**School of Sustainability**
**Arizona State University**

# MSUS Culminating Experience Final Report

Christa Burgess & Jacob Ivy
April 25, 2021

## A Framework for Place-Based Experiential Learning to Inspire Sustainability Action
*Hawaiʻi Tropical Bioreserve & Garden*

## 1. Abstract

Human behavior is driving many sustainability problems, which means that resolving these issues will require far more people to participate in solutions and act in sustainable ways. However, there is a recognized gap between knowledge and action that remains a significant barrier in achieving transformative sustainability solutions. One way to overcome the knowledge-action gap is to engage more people in place-based experiential learning centered around sustainability. In partnership with Hawaiʻi Tropical Bioreserve & Garden (HTBG), we set out to learn about utilizing place-based experiential learning to engage a wider audience to actively participate in sustainability solutions. We researched place-based learning, experiential learning, sustainability education, and behavior change theory. We also conducted several informational interviews with experts in environmental education, STEM, and sustainability science to better understand what is needed for designing meaningful educational experiences that inspire action. We used this research to develop an easily understandable and scalable place-based experiential learning framework that can teach learners about any sustainability challenge or solution. Overall, we found that when grounded in behavior change theory and sustainability principles, place-based experiential learning has the potential to mobilize large groups of people to actively participate in sustainability solutions.

## 2. **Table of Contents**

## 3. **Introduction and Background**

For this Culminating Experience, we addressed the sustainability problem of the gap between knowledge and action by initiating the first phase of the Place-Based Experiential Learning Synthesis (PBELS). This Initiative was developed by Hawai'i Tropical Bioreserve & Garden (HTBG) and Arizona State University (ASU), and it will reach a wide audience of people from all around the world. Before the COVID-19 pandemic, HTBG had plans to create experiential learning activities and interactive signage that could be displayed on-site at the garden. They have since recognized that place-based experiential learning could be an effective strategy for achieving sustainability goals if it reaches a wider audience of people. HTBG believes that the PBELS Initiative will ultimately help stakeholder organizations broadcast their sustainability projects and solutions to more people, which will help them gain support and new perspectives. These stakeholders include people and organizations that are currently implementing some form of place-based experiential learning, but they still require an approach for creating materials or programs that foster personal connections with nature and train people to be sustainability changemakers.

Although personal responsibility and engagement in solutions is vitally important to the field of sustainability, changing human attitudes and behaviors is not easy to accomplish. In many cases there is a recognized gap between knowledge and action that poses significant barriers to achieving solutions. Some groups have attempted to resolve this knowledge-action gap through education, but this is proven to be relatively ineffective (Knutti, 2019; Frisk & Larson, 2011). Learning new information about a sustainability challenge is not necessarily enough to instigate behavior change, and knowledge alone does not guarantee that people understand how to effectively implement solutions (Knutti, 2019; McKenzie-Mohr, 2011; Kollmuss & Agyeman, 2002). Even those who feel motivated to act in more sustainable ways do not always follow through with action, and many are unwilling to change their lifestyles or break their well-established habits (Chaplin & Wyton, 2014). Many experts and organizations have attempted to bridge the knowledge-action gap, but unfortunately these campaigns have often failed and there remains a lack of problem-solving capacity (McKenzie-Mohr, 2011).

A serious issue that further exacerbates the knowledge-action gap is a disconnect between people and nature. The biophilia hypothesis proposes that humans innately want to connect to nature and different forms of life (Kellert & Wilson, 1993). Several experts pose that the current human-nature disconnect is one reason why caring about the environment does not always result in pro-environmental behaviors (Amel et al., 2009). The experiences people have with the environment often influence the way they think, feel, and act towards the natural world (Abson et al. 2017; Ives et al. 2018). Many Indigenous worldviews maintain that connecting with and learning from nature "is critical for fostering an emotional and spiritual bond with place" (Nelson, 2017). People who have experiential, emotional, and cognitive connections to nature generally have positive attitudes towards the environment, visit natural places more often, and act in pro-environmental ways (Ives et al. 2018; Collado et al. 2013; Lin et al. 2014; Kesebir & Kesebir 2017). When people are disconnected from the natural systems that support and surround them, they can end up contributing to issues that will impact generations to come (Abson et al. 2017). Stronger and deeper connections with the environment and ecosystems are

needed to help drive the necessary changes for a more just and sustainable future (Abson et al. 2017; Ives et al. 2018).

PBELS aims to help bridge the knowledge-action gap by inspiring learners to build a closer connection to nature and act more sustainably. To contribute to this larger overarching initiative, our team conducted extensive research on place-based learning, experiential learning, and behavior change theory. We have explored what kinds of place-based experiential learning examples already exist and why they are or are not successful. We have created a framework that outlines how to effectively construct a place-based experiential learning program or material that inspires sustainable behavior change, and we presented our framework to stakeholders during workshop meetings. The participating stakeholders assessed how useful and successful this approach is, as well as determined whether or not they can fill out the framework with an example using place-based experiences from their own lives. We completely acknowledge that the framework we created is a partial solution for a more wide-reaching initiative that will tackle the knowledge-action gap on a larger scale. However, we feel that the kind of individual behavior change and action inspired by using our framework are important components of more comprehensive sustainability movements and solutions that can ultimately influence institutional change.

## 4.  **Literature Review**

The purpose of this project is to utilize place-based experiential learning to inspire individuals to behave more sustainably. The project deliverable includes a framework that guides the development of place-based experiential learning materials or programs that encourage people to become sustainability change agents in their own communities. As such, it is important to understand exactly what is meant by place-based experiential learning and what kind of existing theories and frameworks can be used to best leverage it for sustainability.

Place-based experiential learning is the combination of two separate educational pedagogies: place-based education and experiential education. Place-based learning (PBL) is learning centered around a specific local community and its surrounding environment. It involves using critical thinking, mindfulness, and engaging with the local community to learn about the culture, natural ecosystems, and environmental and social justice issues of the chosen place (Deringer, 2017). Connecting learners to different aspects of a place can ultimately provide opportunities for them to ask questions, understand complex information, and reflect on their role in shaping the place's social-ecological systems (Deringer, 2017). PBL can exist in any context or location, and it can be said that "There is no place on Earth that is not a place-based classroom" (Nelson, 2017). Experiential learning (EL) involves engaging people in firsthand, interactive activities and then having them reflect and think about ways to apply the insights they gained (Seaman et al., 2017). Experiential learning programs typically cycle through four steps: (1) having concrete experience, (2) reflective observation, (3) abstract conceptualization, and (4) abstract experimentation (Kolb, 1984). Additionally, experiential learning should be fun and relevant to the learner. Together these methodologies can help forge connections between people and places, as well as inspire people to care about the challenges facing the communities they learn about.

Place-based experiential learning is relevant to sustainability, as it helps people gain the knowledge, skills, and experience needed to become successful change agents. Regular classrooms and learning methods do not typically provide people with the opportunities to build the kinds of skills and knowledge they need to be successful in collaborating with stakeholders and thinking through all the complexities involved in real-world wicked problems (Fadeeva et al., 2010). Place-based experiential learning opportunities on the other hand inspire people to care and empower people to take action because they are much more personal to people's own lives (Frisk & Larson, 2011). Additionally, when an experience is paired with contemplation, critical thinking, and reflection, people tend to learn more and gain new knowledge (Christian et al., 2020). Generally speaking, it is important for sustainability learners to have hands-on experiences that help them translate knowledge into action (Fadeeva et al., 2010). This kind of learning is invaluable when trying to come up with strategies and solutions for sustainability challenges.

Both the larger PBELS Initiative and this culminating experience project will be guided by the United Nations Sustainable Development Goals (UN SDGs) and the sustainability competencies. It is widely recognized that in order to achieve goals like the UN SDGs, interdisciplinary education for sustainable development will need to be undertaken (Annan-Diab & Molinari, 2017). The sustainability competencies are also useful when developing educational content, as they provide a clear framework that can be utilized to evaluate people's knowledge and skills related to sustainability so that they can become successful change agents (Wiek at al., 2011). These five competencies include systems thinking, anticipatory or futures thinking, normative or values thinking, strategic thinking, and interpersonal skills (Wiek et al., 2011).

The ultimate goal of this project is for our learning framework to inspire the creation of meaningful and transformative experiences, programs, and materials related to sustainability. This means that we want the use of our framework to result in place-based experiential learning that connects people to a place, inspires them to care, and then motivates them to act. In order for lasting behavior change to occur, it cannot be forced on people and it needs to stem from an emotional connection and meaningful experiences (Pisters et al., 2019). Place-based experiential education can help create these connections and provide the kinds of experiences that resonate with people. However, people also need to understand and be capable of analyzing what impacts their actions have and where there might be tradeoffs before they will be willing to engage in sustainable behavior change (Frisk & Larson, 2011).

Values are another strong driver of behavior and are often dependent on a place's culture (Pisters et al., 2019). This means that sometimes motivating sustainable behaviors will require changes in culture or an alignment of sustainable changes with the existing culture (Pisters et al., 2019). When it comes to knowledge-action gaps and the disconnect between people and nature, it is especially important to foster an "ecological consciousness" where people are more thoughtful and compassionate towards the environment and aware of how they are connected to it (Pisters et al., 2019). It is essential for more people to be actively involved in decision-making and problem-solving in order to successfully achieve sustainability targets, and place-based experiential learning can help people develop the skills they need to become highly engaged change agents (Frisk & Larson, 2011). People are also more likely to behave in pro-environmental ways if the cost

of participating in them is low, whether it be financial cost or a more intangible social cost like how convenient the behavior is (Chaplin & Wyton, 2014). Other factors that influence how likely someone is to act in pro-environmental ways include whether or not they feel they have enough knowledge or skills to implement solutions and how personally responsible they feel for a sustainability issue (Amel et al., 2009).

In order to address the multitude of behavior drivers this project is addressing, a theory or framework of behavior change is helpful to guide content creation. There are many theories regarding behavior change, and one relevant framework for this project was developed for sustainability behavior change in order to address the knowledge-action gap (Frisk & Larson, 2011). It is called the Educating for Sustainability (EfS) framework, and it presents four knowledge domains that were developed by incorporating behavioral change research, sustainability scholarship, and educational pedagogy. These four knowledge domains include: declarative knowledge, procedural knowledge, effectiveness knowledge, and social knowledge. They are described in more detail in the figure below and will be used to guide the behavior change aspect of this project's approach to transformative education.

**Figure 1 - Educating for Sustainability (EfS) Framework**
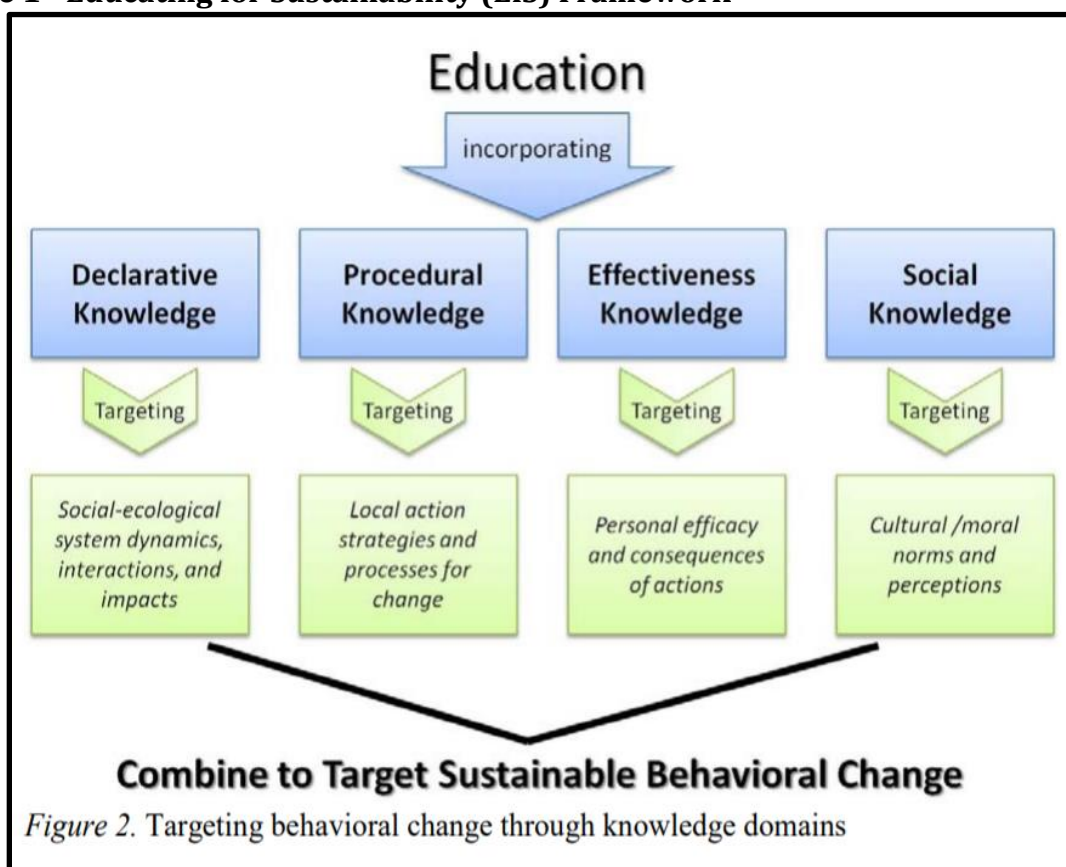


*Caption:* *This diagram is from Frisk & Larson's 2011 paper "Educating for Sustainability: Competencies & Practices for Transformative Action," and it depicts the EfS framework.*

After conducting our initial research, we have discovered many other frameworks for STEM and sustainability education that provide useful information and guidance. One valuable resource is the National Project for Excellence in Environmental Education, which is a series of guidelines developed by the North American Association for Environmental Education (NAAEE) to set high-quality standards for environmental education (NAAEE, 2015). This series has been reviewed by thousands of professionals and provides guidelines for a diverse range of educational situations. The guidelines in these documents are helpful for guiding a framework for sustainability education. Experiential education can be a broad topic, and effective learning is not necessarily covered in traditional learning frameworks. The National Research Council (NRC) developed six guidelines for schools and informal environments to organize and access learning science in a participatory environment (National Research Council, 2009). These guidelines focus on how individual cognitive, social, development, and emotional factors when learning in an experiential context, and can be utilized for building effective experiential learning. One thing that the NAAEE guidelines and the NRC guidelines have in common is that they call for learners to enjoy their learning experiences. This was also found from multiple interviews with individuals who actively produce place-based, experiential, and sustainability learning experiences (M. Angilletta, personal communication, February, 2021; D. Leoni, personal communication, December, 2020). It was suggested in these interviews that storytelling is an effective mechanism for engaging learning experiences for learners. Literature on storytelling in sustainability confirms these findings as well (Fischer, 2020; Leinaweaver, 2015). In order to engage learners and increase useability, elements of storytelling will be woven into the framework.

## 5. **Project Approach and Intervention Methods**

This culminating experience project is being conducted on a much smaller scale than the larger PBELS initiative, so our main deliverable consists of a replicable underlying framework for developing effective place-based experiential learning materials and programs. This framework is easily digestible and shareable so that it can be applied to a wide variety of places and sustainability challenges. Our hypothesis for this project was that if an educational program combines place-based learning, experiential learning, behavior change theory, and sustainability principles, then learners will be inspired to engage in sustainability solutions.

The United Nations Sustainable Development Goals and the sustainability competencies have been identified as valuable frameworks for developing educational materials, and the EfS framework developed by Frisk and Larson 2011 is useful for guiding a deliverable that incentivizes sustainable behavior change (Annan-Diab & Molinari, 2017; Frisk & Larson, 2011).  As part of our research, we also conducted several informational interviews with experts in environmental education, STEM, and sustainability science to better understand what is needed for designing meaningful educational experiences that inspire action. After developing an initial framework based on these resources, we invited our subject matter experts to virtual workshop meetings. During those meetings, they evaluated the success of the framework in terms of how pragmatic and transferable it is. We utilized PowerPoint and Zoom to present the framework and a case study so they could provide feedback and recommendations for improvement.

The overarching theory of change for this project is that place-based experiential learning that is grounded in behavior change theory and sustainability principles leads people to have more sustainable behaviors. In other words, we believe that learning about a place, having an experience with that place, and learning about how to apply this knowledge to daily life can help reconnect people with nature and inspire them to change their behaviors to become more sustainable.

**Figure 2 - Theory of Change Diagram**
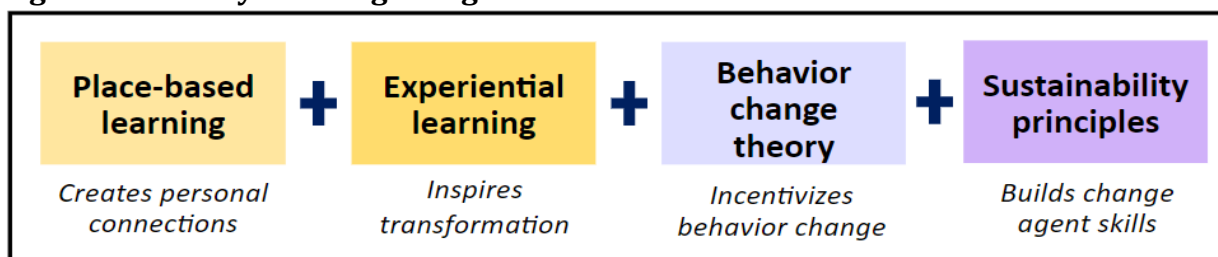


*Caption:* *This diagram outlines the four fields of study that we feel should be combined and targeted in order to successfully generate learning that results in sustainable behavior change.*

## 6. Outcomes

During our research and informational interviews, we identified key attributes of PBL, EL, and the EfS framework that are necessary to successfully lay the foundation for inspiring learner behavior change. Successful PBL occurs when learners engage with a place's community to learn about the local culture, natural ecosystems, and environmental and social justice issues, as well as participate in critical thinking and mindful reflection on their knowledge, emotions, and personal connections related to this place (Deringer, 2017). Successful EL requires that learners cycle through the four stages of (1) having a concrete experience, (2) reflective observation, (3) abstract conceptualization, and (4) abstract experimentation (Kolb, 1984). EL programs typically have some overlap with PBL since experiences usually happen in a physical location, making these two pedagogies extremely complementary. PBEL is ultimately very valuable in the context of sustainability education, as sustainability challenges and solutions are rooted in real world experiences and require knowledge of local places. Combining the four knowledge dimensions of declarative knowledge, procedural knowledge, effectiveness knowledge, and social knowledge with PBEL creates the potential for a comprehensive and highly impactful educational experience (Frisk & Larson, 2011).

After conducting research and identifying what individual attributes are needed for meaningful learning and behavior change, we synthesized our findings and developed our own five-step framework that outlines the necessary aspects of PBEL for sustainable behavior change. These five steps include "Place," "Knowledge," "Capacity," "Experience," and "Reflection," and our methodology for developing these five steps is summarized in Appendix A.

The step of "Place" involves learners forming personal connections and relationships with a specific location and local community who are facing a sustainability challenge. This also includes forming relationships and establishing trust with community

members, educators, and fellow learners. For example, learners could visit a farm, look at what is growing, speak with the farmers who are growing the crops, and learn about how bee population decline is a serious sustainability problem that poses major challenges for the farmers.

"Knowledge" is where learners gain foundational knowledge on the local values, culture, economy, and social-ecological systems of the place. They receive information from community members and educators, as well as learn through personal exploration, discovery, and play. An example of this could be learners exploring a farm and engaging with the farmers to better understand what growing food entails and why the farmers chose to grow certain plants. They could also learn about the role that bees play in ensuring that many plants are able to survive, thrive, and produce fruits or seeds.

"Capacity" refers to learners building the expertise, infrastructure, personal capacity, and relationships at a local level to prepare strategies for solutions. They learn how to perform actions and how they can participate in equitable and effective sustainability solutions. One example of building capacity might be working with farmers and conservation biologists to envision what a sustainable, bee-friendly habitat that enhances productivity and profits for the farmers could look like. Part of this process would also include picking out native seeds that attract bees and collecting materials that could be used to build bee nesting places.

"Experience" is where learners take action, experiment, and participate in a targeted sustainable behavior. The learners have a meaningful and concrete experience related to assessing and addressing a sustainability solution in the place. In the context of the farming example, this transformative experience could involve learners actually implementing their designs for a bee-friendly habitat to help attract and protect pollinator species on the farm. This would include planting native vegetation, setting up water sources, and constructing bee nesting places.

"Reflection" is a time for learners to rest, practice mindfulness, and engage in contemplative reflection on their emotions, personal connections, and the new knowledge they have gained. Learners also reflect on the experiences they participated in, lessons learned, UN SDG alignment, and how to progress towards future actions. For example, learners could consider their new knowledge, relationships, feelings, connections, and insights about farming and pollinator species through journaling, group discussions with the farmers, and contemplating during free time where they can explore the farm. They might participate in a conversation about sustainable farming and lessons learned during a meal that was prepared with food harvested right from the farm itself. Reflection would also include mapping out the ways that creating pollinator habitat on the farm fulfills certain UN SDGs, as well as brainstorming how this idea could be improved or perhaps applied on other farms or even in the learner's own backyards.

These five steps do not necessarily happen in order, and they can be repeated as often as necessary. The iterative nature of this process means that learners may bounce back and forth between the steps, and both "Place" and "Reflection" in particular will be re-visited often as learners build their sustainability knowledge and capacity. Learners can also enter this process at different steps depending on their prior knowledge, their personal situation, and their capacity. For example, a learner who is already a member of the chosen place's local community might be able to skip over the steps "Place" and

"Knowledge" and go straight to the steps of "Capacity," "Experience," and "Reflection." Additionally, a learner could also enter the cycle by having a thought-provoking "Experience" first, then cycle back to "Place" to further improve their sustainability awareness and action skills. There is no set time limit for any of these steps, and it is recognized that certain steps like "Place" might take longer than other steps like "Experience." Learners will ultimately cycle through these steps one or more times depending on the educational program or initiative they are participating in, and educators or mentors should be prepared to guide learners through multiple iterations of this cycle.

**Figure 3 - Framework for PBEL that Inspires Sustainability Action**
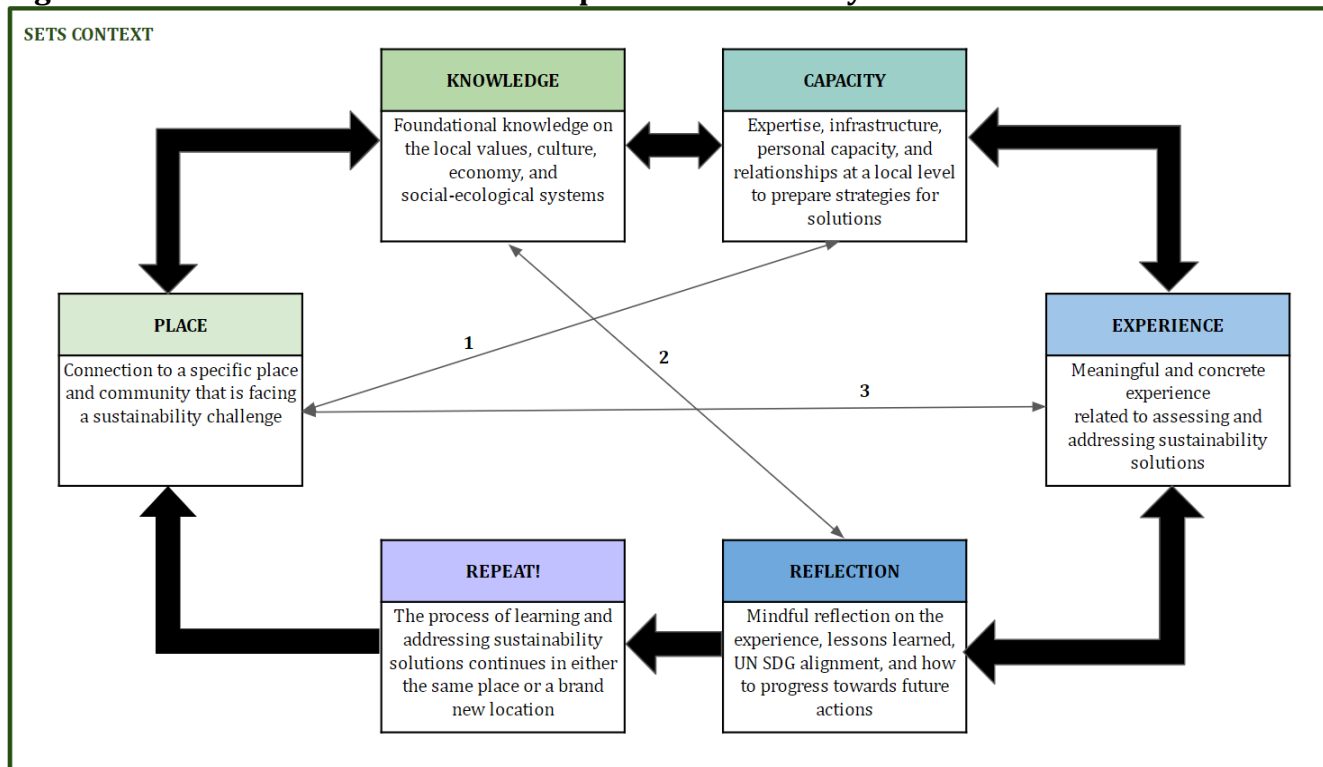


*Caption:* *This diagram depicts our five-step framework for PBEL that inspires sustainability action. The five steps are "Place," "Knowledge," "Capacity," "Experience," and "Reflection," and they can be iterated as many times or in whichever order is best suited for the learner. Some steps have a stronger influence on others, and we have drawn arrows to represent these relationships. Arrow 1 shows how "Place" is incredibly important for "Capacity," as capacity building is dependent on the resources available to learners in the place. Additionally, building "Capacity" might change the way the "Place" is impacted by the sustainability challenge. Arrow 2 demonstrates that "Knowledge" is necessary for "Reflection," and sometimes "Reflection" can enhance and increase a learner's understanding. Arrow 3 indicates that having an "Experience" is dependent on place, and the learner's "Experience" of participating in sustainability solutions might even go on to influence the "Place" itself.*

**Figure 4 - Framework Iterations to Achieve Sustainability Goals**
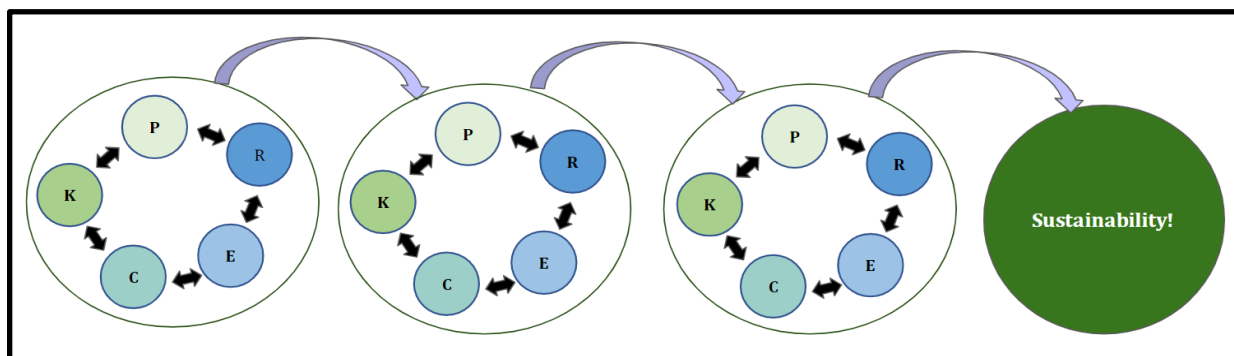


*Caption:* *This diagram shows how our five-step framework could be repeated over and over again so that learners are continuously engaging in educational sustainability experiences and solutions. The P in this diagram stands for "Place," the K stands for "Knowledge," the C stands for "Capacity," the E stands for "Experience," and the R stands for "Reflection." The hope is that continuously working to inspire behavior change and motivate higher participation rates in solution strategies would eventually result in more sustainable systems and a more sustainable world. Although this diagram is a dramatic oversimplification of reality, we believe that it is important to keep this overarching goal in sight.*

**Case Study: Dr. Jesse Senko's Bycatch Reduction and Sustainable Fisheries Program**

Our five-step framework to inspire sustainability action was designed to be widely applicable in a variety of different situations. One way that we preliminarily tested its effectiveness was by exploring a relevant case study through the lens of the five steps. Dr. Jesse Senko's Bycatch Reduction and Sustainable Fisheries Program is one example of a highly successful initiative that involves learning from and collaborating with fishers from all around the world to advance marine conservation and sustainability. This program also involves engaging students from Arizona State University in PBEL during a study abroad course in Baja California Sur, Mexico. All relevant information for this case study was obtained from meeting directly with Dr. Senko throughout the course of this project, reading about his bycatch reduction technology in the Seckel (2020) ASU Now article, and from Christa Burgess' personal experience participating in Dr. Senko's Sea Turtles, Sharks, & Fisheries of Baja California study abroad class.

In the context of our framework, the step of "Place" refers to the location of Baja California Sur, Mexico. More specifically, this program introduces students to the unique locations of La Paz, Magdalena Bay, and El Pardito Island. These locations are home to communities of fishers who have lived there for many generations, and the surrounding ecosystems are incredibly beautiful and biodiverse. Students who participate in the program engage with these local stakeholders to learn more about the sustainability challenge of bycatch. Bycatch is when fishers inadvertently entangle unwanted species of wildlife in their nets, and it takes a great deal of time, energy, and money to remove these animals and fix or replace broken nets. It also can be catastrophic for local ecosystems and endangered species, as the animals who are accidentally entangled in nets are often gravely injured or die.

The collaboration between community members, fishers, and researchers enables students to gain "Knowledge" on the local community's values and perspectives, especially when it comes to the issue of bycatch and why it is such a challenge for the people whose livelihoods depend on productive fisheries. The students also learn from stakeholders, researchers, and nature itself about the social-ecological systems of this place and how people interact with the environment.

The step "Capacity" is where students build expertise and work with the community fishers and their peers to develop the infrastructure, personal capacity, emotional connections, and relationships they need to start assessing and addressing the features of the bycatch challenge. This step includes learning how to modify fishing gear by removing buoys and attaching solar-powered fishing lights.

Much of the learning in this program is experiential in nature, and the program's central "Experience" allows students to go out on the fishing boats to see firsthand what fishing is like. If any sea turtles are caught in the nets, the students assist in conducting sea turtle monitoring where they collect scientific data that contributes to critical conservation efforts spearheaded by a nonprofit coalition called Grupo Tortuguero de las Californias.

Throughout this program, students make time for "Reflection" on what they have felt and experienced throughout this immersive learning process. They write in journals and have group discussions where they share their feelings and consider the new knowledge they gained related to understanding social-ecological systems, small-scale fisheries, fishing with gillnets, and bycatch reduction strategies. They brainstorm about future actions and how to apply the new knowledge and skills they acquired to improve sustainability efforts in Baja and back home in their own communities, as well as how this local solution ties into the global UN SDGs.

The five-step framework learning cycle can be repeated by the same group of learners as many times as desired, or it can be continued by a new group of college students or other learners from fishing communities around the world. Overall, this program has been very successful, as many students end up inspired to learn more and express a desire to engage in more behaviors that support marine conservation and sustainability. Previous students from this program have gone on to found the Ocean Conservation Club at ASU or even conduct research as Lab Technician Interns for the Senko Lab. This case study ultimately validates our five-step framework and shows how covering the aspects of "Place," "Knowledge," "Capacity," "Experience," and "Reflection" can be a powerful way to learn about sustainability and motivate sustainable behavior change.

**Figure 5 - Dr. Jesse Senko's Bycatch Reduction and Sustainable Fisheries Program Framework Alignment**
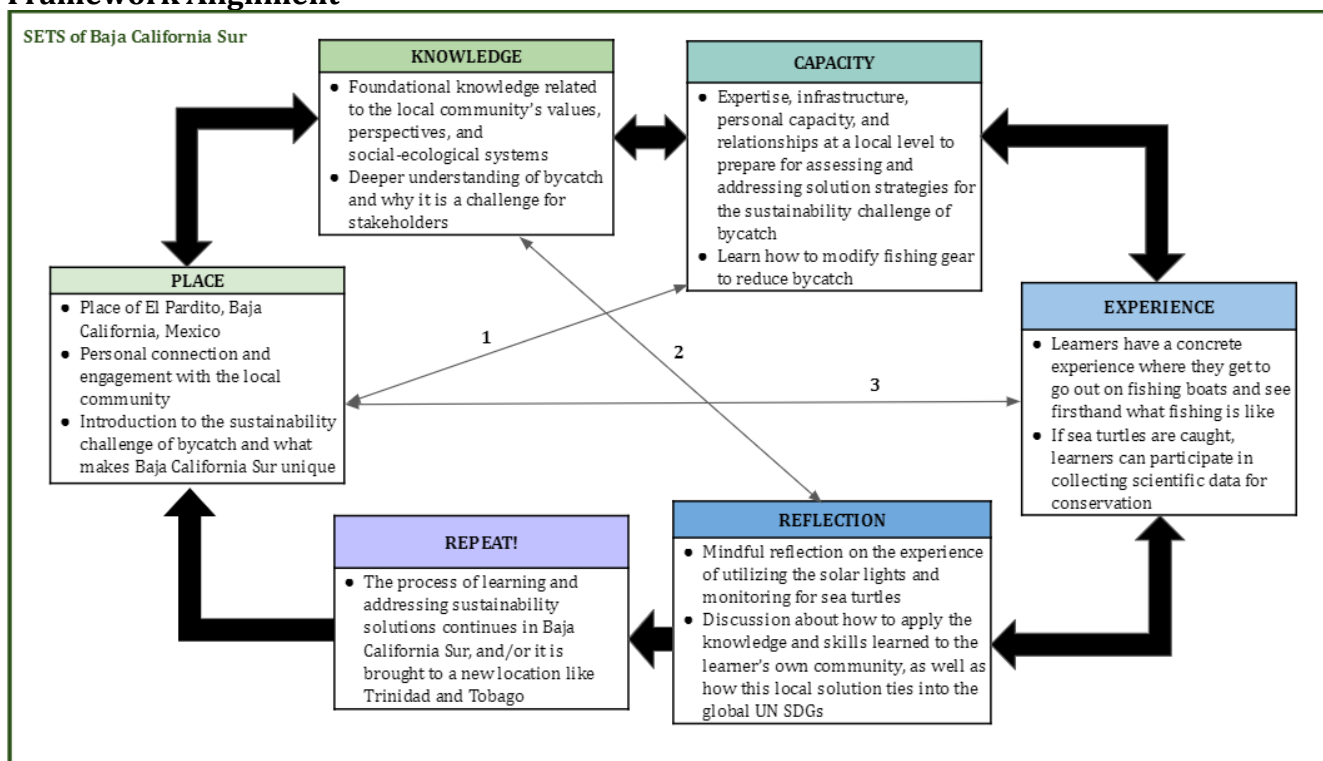


*Caption:* *This figure shows our five-step framework filled out with the information from our case study on Dr. Jesse Senko's Bycatch Reduction and Sustainable Fisheries Program.*

       In order to further refine and validate the success of our framework, we conducted small workshops with our subject matter experts. We met individually with Dr. Roberta Martin, Dr. Jesse Senko, and Dr. Kelli Larson and presented them with the first draft of our framework and case study. We then asked them the following questions: (1) "Do you think this framework is intuitive and user-friendly," (2) "Can you think of an example from your personal or professional experience that could be plugged into this framework," (3) "What kind of assessment tools do you think could be used to measure this framework's success," (4) "What are five words you would use to describe this framework," and (5) "Do you have any suggestions to improve this framework." We were met with an overwhelmingly positive response, and they each had excellent feedback that we have since incorporated into our framework and case study. The feedback we received from these subject matter experts is summarized in Appendix B, and the words they used to describe our framework are depicted in Figure 6 below.

**Figure 6 - Subject Matter Expert Descriptive Responses to Framework**



*Caption:* This word cloud was created to visually represent how subject matter experts reacted to our framework. Descriptors of our framework that were more frequently used by subject matter experts are pictured in larger text.

After walking through a case study and conducting workshops with subject matter experts, we validated that our initial theory of change is supported by both academic literature and by experts in this field. We have successfully shown that combining PBEL with behavior change theory and sustainability principles has a great deal of potential to lead more people to act in sustainable ways and engage in sustainability solutions. However, we also recognize that the best way to determine the success of this framework is to test it in a real-world educational context with learners and educators who can provide feedback. The next phase of the PBELS Initiative will involve discovery sessions that will be able to further test this theory and validate success.

Our clients at HTBG have been very engaged in the research and development process of our Culminating Experience, and we presented our framework to them in late February. Our main client deliverable was a comprehensive PowerPoint that walks the viewer through our five-step framework and how it can be applied to the case study of Dr. Senko's Sustainable Fisheries and Bycatch Reduction Program. We also provided the client with PowerPoint slides and a written summary of our findings related to the key attributes of PBL, EL, and the EfS framework knowledge dimensions that are needed for success. The HTBG PBELS Initiative team will use our deliverables as a foundation for further research, discovery sessions, and as a starting point to share the PBELS Initiative with other professionals. We plan to share this final project report with the client team as well.

Overall, this project has brought together academic literature from several different fields and synthesized them into an easily understandable and scalable format. PBL, EL, and behavior change theory are not often utilized together in the context of sustainability

education and solutions, so this project is a first step in the right direction in terms of creating guidelines for developing educational programs, materials, or experiences that inspire more people to engage in sustainable behaviors. The five-step framework we developed has laid the foundation for the PBELS Initiative and future students to conduct further research, implementation, and testing to refine this process and achieve success.

## 7. **Recommendations**

Our five-step framework is a first attempt at proposing a strategy for designing effective sustainability PBEL programs or materials, and we highly recommend that further research and testing be undertaken. There is a huge amount of literature and hundreds of expert practitioners in this field, and within the time constraints of our Culminating Experience we have just begun to scratch the surface of the available knowledge on this topic and related subjects. We have created a solid foundation and starting point to guide future research and experimentation, and as such we hope that in the future our framework will be applied and tested in a number of different situations to further validate and improve upon our work. One way this could be accomplished is by exploring more successful PBEL case studies both inside and outside the field of sustainability to see how well they align with our five steps. We feel that PBEL case studies that involve examples of Indigenous education and Indigenous Knowledge Systems would be particularly transformative, as there is a great deal that sustainability scientists and educators could learn from these fields. Indigenous education is very complimentary with PBEL because "One cannot learn about the history of *any* place without understanding the First Peoples of the land and their unique cultural and environmental practices, as well as the impacts of conquest, and cultural resilience" (Nelson, 2017).

Another avenue we feel should be pursued in the future is exploring how storytelling can be better incorporated into our framework and its application. The importance of effective storytelling was mentioned by nearly every stakeholder we talked to, and we structured our five-step framework with the idea of designing a way to share sustainability stories in mind. For example, the steps of "Place," "Knowledge," "Capacity," "Experience," and "Reflection" loosely follow the same pattern as the storytelling elements of exposition, rising action, climax, falling action, and resolution. We are especially excited about the possibility of overlaying the Hero's Journey onto our framework and experimenting with how to create a Hero's Journey model for sustainability (Campbell, 2003). We feel that this approach would be especially valuable if it involves diving into the story of the land itself. A comprehensive tool or guidebook should be developed in the future to give users more detailed instructions for designing and implementing educational programs, materials, or experiences based on the five steps. This tool could then be used to help determine areas where the five-step framework needs to be improved.

During our research, we also discovered that our framework is very well-aligned with established guidelines for environmental education and STEM education. As such, we feel that it would be interesting and useful to perform a comprehensive assessment of how our framework compares to the NAEE Guidelines for Excellence and the "strands of science learning" framework proposed by the NRC (NAAEE, 2015; National Research Council, 2009). It would also be beneficial to delve deeper into research on target audiences and

different types of learning styles to ensure that our framework meets the needs of everyone who uses it.

Ultimately, we recommend that our clients at HTBG utilize our framework and scale up our findings to help guide the development of the PBELS Initiative moving forward. The PBELS Initiative team is currently researching more on the behavior change theory, community-based social marketing (CBSM), and application of sustainability principles, so our framework could be useful for organizing information and directing this research process. We recommend that any new findings they discover be integrated into our five-step framework so that it can become even more comprehensive and successful. Continuing this project would also be a great opportunity for future MSUS students interested in developing real-world strategies for sustainability behavior change.

## 8. **Conclusions**

Bridging the gap between sustainability knowledge and sustainability action is a monumental, but necessary, task in order for many communities to overcome the environmental and social problems they currently face. There are countless resources and initiatives trying to address this gap with varying degrees of success, and a comprehensive solution for connecting people with nature and motivating action is needed. For this project, we collaborated with HTBG to develop a successful strategy for inspiring more people to become actively engaged in sustainable behaviors and solutions. We conducted a literature review on PBL, EL, and behavior change research, and our theory of change was that PBEL that is grounded in behavior change theory and sustainability principles leads people to have more sustainable behaviors. The results of our research were synthesized into an intuitive five-step PBEL framework that can be utilized by practitioners and educators as a guide for transferring knowledge to learners in a way that leads to action. These five steps include "Place," "Knowledge," "Capacity," "Experience," and "Reflection," and they were validated by both a case study and subject matter experts. Overall, we are confident that this framework is robust and captures many important aspects of PBEL. Our theory of change has been initially confirmed, and we recommend that more extensive research and practical testing be done in the future to further improve upon and refine our work.

## 9. **Acknowledgements**

insight into the EfS framework and social-ecological-technological system dynamics was invaluable. **Dr. Roberta Martin** was always there to listen and support us, and we greatly appreciate her thoughtful feedback and enthusiasm for our project.

Additionally, we would like to extend our deepest gratitude to all of the stakeholders who participated in informational interviews and offered us their expert recommendations based on their work in the field. We thank **Dr. Michael Angilletta, Dr. Debra Colodner**, **Danielle Leoni**, **Dr. Agnese Mancini**, and **Paul Martin** for sharing their valuable time and exchanging ideas with us. This project could not have been what it is today without each and every one of them.

Lastly, we would like to acknowledge and thank our instructors **Paul Prosser** and **Dr. Caroline Harrison**, as well as the 2020-2021 MSUS Committee Members **Dr. George Basile, Dr. Katja Brundiers, Dr. Peter Byck, Dr. Candice Carr-Kelman, Dr. Scott Cloutier, Dr. Melissa Nelson, Dr. Stephanie Pfirman, and Dr. Charles Redman** for providing guidance and insightful recommendations that helped polish each milestone of this culminating experience. The final version of our project is strongly influenced by their valuable feedback.

# 10. **Appendices**

## Appendix A - Framework Attribute Alignment

| | PLACE | KNOWLEDGE | CAPACITY | EXPERIENCE | REFLECTION |
|---|---|---|---|---|---|
| **Christa and Jacob's Framework** | Connection to a specific place and community that is facing a sustainability challenge | Foundational knowledge on the local values, culture, economy, and social-ecological systems | Expertise, infrastructure, personal capacity, and relationships at a local level to prepare strategies for solutions | Meaningful and concrete experience related to assessing and addressing sustainability solutions | Mindful reflection on the experience, lessons learned, UN SDG alignment, and how to progress towards future actions |
| **Place-Based Learning Attributes** | • Community connection | • Nature studies<br>• Cultural studies<br>• Environmental justice<br>• Social justice | • Critical thinking | • n/a | • Mindfulness<br>• Critical thinking |
| **Experiential Learning Attributes** | • Relevant and exciting to learner | • n/a | • Abstract experimentation | • Concrete experience | • Reflective observation<br>• Abstract conceptualization<br>• Abstract experimentation |
| **EfS Framework** | • n/a | • Declarative knowledge<br>• Social knowledge | • Procedural knowledge | • n/a | • Effectiveness knowledge |
| **Sustainability Competencies** | • Interpersonal Skills | • Systems Thinking<br>• Values Thinking | • Strategic Thinking | • n/a | • Futures Thinking |

_Caption:_ _This table shows the methodology that was used to develop the five-step PBEL framework. The top row is the framework we developed, and each column represents the PBL attributes, EL attributes, EfS Knowledge Dimensions, and aspects of the Sustainability Competencies that we felt could be combined to create each step._

## Appendix B - Feedback from Subject Matter Experts

| Subject Matter Experts | Feedback from Subject Matter Experts | | | | |
|---|---|---|---|---|---|
| | Do you think this framework is intuitive and user-friendly? | Can you think of an example from your personal or professional experience that could be plugged into this framework? | What kind of assessment tools do you think could be used to measure this framework's success? | What are five words you would use to describe this framework? | Do you have any suggestions to improve this framework? |
| Dr. Roberta Martin | • Yes | • Yes - her work with Miloliʻi Fishing Village in Hawaiʻi | • Survey what people knew before and after participating in a PBEL program <br> • Success = learners want to continue on with the learning program or come back <br> • Success = new knowledge is embedded in learners' language when they talk to each other | • Organized <br> • Holistic <br> • Community <br> • Place <br> • Experience-based | • Make the framework diagram less linear <br> • Emphasize the importance of building trust and establishing community relationships |
| Dr. Jesse Senko | • Yes | • Yes - the Senko Lab's Sustainable Fisheries and Bycatch Reduction Program | • Count how many learners want to participate in the sustainable behavior or solution after the program ends | • Global applicability <br> • Empowerment <br> • Community values <br> • Knowledge transfer <br> • Cultural innovation <br> • Tech innovation | • Update and expand the case study so it has more of a systems perspective <br> • Change the third step in the framework from "Action Skills" to "Capacity" |

| | | | | | |
|---|---|---|---|---|---|
| **Dr. Kelli Larson** | ● Yes | ● Yes - Dr. Erin Redman's work with students at the University of Wisconsin | ● Look at real world case studies and determine if they hit the same points as our five-step framework. If yes, then assess whether or not those components contribute to success | ● Behavior change<br>● Systems approach<br>● Integrative<br>● Balanced (between simplicity and complexity)<br>● Widely applicable<br>● Dynamic | ● Make the framework less linear and add arrows to show how learners might bounce back and forth between steps<br>● Add a "context" box around the steps to show that the process is grounded in a social-ecological-technological system (SETS) |

*Caption: This table is a representation of the major feedback we received from our subject matter experts during the workshops we hosted. Each row shows the answers the subject matter experts gave in response to our questions.*

## 11.   References

Abson, D. J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., ... & Lang, D. J. (2017). Leverage points for sustainability transformation. *Ambio*, *46*(1), 30-39.

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In *Action control* (pp. 11-39). Springer, Berlin, Heidelberg.

Amel, E. L., Manning, C. M., & Scott, B. A. (2009). Mindfulness and sustainable behavior: Pondering attention and awareness as means for increasing green behavior. *Ecopsychology*, *1*(1), 14-25.

Annan-Diab, F., & Molinari, C. (2017). Interdisciplinarity: Practical approach to advancing education for sustainability and for the Sustainable Development Goals. *The International Journal of Management Education*, *15*(2), 73-83.

Brooks, J. S., Waring, T. M., Mulder, M. B., & Richerson, P. J. (2018). Applying cultural evolution to sustainability challenges: an introduction to the special issue. *Sustainability Science*, *13*(1), 1-8.

Campbell, J. (2003). The hero's journey: Joseph Campbell on his life and work (Vol. 7). New World Library.

Capaldi, C. A., Dopko, R. L., & Zelenski, J. M. (2014). The relationship between nature connectedness and happiness: a meta-analysis. *Frontiers in psychology*, *5*, 976.

Chaplin, G., & Wyton, P. (2014). Student engagement with sustainability: Understanding the value–action gap. *International Journal of Sustainability in Higher Education*.

Christian, D. D., McCarty, D. L., & Brown, C. L. (2020). Experiential Education during the COVID-19 Pandemic: A Reflective Process. Journal of Constructivist Psychology, 1-14.

Collado, S., Staats, H., & Corraliza, J. A. (2013). Experiencing nature in children's summer camps: Affective, cognitive and behavioural consequences. *Journal of Environmental Psychology*, *33*, 37-44.

Deringer, S. A. (2017). Mindful place-based education: Mapping the literature. *Journal of Experiential Education*, *40*(4), 333-348.

Fadeeva, Z., Mochizuki, Y., Brundiers, K., Wiek, A., & Redman, C. L. (2010). Real-world learning opportunities in sustainability: from classroom into the real world. International Journal of Sustainability in Higher Education.

Fischer, D., Selm, H., Sundermann, A., & Storksdieck, M. (2020). 4 Storytelling for sustainability. *Storytelling for Sustainability in Higher Education: An Educator's Handbook*.

Frisk, E., & Larson, K. L. (2011). Educating for sustainability: Competencies & practices for transformative action. Journal of Sustainability Education, 2(1), 1-20.

Gosling, E., & Williams, K. J. (2010). Connectedness to nature, place attachment and conservation behaviour: Testing connectedness theory among farmers. *Journal of environmental psychology*, *30*(3), 298-304.

Haywood, B. K., Parrish, J. K., & Dolliver, J. (2016). Place-based and data-rich citizen science as a precursor for conservation action. *Conservation Biology*, *30*(3), 476-486.

Ives, C. D., Abson, D. J., von Wehrden, H., Dorninger, C., Klaniecki, K., & Fischer, J. (2018). Reconnecting with nature for sustainability. *Sustainability science*, *13*(5), 1389-1397.

Kaplan, R. (1993). The role of nature in the context of the workplace. *Landscape and urban planning*, *26*(1-4), 193-201.

Kellert, S. R., & Wilson, E. O. (1993). The biophilia hypothesis. Island Press.

Keniger, L. E., Gaston, K. J., Irvine, K. N., & Fuller, R. A. (2013). What are the benefits of interacting with nature?. *International journal of environmental research and public health*, *10*(3), 913-935.

Kesebir, S., & Kesebir, P. (2017). A growing disconnection from nature is evident in cultural products. *Perspectives on Psychological Science*, *12*(2), 258-269.

Knutti, R. (2019). Closing the knowledge-action gap in climate change. *One Earth*, *1*(1), 21-23.

Kolb, D.A. (1984). Experiential learning: experience as the source of learning and development. Englewood Cliffs, NJ: Prentice Hall.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?. *Environmental education research*, *8*(3), 239-260.

Leather, P., Pyrgas, M., Beale, D., & Lawrence, C. (1998). Windows in the workplace: Sunlight, view, and occupational stress. *Environment and behavior*, *30*(6), 739-762.

Leinaweaver, J. (2015). *Storytelling for sustainability: Deepening the case for change*. Do Sustainability.

Lin, B. B., Fuller, R. A., Bush, R., Gaston, K. J., & Shanahan, D. F. (2014). Opportunity or orientation? Who uses urban parks and why. *PLoS one*, *9*(1), e87422.

Louv, R. (2008). Last child in the woods: Saving our children from nature-deficit disorder. Algonquin books.

McKenzie-Mohr, D. (2011). *Fostering sustainable behavior: An introduction to community-based social marketing*. New society publishers.

Miller, J. R. (2005). Biodiversity conservation and the extinction of experience. *Trends in ecology & evolution*, *20*(8), 430-434.

NAAEE. *Guidelines for Excellence*. (2015, April 28). https://naaee.org/our-work/programs/guidelines-excellence

National Research Council. *Learning Science in Informal Environments: People, Places, and Pursuits*. (2009). Washington, DC: The National Academies Press. https://doi.org/10.17226/12190

Nelson, M. K. (2017). Education for the Eighth Fire: Indigeneity and Native Ways of Learning. In *EarthEd* (pp. 49-60). Island Press, Washington, DC.

Pergams, O. R., & Zaradic, P. A. (2008). Evidence for a fundamental and pervasive shift away from nature-based recreation. *Proceedings of the National Academy of Sciences*, *105*(7), 2295-2300.

Pisters, S. R., Vihinen, H., & Figueiredo, E. (2019). Place based transformative learning: a framework to explore consciousness in sustainability initiatives. Emotion, Space and Society, 32, 100578.

Pyle, R. M. (2003). Nature matrix: reconnecting people and nature. Oryx, 37(2), 206-214.Andersson et al. 2014

Robin, B. R. (2008). Digital storytelling: A powerful technology tool for the 21st century classroom. Theory into practice, 47(3), 220-228.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., ... & Nykvist, B. (2009). A safe operating space for humanity. nature, 461(7263), 472-475.

Roszak, T. E., Gomes, M. E., & Kanner, A. D. (1995). Ecopsychology: Restoring the earth, healing the mind. Sierra Club Books.

Seaman, J., Brown, M., & Quay, J. (2017). The evolution of experiential learning theory: Tracing lines of research in the JEE. Journal of Experiential Education, 40(4), NP1-NP21.

Seckel, S. (January 7, 2020). *A bright idea*. ASU News. Retrieved from https://news.asu.edu/20200107-solutions-asu-jesse-senko-solar-fishing-lights-sea-turtles

Shelton, C. C., Warren, A. E., & Archambault, L. M. (2016). Exploring the use of interactive digital storytelling video: Promoting student engagement and learning in a university hybrid course. TechTrends, 60(5), 465-474.

Steffen, W., Crutzen, P. J., & McNeill, J. R. (2007). The Anthropocene: are humans now overwhelming the great forces of nature. *AMBIO: A Journal of the Human Environment*, *36*(8), 614-621.

Steffen, W., Persson, Å., Deutsch, L., Zalasiewicz, J., Williams, M., Richardson, K., ... & Molina, M. (2011). The Anthropocene: From global change to planetary stewardship. *Ambio*, *40*(7), 739.

Taniguchi, S. T., Freeman, P. A., & Richards, A. L. (2005). Attributes of meaningful learning experiences in an outdoor education program. *Journal of Adventure Education & Outdoor Learning*, *5*(2), 131-144.

Townsend, M. (2006). Feel blue? Touch green! Participation in forest/woodland management as a treatment for depression. *Urban Forestry & Urban Greening*, *5*(3), 111-120.

Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: a reference framework for academic program development. *Sustainability science*, *6*(2), 203-218.

Wilson, E. O. (1984). Biophilia: the human bond with other species. Harvard University Press, Cambridge

Zaradic, P. A., Pergams, O. R., & Kareiva, P. (2009). The impact of nature experience on willingness to support conservation. *PLoS One*, *4*(10), e7367.

**For further information on the PBELS Initiative, please contact:**
**PBELS-Initiative@PBELS.org**