.
- Kablan, Z., and S. Kaya. 2013. Assessing the relationship between learning strategies and science achievement at the primary school level. *Journal of Baltic Science Education* 12(4): 525-534.
- Kennedy, M., M. B. Fisher, and R. H. Ennis. 1991. Critical thinking: Literature review and needed research. In L. Idol & B.F. Jones (Eds.), *Educational values and cognitive instruction: Implications for reform* (pp. 11-40). Hillsdale, New Jersey: Lawrence Erlbaum & Associates.
- Lapan, R. T. 2004. *Career development across the K-16 years: Bridging the present to satisfying and successful futures*. Alexandria, VA: American Counseling Association.
- Lew, M. D. N., and H. G. Schmidt. 2011. Self-reflection and academic performance: is there a relationship? *Advances in Health Sciences Education* 16(4):529-545.
- Maggioni, E. 2015. Water demand management in times of drought: What matters for water conservation. *Water Resources Research* 51(1):125-139.
- Marcelli, E. and M. Pastor. 2015. Unauthorized and Uninsured: City Heights and San Diego County, A Fact Sheet. Retrieved from https://dornsife.usc.edu/assets/sites/731/docs/Web_01_City_Heights_San_Diego_Final.pdf

- Marin, L. M. and D. F. Halpern. 2011. Pedagogy for developing critical thinking in adolescents: Explicit instruction produces greatest gains. *Thinking Skills and Creativity* 6(1): 1-13.
- Maslow, A. H. 1943. A theory of human motivation. *Psychological Review* 50(4):370-396.
- MENTOR. 2014. The Mentoring Effect: Young People's Perspectives on the Outcomes and Availability of Mentoring. Retrieved from http://www.mentoring.org/new-site/wp-content/uploads/2015/09/The_Mentoring_Effect_Full_Report.pdf
- Messner, S., S. C. Miranda, E. Young, and N. Hedge. 2011. Climate change -related impacts in the San Diego region by 2050. *Climatic Change* 109(1):505-531.
- Mok, M. M. C., C. L. Lung, D. P. W. Cheng, R. H. P. Cheung, and M. L. Ng. 2006. Self-assessment in higher education: Experience in using a metacognitive approach in five case studies. *Assessment & Evaluation in Higher Education* 31(4):415-433.
- Myers, C. B., D. E. Brown, and D. M. Pavel. 2010. Increasing access to higher education among low-income students: The Washington State Achievers program. *Journal of Education for Students Placed at Risk* 15(4):299-321.
- National Science Foundation. 2015. Women, minorities, and persons with disabilities in science and engineering: 2015 (NSF 15-311). Retrieved from <https://www.nsf.gov/statistics/wmpd>
- Osborne, J., S. Simon, and S. Collins. 2003. Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education* 25:9:1049-1079.
- Oyserman, D., D. Bybee, and K. Terry. 2006. Possible selves and academic outcomes: How and when possible selves impel action. *Journal of Personality and Social Psychology* 91(1):188-204.
- Paul, R., and G. M. Nosich. 1992. A Model for the National Assessment of Higher Order Thinking. National Council for Excellence in Critical Thinking Instruction. Report.
- Pfund, C., K. C. Spencer, P. Asquith, S. C. House, S. Miller, and C. A. Sorkness. 2015. Building national capacity for research mentor training: An evidence-based approach to training the trainers. *CBE – Life Sciences Education* 14(2):1-12.
- Pittman, K. 2010. College and career readiness. *School Administrator* 67:10-14.
- Ruzic, R., L. Goodwin, R. Mothokakobo, and T. S. Talley. 2016. Developing a Citizen Science Model to Engage Members of Underrepresented Minority Groups. Retrieved from <http://www.informalscience.org/pathways-project-developing-citizen-science-program-model-engage-underrepresented-minority-groups>.

- Solorzano, D., and A. Ornelas. 2004. A critical race analysis of Latina/o and African American advanced placement enrollment in public high schools. *The High School Journal* 87(3):15-26.
- Stolle-McAllister, K., M. R. Sto Domingo and A. Carillo. 2011. The Meyerhoff way: How the Meyerhoff scholarship program helps Black students succeed in the sciences. *Journal of Science Education and Technology* 20(1):5-16.
- Walton, G. M., and G. L. Cohen. 2011. A brief social-belonging intervention improves academic and health outcomes of minority students. *Science* 331(6023):1447-1451.
- Warburton, E. C., and B. Torff. 2005. The effect of perceived learner advantages on teachers' beliefs about critical-thinking activities. *Journal of Teacher Education* 56:24-33.
- Wilson, T. D. 2006. The power of social psychological interventions. *Science* 313(5791):1251-1252.
- Yeager, D. S., and G. M. Walton. 2011. Social-psychological interventions in education: They're not magic. *Review of Educational Research* 81(2):267-301.
- Zimmerman, B. J. 2002. Becoming a self-regulated learner: An overview. *Theory into Practice* 41(2):64-70.
- Zohar, A., and Y. Dori. 2003. Higher order thinking skills and low-achieving students: Are they mutually exclusive? *Journal of the Learning Sciences* 12(2):145-182.

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.