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Self-determined Exploration of the Outdoors and What Students Can Teach Themselves: A Report on the Beach Investigators Summer Program

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Self-determined exploration of the outdoors and what students can teach themselves: A report on the Beach Investigators summer program

By

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A Field Project
Presented to
The Faculty of
Western Washington University

In Partial Fulfillment
Of the Requirements for the Degree
Master of Environmental Education

by
Mark Bryant
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Abstract

For my masters field project, I designed and ran a five-day week long summer program called Beach Investigators that teaches about the beach, and observing and investigating out surroundings. The Program aimed to provide 5th through 9th grade students with skill and internal motivation they could use to engage in more thoughtful and in-depth exploration of their local ecosystem. This program is based in Self Determination theory (SDT), which has the potential to aid in the aims and goals of EE. I found that SDT programming has the potential both increase student ecological knowledge, as well as increase motivation for continued self-driven learning in the short term. Because SDT can serve this purpose, it is likely to be add a powerful foundation to EE and outdoor education.

Acknowledgements

This program has introduced me to some of the most amazing people I have ever met. I want to thank Gene Myers, and Nick Stanger for all the guidance and advice they have given me along the way. I also want to thank Alison Smiley and Shannon Point Marine Center for the resources to run this program. Without their partnership, this program may not have happened.

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My roommates Adam Jones and Jacob Strain have been like a family to me through these past two years. Family is a strange thing that can emerge from anywhere and can come from some of the most unexpected places. This family has turned an apartment into a home.

My other family, the one that raised me, has also been present over the phone and through visits. They have always been supportive and loving. Without them, I would not be the person I am today, the person who was able to do this work and see it through to the end.

And finally, thank you Lindsey, whom I love dearly. I have done this work for you, and to make you proud. Your love, kindness, and support have been a constant presence even though we live miles apart. My future looks brighter with you in it, and there is no one I would rather spend it with.

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Introduction

For my master's field project, I have designed and run a five-day long summer program about the intertidal-zone, self-directed learning, and exploration of one's environment. The program aimed to provide 5th through 9th grade students with skills they could use to engage in more thoughtful and in-depth exploration of their local ecosystem. This program is based partly in Self Determination theory (SDT), which has the potential to aid in the aims and goals of Environmental Education (EE). Outdoor Education and Place-based education have also played roles in the development of this program.

The Goals of this program were to use SDT based programing to help students develop intrinsic motivation for exploration of their own environment and self-driven learning, thereby serving the aims and goals of EE. At the same time, this program was being run through Shannon Point Marine Center (SPMC), which aims to increase the understanding of costal marine systems by integrating research and education. To fit both goals, the Beach Investigators program used the intertidal zone location and focus of the program. Students participated in lessons that provided them with the basics of skills such as nature journaling, photography, and observation. They were then provided with time to freely explore the beach located at Shannon Point.

The field project included an evaluation of aggregate student learning. The evaluation aimed to see if free exploration through SDT based programming could increase learner knowledge of local intertidal ecosystems, and if students had developed the motivation for continued exploration of their environment and self-motivated learning. I found that SDT programming has the potential both increase student ecological knowledge, as well as increase

motivation for continued self-driven learning in the short term. Because SDT can serve this purpose, has potential to be a powerful tool for EE and outdoor education.

Rationale

The aim of this summer program was to explore how SDT can be implemented in an outdoor education environment. A person is said to be acting on intrinsic motivation when they perform a task to fulfill their own internal values and beliefs. SDT proposes that pursuing intrinsic goals promotes learning because these goals satisfy basic psychological needs for autonomy, competence, and relatedness (Deci & Ryan, 2002). Also, SDT states that offering students choice within educational programming can help facilitate a student's autonomy, leading to deeper learning and enjoyment of a program (Wang, Ang, Teo-Koh, & Kahlid, 2004; Mackenzie, Son, & Hollenhorst, 2014). The principles of SDT can be extended to participation in EE and outdoor education programs (Wang, Ang, Teo-Koh, & Kahlid, 2004; Mackenzie, Son, & Hollenhorst, 2014; Sproule et al., 2013).

My previous work at a Camp MaKaJaWan, run by the Boy Scouts of America (BSA) in Wisconsin, first introduced me to the idea of offering learners a choice in their day to day activities. At MaKaJaWan, the scouts were encouraged but not required to participate in merit badge lessons, hiking, boating, and other staff designed activities. By offering its learners so many options and allowing them to be in control of their own camp experience, MaKaJaWan and similarly structured camps implement SDT, possibly without realizing it. After learning about SDT during my graduate school studies, I felt it was a natural path for me to follow.

Because EE aims to improve attitudes and behaviors of citizens towards the environment in which they live (UNESCO, 1992), it is possible to use SDT to achieve these goals. This is because SDT describes the process of internalization. Internalization is the process by which people incorporate new values into their own beliefs and world views (Deci & Ryan, 2002). By

supporting a student's autonomy through the ideas of SDT, educators can promote the process of internalization of values associated with EE (Wang, Ang, Teo-Koh, & Kahlid, 2004; Mackenzie, Son, & Hollenhorst, 2014; Sproule et al., 2013). Through these means, SDT supports the goals described by EE.

Because of my previous work, and the aims of EE, I decided to use SDT as the main theory informing the Beach Investigators summer program. This was accomplished by providing students with a location to freely explore, a nature journal they could use in any way they liked, and badges that they could choose to earn or ignore depending on their own interest. Students were encouraged to find ways of exploring their environment that worked for them, rather than being directed into specific methods of outdoor exploration and observation. Through these methods, the beach investigators program aimed to foster student motivation for continued self-driven learning about the environments that surround them.

Goals

The Beach Investigators Summer Program had two main goals. The first was to implement quality SDT based programming that would help students develop intrinsic motivation to explore their environment. This goal is based in my own interests of supporting student freedom, and allowing them to pursue interests and activities that they find value in.

The second goal was to increase student knowledge of a local ecosystem through free exploration and SDT based programming. This goal is in line with the mission statement of SPMC: “Our mission is to increase understanding of complex coastal and marine systems by integrating research with student-centered, immersive education, with a continuing commitment to diversity and mentoring” (Shannon Point Marine Center, 2018).

The various stakeholders in this program, including SPMC, undergraduate volunteers, and myself, had other goals that the Beach Investigators program could potentially serve. The goals for these three stakeholder groups are displayed in Table 1 on page 5. This table identifies each stakeholder group, and the goals that they have for the Beach Investigators program in a clear manor. These goals are based on the needs and wants expressed during discussions with the three stakeholder groups. I believe that working with stakeholders is key to working in EE, and that a strong working relationship with stakeholders is needed to strengthen EE efforts. Working together on a common project has not only helped each group reach these goals, it has created a working relationship and laid foundations for future projects.

Table 1: Stakeholders and Goals

Stakeholder	Goals
Shannon Point	Develop a closer relationship with Huxley College
	Expand education programs for younger learners
	Provide quality hands on Marine Science education
Undergraduate Volunteers	Obtain valuable work experience through practice teaching and observing how the program is run
	Learn about Self Determination Theory and how it can be used to shape education programs
Myself	To experience the process of designing and running an outdoor education program
	Help students develop motivation for continued outdoor activity

Review of the Literature

Environmental Education aims to improve attitudes and behaviors of citizens towards the environment in which they live (UNESCO, 1992). This objective was born out of concerns that as we entered an age of rapid technological advancement and development, the planet faced severe social and economic consequences (UNESCO, 1975). EE aims to address the complexities of the environments in which people live and encourage forms of development that were harmonious with the environment, as well as help to create new awareness of the economic, political, and ecological interdependence of the modern world (UNESCO, 1977). To meet these complex new ideals, EE must make efforts to help people learn from the environment as well as about the environment. EE must also adapt its methods, materials, and strategies to meet the needs of its learners.

EE should be in, about, and for the environment (Lucas, 1972). Often, EE is only conducted as one of these three factors depending on what the goals of a particular EE program may be. While these three factors do not always co-occur, this simple statement hints at the larger overall goals of EE, which are to provide opportunities to explore a place, information about a place, and the opportunity to learn how to protect a place (Monroe, Andrews, & Biedenweg, 2008; UNESCO, 1992, UNESCO, 1977, UNESCO, 1975). Current trends in EE continue working to address not only the ecological aspects of a place, but also the social and cultural aspects (Blenkinsop, Telford, & Morse, 2016; Borden & Wiseman, 2016; Chawla & Derr, 2012; Derringer, 2017; Dolan, 2016; Zimmerman & Weible, 2015). In this way, EE has expanded to work not only on improving the ecological literacy of its audience, but also the social and physical wellbeing of the audience (Waite, 2010).

While EE is becoming more widespread, it begins to reach more than those who love nature and the outdoors for its own sake (Wang, Ang, Teo-Koh, & Kahlid, 2004). Serious EE aims to motivate individuals to take responsible action (Bogner, 1998). Bogner (1998) found in his review of EE programs that many programs that aim to increase environmental concern do not address the need to invest oneself to help solve environmental problems. Students who are not interested in nature and the outdoors may not see a point to participation in EE programs which could be beneficial to them (Wang, Ang, Teo-Koh, & Kahlid, 2004; Mackenzie, Son, & Hollenhorst, 2014; Sproule et al., 2013). Because of this, forms of EE are needed that address a student's motivations to engage in forms of EE such as outdoor education (Wang, Ang, Teo-Koh, & Kahlid, 2004; Mackenzie, Son, & Hollenhorst, 2014; Joussarnet, Landry, & Koesnter, 2008).

In trying to meet these diverse goals, EE was developed as a multifaceted, interdisciplinary field (Monroe, 2008; UNESCO, 1977). The instructional styles and materials involved in EE efforts should reflect this complexity (NAAEE, 2000). Lessons should not focus only on the natural science behind environmental issues, but also work on developing student's critical thinking skills, and social skills that will prepare them to face these issues with their communities. EE challenges us to both focus on our local communities, as well as addressing the increasingly global nature of today's society (UNESCO, 1977; UNESCO, 1992). In this way, EE can work with communities locally, nationally, and globally to build a better future.

Theoretical Framework

- **Self Determination Theory**

For an EE program to be successful, it should be firmly rooted in theory (Jacobson, McDuff, & Monroe 2006; NAAEE, 2000). Educators that base their programs in theory know why they are using the tools, materials, and instructional techniques that they are using (Thomas, 2008). One theory that that has informed this project is Self Determination Theory (SDT). SDT assumes that all people are active, self-motivated, and curious, which is born out of a need to make send of their environment and find meaning in their lives (Darner, 2009; Deci & Ryan, 2008). Humans are constantly processing new experiences and information that may or may not agree with their current world view. When individuals encounter experiences that disagree with the individuals' way of thinking in a way that can be resolved, they can modify that way of thinking to come to a new understanding of the world. It is because of this need for understanding that humans seek out challenges that enable them to come to a better understanding of the world and their place in it (Darner, 2009).

How can we motivate the next generation of people to connect with and find their own values in nature? Part of this process involves encouraging students to act on their own ideas and values. Autonomous behavior, and the factors that lead to it, are described by SDT. Activities or actions performed out of autonomous motivation are approached with greater persistence, enhanced performance, and can lead to better psychological wellbeing (Deci & Ryan 2008; Mackenzie, Son, & Hollenhorst, 2014).

Deci and Ryan (2002, 2008) discuss two main forms of motivation in SDT. The first form of motivation is intrinsic motivation, or motivation that comes from ones own internal

values and beliefs. A behavior or action that is intrinsically motivated is carried out purely to elaborate an individual's cognitive structures by assimilating challenging experiences (Darner 2009). SDT proposes that pursuing intrinsic goals promotes learning because these goals satisfy basic psychological needs for autonomy, competence, and relatedness (Mackenzie, Son, & Hollenhorst, 2014). Deci and Ryan (2002, 2008) also discuss a second form of motivation called extrinsic motivation. People acting out of extrinsic motivation are doing so for compensation, and not their own personal reasons. Some forms of compensation can be expected payment, concern for grades, or fear of consequences. Extrinsic motivation does not promote learning in the same ways as intrinsic motivation. Rewards and attempts to control intrinsically motivated behaviors through external rewards can have a negative effect on the behaviors (Darner, 2009). However external values, such as ones related to important societal values, can be incorporated over time through a process called internalization (Deci & Ryan 2008).

- **Internalization**

Internalization is the process by which individuals incorporate external values into their own internal values, which could be key in finding ways to motivate students to continue their own process of outdoor exploration. Through the processes of internalization and intrinsic motivation, children take an active role in their own development (Joussarnet, Landry, & Koesnter, 2008; Wang, Ang, Teo-Koh, & Kahlid, 2004; Mackenzie, Son, & Hollenhorst, 2014). This includes exploration of their environment and pursuing their own interests. People act based on autonomous motivation when they participate in activities that they perceive as in alignment with their own values and identity (Deci & Ryan 2008).

SDT posits factors that can be incorporated into a lesson that encourage internalization of values. One of the most fundamental ways in which teachers can encourage internalization is by

supporting the experience of choice (Deci & Ryan 2008; Wang, Ang, Teo-Koh, & Kahlid, 2004; Mackenzie, Son, & Hollenhorst, 2014). By creating choices for students, we allow them to feel as though they have control over their learning experience which reinforces the student's autonomy. Support for autonomy by both parents and teachers has been linked to better performance in school, and stronger self-regulating behavior (Joussarnet, Landry, & Koesnter, 2008). Autonomy supportive environments involve situations where choice, the students point of view, and the student's own initiative are all supported (Deci & Ryan 2008). Supporting a student's autonomy has also been shown to increase the internalization of cultural and social values. Conversely, things like pressure can result in a decrease in internalization (Deci & Ryan 2008). This means that using strong too strong of incentives, such as grades, to convince students to participate in an activity that does not interest them will not lead to internalization and fail to promote the autonomous motivation for continued learning.

Outdoor Education

As a separate but longstanding body of literature also demonstrates, teaching in the outdoors can be an effective method for educating students (Martin, 2003; Rios & Brewer, 2014). It has the potential to involve a community of learners, and fosters total engagement in the educational experience (Linney, 2010). The outdoor environment has many benefits to offer learners, especially for those younger than 18 years of age (Zelezny, 1999). There is also great importance for opportunities to spend time in nature, especially before age 11 (Ernst & Theimer, 2011). In conversations with Australian college students, Preston (2013) found that outdoor spaces are desirable places in which to be and through which to learn. Conversely, indoor spaces are unappealing where learning becomes a chore and is less effective (Preston, 2013).

There are many subjects that can be learned in an outdoor environment, including English, math, and science (Maynard & Waters, 2007; Dakin, Eatough, & Turchon, 2011; Mazor, 2011; Fägerstam & Samuelsson, 2012; Dolan, 2016; Gray & Carol, 2015; Loveland, 2003; Galizio, Stoll, & Hutchins, 2009; Eick, 2012). Some biology lessons are easily moved into the outdoors as students are given hands on experience with specimen and ecological connections (Dakin, Eatough, & Turchon, 2011). The outdoor classroom has been used effectively to make sure students meet mandated curriculum for both science and literacy (Eick, 2012). Math lessons have been taught with games that include dice and counting frogs and lily pads (Maynard & Waters, 2007), and a study found differences in academic performance in favor of outdoor learning during a 10-week unit in arithmetic (Fägerstam & Samuelsson, 2012). English lessons have been taught by bringing students into nature or using collected specimen to inspire their writing (Dakin, Eatough, & Turchon, 2011; Mazor, 2011). Gray (2015) found evidence that outdoor education efforts can foster a closer connectedness of students with the natural world through an art-based approach.

Some findings also indicate that nontraditional settings may be more effective for environmental education than traditional classroom settings (Disinger, 1982, Zelezny, 1999; Rickinson, 2001). In a review of various environmental education programs, Zelezny (1999) found no studies of classroom education programs for high school students measured changes in environmental behavior. Positive environmental behavior has been linked to experiences in nature, as well as active participation in environmental activities outside of the classroom setting (Zelezny, 1999). Students can use the variation in outdoor landscapes for different types of play. For environmental education, these natural landscapes can be vital because they allow children to

develop positive caring attitudes about the environment (Maynard & Waters, 2007; Rivkin, 2000; Chawla & Rivkin, 2014).

Outdoor education also has the chance to deconstruct anthropocentric views that establish humans as separate from nature (Malone, 2016; Mullins, 2014). While many programs aim to take students into natural places for outdoor education, they often ignore the environments in which people live (Linney, 2010). There is merit to having students learn in places that are close to home, and do not require trips to faraway places. Trips to distant, more "natural" locations could potentially reinforce the idea that humans and nature are separate things found in separate locations (Linney, 2010).

One of the most accessible outdoor spaces available to educators is a school yard like the setting that will be used in the Evergreen Elementary version of the Beach Investigators Program. School yards work as settings for education because they are accessible to teachers and familiar to students (Rios & Brewer, 2014; Martin, 2003). Martin (2003) showed that 5th graders tested higher than a control group on environmental knowledge and behavior after learning in school yards. However, there are indicators that factors such as age and gender may change the effectiveness of using a school yard for EE (Martin, 2003). In the same study, 4th graders learning about environmental issues showed no difference on knowledge from their control group. Also, within the 5th graders, female students showed higher scores on environmental attitudes and behaviors (Martin, 2003).

While school yards may be the most accessible and commonly used type of outdoor space, other more natural landscapes are also being used by educators (Maynard & Waters, 2007; Fjørtoft, 2004). Children who play in flexible, natural landscapes appear to be healthier, have improved motor fitness, balance, coordination, and demonstrate more creativity in their play

(Maynard & Waters, 2007; Fjørtoft, 2004). Natural landscapes have qualities that meet children's needs for diverse and stimulating play environments, and provide rich sensory environments for children's own investigation, and group activities (Maynard & Waters, 2007; Fjørtoft, 2004; Waite, 2010).

Some schools that do not have full time access to natural outdoor spaces have employed one day experiential field trips (Jose, Patrick, & Moseley, 2017; Nadelson & Jordan, 2012; Farmer, Knapp, & Benton, 2007). Field trips can promote the retention of information in the long term (Nadelson & Jordan, 2012; Farmer, Knapp, & Benton, 2007). Students hold positive memories and attitudes towards field trips. Nadelson (2012) found that students recalled hands-on activities at least one month after the trip occurred. Students who attend field trips to natural outdoor locations such as national parks can retain long term environmental and ecological content and can evidence a potentially perceived increase in pro-environmental attitude (Farmer, Knapp, & Benton, 2007). These one-day trips can often be supplemented by indoor classroom activities before and after the field trip (Jose, Patrick, & Moseley, 2017).

- **SDT in the Outdoors**

The principles of SDT can be extended to outdoor education participation (Darner 2009; Wang, Ang, Teo-Koh, & Kahlid, 2004; Mackenzie, Son, & Hollenhorst, 2014; Sproule et al., 2013). Outdoor education programs can present an opportunity to experience an autonomy supportive environment where significantly higher levels of autonomous motivation and competence are experienced (Sproule et al., 2013). More controlling regulations, such as specific tasks that must be done in specific ways, negatively predict self-reported satisfaction, while more autonomous regulations positively predict self-reported satisfaction (Wang, Ang, Teo-Koh, & Kahlid, 2004; Mackenzie, Son, & Hollenhorst, 2014; Sproule et al., 2013).

Schools and traditional teaching methods use bells, desk placement, and walls to contribute to an atmosphere that evokes certain behavior from students, and aid teachers in their lessons (Blenkinsop, Telford, & Morse, 2016). Without these teaching aids present, some teachers can struggle. Being outside changes the relationship between students and adults. Indoors, the expectation is that students sit still, stay quiet, and behave (Blenkinsop, Telford, & Morse, 2016; Waite, 2010). However, one of the main advantages to using outdoor spaces is that they can provide students with the ability to move freely (Maynard & Waters, 2007). Many children have the competence to move about their environment and being in the outdoors allows them to do this at their own self determined pace. Sandseter (2009) found that children are aware of their own ability and regulate the exploration of their environment according to their abilities and fears. There are also less restrictions on noise in the outdoors (Blenkinsop, Telford, & Morse, 2016; Waite, 2010), which allows students to express themselves, as well as communicate freely with each other with less concern for rules and disturbing others.

Schools that are working to increase their use of the outdoors have started to use strategies and knowledge that are beneficial for making use of the outdoor learning space. One lesson they have learned is that teaching outdoors can be more spontaneous and less structured (Blenkinsop, Telford, & Morse, 2016). This is a strong benefit for SDT focused learning because less structured lessons allow for more student freedom. This spontaneous form of learning means that teachers must be more prepared. Blenkinsop (2016) states that it helps to explore and be familiar with an outdoor space you plan to use prior to teaching a lesson there. Having a preexisting knowledge of a place can help a teacher make use of the spontaneous teaching and learning opportunities that may arise (Blenkinsop, Telford, & Morse, 2016).

It is important to explain the rationale of a program to students, rather than simply direct them into activities. This will help youth understand the value of participation in outdoor education and EE programs (Wang, Ang, Teo-Koh, & Kahlid, 2004; Sproule et al., 2013). Using fun activities and games as a part of teaching ecological behavior may help students find a reason for being outdoors that resonates with them. This may lead to these students spending more time outdoors exploring their environment in a way they enjoy (Darner, 2009).

Place-Based Education

Outdoor education is inherently linked with another EE framework: place-based education (Woodhouse & Knapp, 2000). Outdoor education should take a strategy of providing area specific, local, hands-on experience for students (Ernst & Theimer, 2011; Linney, 2010). Place-based education is an approach to EE with a focus on a specific place and involves learning in that specific place. A potent inspiration for environmental stewardship consists of experiences that engender love, attachment, and affinity for natural spaces (Gray & Carol, 2015). To develop multivocal and multisensory relationships with learners and the place they live, outdoor education must address being present in and with a place, the power of place-based narratives, and the representation of place experiences (Greenwood, 2013). Places are the contact zones of contested place stories, which allow place-based education programs to address the political and cultural aspects of EE. The main purpose of using an outdoor location in education is to provide meaningful contextual experiences that expand upon classroom instruction, which is often dominated by print or electronic media (Greenwood, 2013).

Something that seems to be a key ingredient in successful environmental education programs is that they should be connected to the real worlds of students' homes, communities, and or regions (Chawla & Derr, 2012). Students tend to disengage with lessons or narratives that

contradict the realities of their home lives (Tzou, Scalone, & Bell, 2010). The subject matter of environmental education programs should be directly connected to the communities that participants are most able to provide action for. SDT fills these needs because it asks that teachers acknowledge student's points of view in order to support autonomy (Deci & Ryan 2008). By working to support a student's points of view and personal values, we address the narratives that students live with at home. This way we can work to help students find motives to participate that are in line with their internal values.

Place-based education is inherently experiential and emerges from the attributes of a place so long as teachers are comfortable in the location and are acting with intentionality (NAAEE, 2000). A guiding theory such as SDT can make sure this happens. Experiential education relies on a process of discovery and evaluation for knowledge and skill acquisition (Collins, Paisley, Sibthorp, & Gookin, 2011). The content is specific to the geography, ecology, sociology, politics, and other dynamics of that place (Woodhouse & Knapp, 2000; Cole, 2007; Deringer, 2017; Waite 2014; Zimmerman & Weible, 2015). The educational purposes within places should align with the cultural aspects of that place, while also looking to the application of principles to other environments (Waite, 2013). Science education within a place-based education effort is not enough (Zimmerman & Weible, 2015). While students may gain a better understanding of the issues that face their community, they may not develop a sense of what needs to change. Many students today are hardwired to expect exact "right and wrong" answers when experiential education does not always distinguish these types of answers (Collins, Paisley, Sibthorp, & Gookin, 2011). Mindfulness must be practiced so that place-based education can address the social and cultural aspects of EE as well (Deringer, 2017).

While outdoor education, place-based education, and EE are all deeply connected, concepts for each of these separate fields is often developed separately by educators (Woodhouse & Knapp, 2000; Aucoin, 2011). The curricula developed for one of these three fields can potentially be useful in the other two. There is importance to creating a new form of curricula that incorporates aspects of EE and outdoor education (Aucoin, 2011). If we begin education in a place we know has the potential to teach, other lessons such at STEM objectives can emerge from these lessons, though it is not a guarantee (Borden & Wiseman, 2016).

Program Duration

In general, longer programs have been shown to be more effective in environmental education (Bogner, 1998; Chawla & Derr, 2012; Zelezny, 1999; Rickinson, 2001; Ernst & Theimer, 2011). Bogner (1998) found that shifts in juvenile knowledge, attitudes, and behavior due to interventions depend on the length of the program. A five-day program is more effective than a one-day program. Because of this, teachers and educators may want to consider activities and program that can be connected into larger programs that last at least a week or more. However, single day programs can still have positive short and long-term effects on environmental attitudes, even though they might not influence other factors such as connectedness with nature (Sellman & Bogner, 2012; Jose, Patrick, & Moseley, 2017). Zelezny (1999) found that interventions with significant effects for younger participants typically lasted more than ten hours, and that programs offered are typically longer for younger audiences.

The influence of in-class pre- and post-activities for environmental education have also been investigated as ways of reinforcing the experience outside of the classroom (Smith-Sebasto & Cavern, 2010; Rickinson, 2001). Pre-week and post week activities were shown to increase the students understanding of how human activities can impact nature when the program alone

had less than the desired effect. However, in the same study, the activities were shown to have little or no effect on a student's affinity for natural areas, or trust and comfort of environments. While there is certainly more research needed to understand the effectiveness of these supplemental activities and lessons, they do provide the opportunity to extend the length of the program into larger curricular goals (Smith-Sebasto & Cavern, 2010; Rickinson, 2001).

Barriers to Outdoor Education

Even though many outdoor educators see the value in using outdoor settings for education, there are still limitations that some teachers see as preventing them from utilizing outdoor spaces. Just as teachers with an affinity towards the outdoors are more likely to use outdoor spaces, teachers who do not describe themselves as 'outdoor people' are less likely to find value in using the outdoor space (Scott, Bloyd, Scott, & Colquhoun, 2014). One common barrier that teachers describe is a lack of resources such as funding for trips, or maintenance of outdoor space (Waite, 2010: Maynard & Waters, 2007; Scott, Bloyd, Scott, & Colquhoun, 2014).

The attitudes of other teachers and colleagues have also been barriers to teaching in the outdoors (Waite, 2010; Maynard & Waters, 2007; Scott, Bloyd, Scott, & Colquhoun, 2014). For example, Maynard (2007) found some teachers have concern for the negative reactions of parents and the perceived expectations of inspectors. School administrators can be less supportive of outdoor porgrams (Maynard & Waters, 2007; Scott, Bloyd, Scott, & Colquhoun, 2014; Lane, Ateşkan, & Dulun, 2018). Student safety is a common concern. (Maynard & Waters, 2007; Scott, Bloyd, Scott, & Colquhoun, 2014). These concerns for safety are born out of what is seen as a lack of supervision to use a space safely or properly maintain the focus of the students. Some teachers do not fully understand the potential of working in the outdoor space. Teachers who do see value in using outdoor spaces for education and will work hard to overcome many of

these perceived barriers if they are able, and some teachers have even reported feeling more relaxed in an outdoor space (Maynard & Waters, 2007; Waite, 2010; Scott, Bloyd, Scott, & Colquhoun, 2014). Also, increased local socio-cultural expectations for outdoor learning can override some teachers' personal reservations toward using the outdoors, resulting in greater use of this powerful pedagogic approach (Waite, 2010).

The quality of a school yard or outdoor space can become a barrier to outdoor learning when the location experiences harsh weather or seems unsafe (Waite, 2010; Maynard & Waters, 2007). In a case study of schools and their use of school yards, Maynard (2007) found that some schools do not use their school yards from November to March to avoid harsh winter weather. Also, some schools that have school yards will not make use of the more natural areas. Some school yards can be improved by the addition of native plant gardens, or native wildlife themed playground equipment (Rios & Brewer, 2014). These additions may help a school yard become a more adequate location for environmental education.

There is concern that learning outdoors is becoming a missed opportunity for some groups of learners (Waite, 2010; Rios & Brewer, 2014; Martin, 2003). One concern is that the outdoor space is used less for older age groups (Waite, 2010; Rios & Brewer, 2014; Martin, 2003; Scott, Bloyd, Scott, & Colquhoun, 2014). Waite (2010) reports that in a survey of a rural county in the UK, fewer educators for older age groups reported plans to develop outdoor learning programs. Daycare centers reported the highest use of outdoor activity in a study based in the UK, however this is attributed to the extra freedoms these educators have with their time management (Waite, 2010). This trend could be due to a perceived barrier between outdoor learning and completing National Curriculum requirements which increase for older age groups (Waite, 2010; Scott, Bloyd, Scott, & Colquhoun, 2014). The pressures of standard assessment

tests and performance requirements get in the way of using outdoor spaces (Waite, 2010; Scott, Bloyd, Scott, & Colquhoun, 2014; Lane, Ateşkan, & Dulun, 2018; MacQuarrie, Nugent, & Warden, 2015). Teachers also state that lack of time to develop outdoor learning experiences as a barrier (Scott, Bloyd, Scott, & Colquhoun, 2014).

It is important to understand that not all students see nature in the same way as their instructor might. Some students living in areas where access to quality outdoor space is limited also develop different attitudes towards nature. Students with little or no direct experience with nature are more likely to base their perceptions of nature through vicarious experiences, such as TV, computers, or books (Aaron & Witt, 2011). There have also been reports that students living in urban areas often express a fear of nature or can become overwhelmed by the rich sensory environment that nature offers (Wals, 1994; Bixler, Carlisle, Hammitt, & Floyd, 1994). These fears can be associated with powerful forces of nature such as hurricanes or tornadoes but can also be associated with the idea that dangerous people can be found in parks or other natural areas. This is a fear that is unique to students that live in cities and is rarely seen in suburban populations (Keliher, 1997; Wals, 1994).

Teachers can be surprised when students of backgrounds that involve reduced access to outdoors express reluctance to participate in some activities, such as sleeping in cabins without locks on the door or going into the woods at night (Tzou, Scalone, & Bell, 2010). Therefore, it is important for teachers to be mindful of the fact that multiple narratives and experiences of the outdoors exist in every class. Narratives that are incongruent with the realities of the students can cause students to disengage in a lesson or activity. Educators should strive for curriculum that can address the unique personal narratives that each learner holds (Tzou, Scalone, & Bell, 2010). In order to accomplish this, Tzou (2010) suggests using research such as cross-setting

ethnographic research to gain a better understanding of the ways in which youth engage in science learning in the various settings of their lives.

Description of Project

This program was designed to be run at SPMC and was also adapted to be run at Evergreen Elementary in Sedro-Wooley. The aspects of both versions of the program are described below.

- **Ecosystem of Focus**

For the purposes of this curriculum I have chosen to focus on the intertidal zone. Focusing on intertidal zone the program puts a local ecosystem focus on the program, which is in line with the goals of EE and place-based education. Intertidal zones are a prominent and unique feature in the western Skagit area. Focusing on an ecosystem close to home will encourage kids to draw from prior knowledge, as well as continue their exploration past the conclusion of the program. This also helps to inform the youth about an ecosystem that they have an impact on. Also, the intertidal zone is an environment in which open ended inquiry can access a complex and rich ecological system, which supports my curricular goals as well as the general goals of outdoor education. My hope is that, in this rich and exciting landscape, students will be more likely to form intrinsic interest in outdoor exploration and inquiry based on the ideas of SDT. This may encourage students to be more active in their community and local government when it comes to protecting important coastal area.

- **Program Locations**

SPMC is located in Anacortes and holds 78 acres of wooded area along a coast. The space serves as a biological reserve that protects small mammal and bird populations. In the past, some of their programs have worked to provide science education to underprivileged undergraduates, as well as work with schools in the area to develop summer education programs.

One of these programs is their Ocean STEM program, in which students get hands on experience with science and engineering as they choose their own research project and build a remote operated vehicle (ROV) in order to carry out that project. Another example is Grandparents U, where grandchildren and their grandparents work together in a STEM program taught by western faculty. Currently, SPMC's education team is looking for ways to expand their programs, such as working with more graduate students like me. SPMC is also currently reaching out to more local schools so they can expand their already existing education programs.

While the main reasons for my use of SPMC were opportunistic, one major advantage of working with them was their access to a beach. There is plenty of space on the beach for students to explore while being supervised by staff. There are also indoor facilities and classrooms in the event of adverse weather. SPMC also has a lab with microscopes and live animals. These tools were useful for teaching students about different observation techniques and provided students with a unique opportunity to use lab equipment. Lastly, SPMC provides all their programs with a small budget from which to operate with, which will allow for the easier acquisition of materials such as notebooks and pencils for the students.

A second version of this program is being offered through Evergreen Elementary in Sedro Woolley School District as part of their summer education program. For this version of the program, the students will meet at the school's location. As was discussed earlier, school yards can be an effective learning environment for students (Rios & Brewer, 2014; Martin, 2003). Evergreen Elementary has a large field for students to explore, and a limited number of plants, trees, insects, birds, and some small mammals for students to observe. First State Recreation area, a wetland preserve rich with biodiversity, is within walking distance of the school. For this

version of the program, the students went on a field trip to the beach at Shannon Point on the final day of the program.

For the program to work at Sedro-Wooley, some adjustments needed to be made. First, the program was cut down to a half day experience, and extended out to be two weeks long. This meant that instead of two lessons each day, only one was offered. Also, since no beach was available at Sedro-Wooley, each day contained a small lesson on various aspects of the ocean and the intertidal zone rather than one intertidal zone lesson on the first day. This way, the beach theme would be apparent even though no beach was available. On the final day of the program, a full day field trip was taken to SPMC where students were given a chance to perform the beach survey activity and use microscopes. For free exploration time, students were given the chance to explore the school yard and were taken on walks to the wetlands preserve near the school. This way, students were given a chance to work on their nature journals while being able to explore an outdoor space.

- **Participants**

For the week at SPMC, students were recruited via the Shannon Point Education Program. Students who signed up for this program were those most likely to see the advertisement on SPMC's website, who live close to the facility, or who have participated in SPMC education programs previously. Some of the students participating in the Beach Investigators program were children of SPMC employees. Students will be entering 5th through 9th grade. In total, 17 students signed up for and participated in the program.

For the Sedro-Wooley version of this program, students were invited by the school based on their performance on standardized testing. Students who perform at or slightly below their

grade level were invited to participate by phone call from teachers. Interested parents can sign their students up for the program during this phone call. For this version of the program students will be in either 4th or 5th grade.

- **Staffing**

The program run at SPMC was staffed by myself and three undergraduate volunteers. The volunteers were students in the environmental studies program and the arts program who had an interest in education. To recruit these assistants, an email was sent out to their respective departments, and interested undergrads contacted me through email. I then met with and interviewed the potential volunteers from which I selected my three volunteers.

I chose undergraduate students who had the most experience in previous education programs. All volunteers selected also expressed interests in SDT and listed this as a reason for being interested in my program. I selected one student from the Environmental Education program, and two students from the Arts program. With myself included, that meant we had two people representing each program. This way, participants would have mentors for both the scientific observations as well as more artistic journaling.

At Evergreen Elementary, staff were provided through the school. There were four teachers who worked at Evergreen during the school year, and one paraeducator. While not all the participants had previously been in a class with one of the teachers, they all seemed to be familiar with each other. Students recognized these teachers as authority figures.

For both programs, I conducted staff training at a meeting prior to the start of the program. Before each meeting, I sent staff members a copy of my curriculum to read and generate questions. Then during the meeting, we conducted a read-through of the curriculum and

addressed any questions that came up. This included a discussion of the theory behind the program and SDT, as well as reading the individual lesson plans. While all lessons were lead by myself, it was important for all staff members to be familiar with their content so they could answer questions the students might have.

At SPMC, we also discussed any site rules that had been communicated to us by the SPMC staff such as where students could be, and how to act while inside the SPMC facility. At evergreen elementary, teachers did their part to familiarize me with the rules that teachers and students were already familiar with. At both locations, staff needed to familiarize themselves with safety and emergency procedures.

- **The Curriculum**

The curriculum for this project was informed by some theories associated with outdoor education, sensory education, and SDT. While at SPMC, the curriculum was followed closely. For more information on how the program at SPMC was run, you can find the full curriculum the appendix of this report (Appendix A).

Lessons on various methods of outdoor observation, such as journaling, sketching, and photography were provided to students throughout the week. The lessons worked to address methods of outdoor exploration that focused on science, as well as methods that focused on more artistic expression. In this way, students were provided with choices as to how they would like to use their nature journal. At no point was a student told how they had to use their journal, but rather how they could use their journal.

As a way of supporting autonomy, a key part of SDT, my program intends to give students freedom to choose the way in which they explore the beach. My hope was that this

would allow the students to find a method of exploration that connected with their own values. I also recognize that if a student chose to not explore the beach in any of the ways presented, it could be difficult to support that student's autonomy. Students were always informed that free exploration time was an opportunity to work on their journals, but it was never a requirement. Staff members would station themselves at multiple locations on the beach so that students could explore freely in different areas. This freedom of exploration was meant to give students time to explore their own ideas and curiosities.

Parts were informed by research into the current frameworks and methods employed by outdoor educators. The classes took place outside and in a specific environment each day. Students were given a chance to explore the beach at SPMC and were encouraged to keep a journal on the sights, feel, smell, and sounds of the environment around them.

Badges were used as a form of encouragement for students to try methods of nature journaling that they might not have been familiar with. Badges are a form of extrinsic motivation which, according to SDT, are less likely to lead to deeper learning, and can even undercut intrinsic motivation if overused (Deci & Ryan, 2008). However, the badges were offered as an option, which is supported by SDT's ideas focusing on choice. Badges were not required, and it was still the student's choice to participate in the badge-earning portion of the program. The purpose of merit badges in the BSA are to introduce scouts to new potential interests and career paths. In a similar way, I hoped the badges in my program would give the students a chance to find new methods of self-directed learning that might be in line with their interests and values.

Evaluation

As was discussed earlier, students in this program could explore the beach on their own and were not given specific lessons on the local beach itself. This means that any change in a student's perception of the beach would be based on a student's own self driven observations of the space provided to them, in this case the SPMC beach. This opportunity to explore the beach freely derived from the SDT framework. However, we must ask the following questions: A) Does SDT based programming motivate students to explore their environment and pursue further knowledge of their local ecosystems? B) Without lessons specifically tied to local Washington beaches, can students gain a better understanding of their local beaches through self-driven exploration alone? In this evaluation there was no comparison group, and thus it is not possible to answer these questions about the causal effects of the program. Pre- and post- responses, however, did provide data that that can be examined to see if such outcomes are associated with participation in the program.

The evaluation methods were qualitative and in part followed others' technique of using children's drawings as a window onto what they have learned. One challenge in working with a younger audience is that they do not always like answering questions or do not have the language or technical knowledge to express their full views on nature or the outdoors (Barraza, 1999, Lewis, 1983, Chambers, 1983). To make working with children easier, some researchers have started using students' drawings to gauge environmental concepts and attitudes (Myers, Saunders, & Garrett 2004, Barraza, 1999, Aaron & Witt, 2011; Jose, Patrick, & Moseley, 2017; Alerby, 2000; Cainey, Bowker, Humphrey, & Murray 2012; Bowker, 2007).

Like Jose and colleagues (2017), the evaluation for the present program compared pre- and post-program surveys. To avoid collecting identifying information, however, data from all subjects in a given week were pooled and compared during the Beach Investigators program. Thus, only speculations about changes in group aggregate perceptions are possible in this evaluation. While not very definitive such results could potentially disconfirm the hypothesized program effects

Prior to the first lesson of each week, students were asked to fill out a survey (appendix B). Within the survey, students were asked questions about how often they go to the beach, what they like to do at the beach, and to draw a picture of the beach. Post-survey questions focused more on experiences in the program itself. This includes how interested students were in intertidal study, keeping a nature journal, and how much fun they had during the program.

The surveys were turned in anonymously. After the week concluded, students were asked to complete a second survey (appendix C). These surveys were also turned in anonymously. At the Shannon Point location, I collected 17 pre-surveys, and 15 post-surveys. At the Sedro-Wooley location, I collected 24 pre-surveys, and 22 post surveys.

Each drawing was assigned an alpha-numeric code. Each administration of the surveys received a different letter. For example, Shannon Point pre-surveys and post-surveys were coded as A and B respectively. Sedro-Wooley pre-surveys and post-surveys were coded as C and D respectively. Each picture's letter was followed by a number, which started at one and ran through the total number of pictures in each lettered group.

To understand the influence of the curriculum, a list of categories was created based on the materials covered in the Beach Investigators curriculum, as well as notes I had taken during

the program. This includes the animals the kids saw on the beach, features of the beach that the program took place on, self-driven activities the kids participated in during free exploration time and the lesson plans. Using both the emergent categories and the curriculum-based categories, I developed the list of categories to be used for coding (Table 2). A more detailed description of how these categories were coded can be found in the appendix (Appendix D).

Table 2: Coding Categories

Category	Definition
Water	Includes the various ways in which students have depicted the ocean.
Beach	Includes land such as sand, rocks, or cliffs.
Rocks	Includes both the presence of a rock covered beach, as well as individual rocks.
Conifer Trees	Includes trees that resemble conifers such as Douglas firs or cedar trees.
Drift wood	Includes logs or sticks that appear on the beach.
Sea Weed	Includes depictions of seaweed both on the beach or in the water.
Crabs	Includes animals that appear to have shelled bodies, and claws.
Anemone	Includes both open anemones in the water and closed anemones on the beach.
Sea Stars	Includes star shapes located in the water and on the beach
Boats	Includes Sail boats, barges, ferries and coast guard ships.
Labels for animals	Includes any instance in which a student has chosen to label an image with a specific biological kind.

A few issues confront this evaluation. One area that could be investigated closer is how the program affected students of different ages. I neglected to have a question regarding age or grade in the pre- and post-week surveys. I suspect based on observations throughout the week that this program engaged students of different age groups effectively. But with the data I have,

there is no way to know. In future evaluations, this question could help me improve the program for certain ages, or identify age ranges with which the program has been more successful.

There is a second weakness relates to the way in which students were able to fill out the survey. Students could sit next to each other and may have looked at neighbor's drawings for ideas on their own. In retrospect, more separation of the students during the administration of the survey would have led to more reliable results. I was also present in the room while students filled out their surveys, which may have had an influence on how they responded. Third, I am both the instructor and the evaluator of this program, and for that reason may carry my own bias in the evaluation process as it is in my best interest for the program to have gone well, and to have a positive evaluation. To my best possible ability, I have worked to makes sure this bias does not influence my data.

My sample size for all groups was small. This is a consequence of the small-scale nature of the program. Because of the small sample size, we cannot generalize on SDT's effectiveness outside of this program. However, a small sample size should not be used to discredit the data entirely. Qualitative data can still be useful to understand how this program may have influenced my student's understanding of the intertidal zone. In this way, the evaluation serves as a formative evaluation for this programs first year to see what improvements could be made to future versions of the program. While this design does not allow me to make generalizations about the populations these students are from, the data is still useful for understanding and improving upon the program with the data I have gathered.

Results

The results of this evaluation are presented in a qualitative manner. Each section addresses one of the specific categories mentioned in Table 2, if that category was present in that groups drawings. It is important to remember that there were strong differences between the SPMC and the Evergreen Elementary groups including age, location, and duration. Because of these differences, it would be inappropriate to evaluate these two groups as one cohesive unit. For these reasons, the groups have been evaluated separately.

Anacortes Group

- **Questionnaires**

In the 17 pre-week surveys, four students reported that they went to a beach less than once a week, nine students reported visiting the beach once or twice a week, and four reported visiting the beach more frequently than that. This high frequency of beach visits could be attributed to the fact that Anacortes is an Island community, and that some of the students in the program may live within walking distance of a beach, or on the beach itself.

In the post-week surveys, 12 students indicated that they were more interested in intertidal study, with six stating more interested, and six stating much more interested. Students appeared to be less enthusiastic about nature journaling, with six stating they were more interested, two stating much more. All students indicated they had fun, with 13 choosing the response “very fun.” Out of all the students, only two of them stated they would not recommend the program to a friend.

Table 1: Number of Occurrences of each Category in Student Drawings

		Water			Beach				Trees and Plants					Animals					Boats			Other			Perspective			
		waving line	cornered waves	context	sand	rocks	Tide Pools	Islands	palm tree	conifer trees	other tree	Driftwood	Sea Weed	Sea Stars	Crabs	Fish	Barnacles	Sea Anemone	Sail Boat	Military Ship	Barge	Labels	No water	No Beach	Water to land	Land to Water	Top Down	Cross Section
Shannon Point	Pre-Week	10	6	11	10	10	1	2	1	1	2	3	5	11	8	7	2	0	4	1	1	5	1	1	1	12	2	2
	Post-Week	9	2	6	5	9	1	1	0	2	0	1	3	5	5	4	2	1	2	1	0	5	2	3	4	2	4	3
Evergreen Elementry	Pre-Week	16	3	16	14	7	2	2	5	0	2	0	6	6	4	15	0	1	2	0	1	1	1	5	2	8	2	5
	Post-Week	14	2	3	0	20	0	0	0	1	3	3	8	0	16	2	4	9	1	0	0	13	2	0	0	4	10	7

- **Water**

Out of the 17 pre-week drawings, 16 contained water. Of these 16 drawings, 11 of them showed animals or a boat in the water (see figures 1 and 2). Ten of the drawings that included water had animals located in the water. Most of these animals included fish, and 5 of those drawings showed other animals, including sharks, seals, and marine mammals (see figure 1).

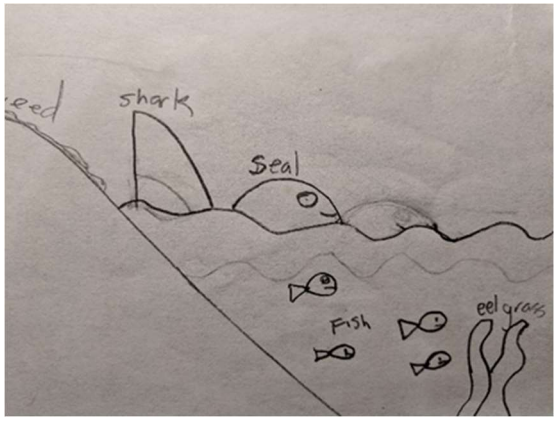


Figure 1: Animals in Water

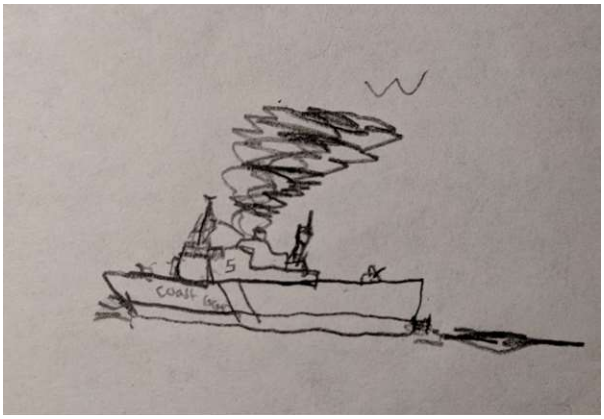


Figure 2: Boat in Water

Out of the 15 post week pictures collected, 13 contained water. This time, only five of the pictures that contained water also had animals located in the water, but three of those drawings did contain more species than just fish, including whales, an orca, and an otter. Because this program chose to focus on the beach itself rather than the underwater environment, students may have focused less on underwater animals in their post drawings.

- **The Beach**

Sixteen out of 17 of the pre-week drawings included the actual beach itself, with one outlier focusing on an underwater scene. Six of the drawings contained sandy or non-rocky beaches (see figure 3). Ten of the pictures depicted the beach as being covered in large rocks (see figure 4), which is a common sight in the pacific northwest. Three of those pictures depicted

scenes that displayed how these rocks serve as a habitat for barnacles, sea stars, and crabs (see figures 5 and 6).

Figure 3: Sandy Beach

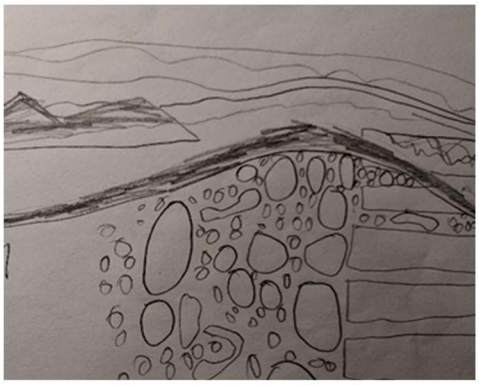


Figure 4: Rocky Beach

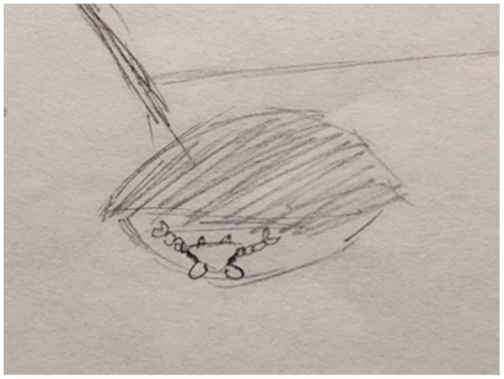


Figure 5: Rock as Habitat for Crab

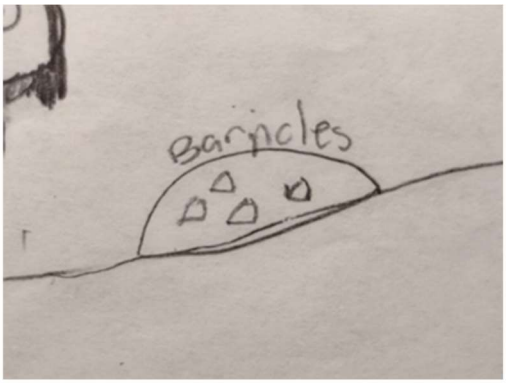


Figure 6: Rock as habitat for Barnacles

In the post week pictures, 13 out of 15 of the drawings included the actual beach itself. This time, only 4 of the pictures did not feature rocks on the beach, and only two the pictures focused on sandy beaches. The remaining 9 pictures featured rocky beaches. Three of those pictures depicted the beach as transitioning from sand, to rocks, to trees the further you got from the water (see figure 7). Four of the drawings depicted how rocks can serve as a habitat for animals such as anemones, sea stars, barnacles, crabs, and other species (see figure 8).

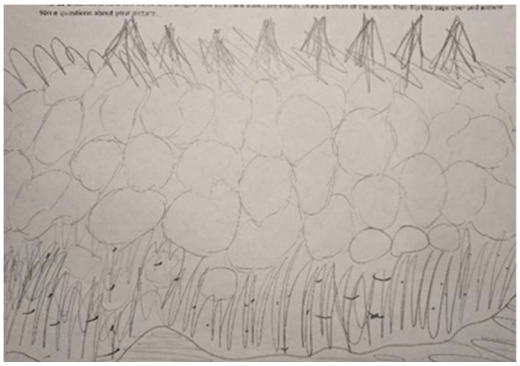


Figure 7: Beach transitioning from water, to rocks, to trees

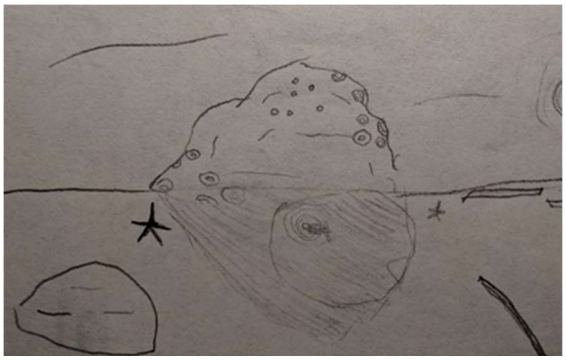


Figure 8: Rocks as habitat for animals

- **Trees**

In the Pre-week drawings, three include trees. One of the pictures contains a palm tree, and one of the pictures contains a conifer tree. Two of the three drawings contain a broad-leafed tree. Each drawing only includes one of each type of tree. Three of the pictures included driftwood.

In the post-week drawings, only two pictures included trees. Both drawings depicted conifer trees. Both drawings placed the conifer trees in appropriate locations on their beaches. One of these drawings depicted a fort some of the students had created out of branches they had found from the trees. Only one post week drawing included driftwood.

- **Sea Weed**

In the pre-week drawings, eight students included seaweed. Four of these student's places seaweed in its correct location on the beach. These depictions included both larger kelp species floating in the water (see figures 9 and 11), as well as smaller alae species growing on rocks where they can be exposed at low tide (see figure 10).

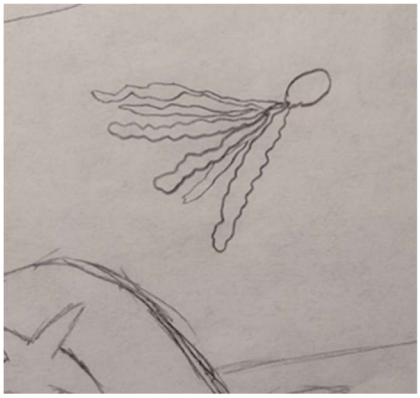


Figure 9: Seaweed Species Floating in water

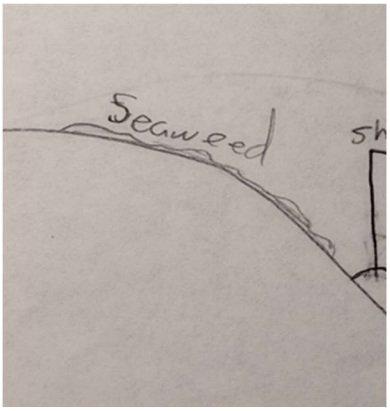


Figure 10: Seaweed clinging to rocks

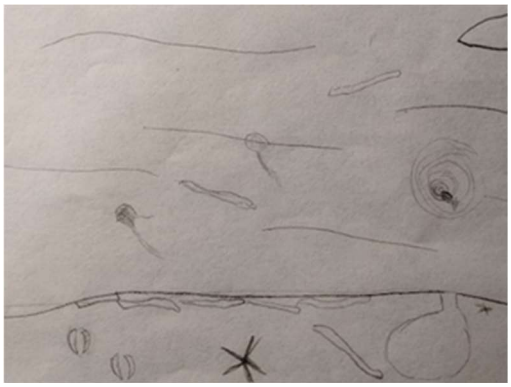


Figure 11: Bull Kelp in water

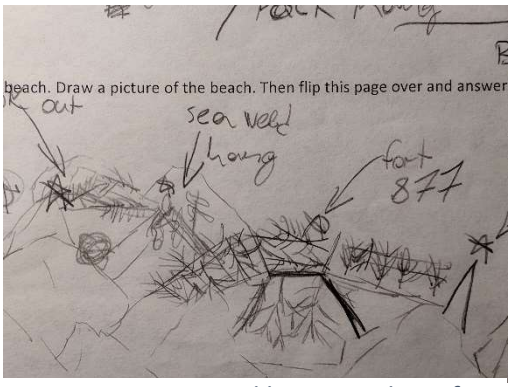


Figure 12: Sea Weed being used in a free time activity

In the post week drawings, only six students included seaweed. Three of these students included detail or a label, and placed seaweed in its proper location. The decline in the number of pictures that include seaweed is surprising considering how frequently it was encountered on the beach. There is a possibility that students began to avoid walking on the seaweed due to it being a slipping hazard, and limited their exposure to the seaweed species. One drawing did feature seaweed being used during a free time activity (see figure 12).

- **Crabs**

In the pre-program drawings, eight students included crabs in their pictures. Out of these eight pictures, seven of the pictures included detailed crabs with identifiable legs and claws. The remaining picture did not include a crab with easily identified legs and claws, but identified the

image as a as a crab by a written label. While all the pictures showed crabs in places they can be found, five of the drawings included the crabs with detail, and placed the crabs on the shore of the beach (See Figure 1 for example).

In the post drawings, there were only five pictures that included crabs, marking a reduction in the total number of pictures that included crabs in their drawings. four of those pictures showed the crabs with identifiable legs and claws and in the correct location on the beach. Crabs were, by far, the most commonly seen animal on the beach.

- **Anemone**

No students included anemone in their pre-week drawings. Only one student included the anemone in their post week drawing, and placed the anemone correctly in its habitat. The anemone in this picture were drawn in the closed state that they enter when the tide is low. The drawing showed good observation skills and understanding of the anemone's behavior.

- **Sea Stars**

In the pre-week drawings, 11 of the drawings included sea-stars. However, the pictures all depicted sea-stars as located on the beach, exposed to the sun (see figures 13, 14, 16) when

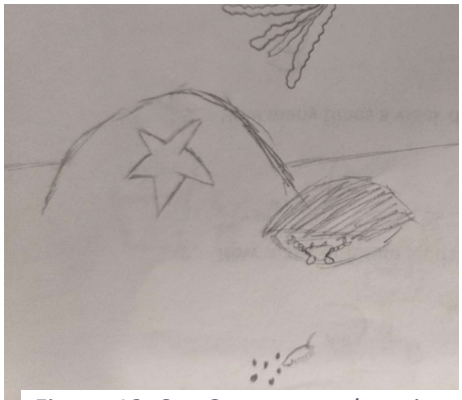


Figure 13: Sea Star exposed to air on rock

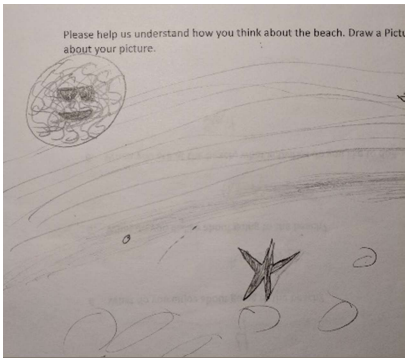


Figure 14: Sea Star exposed to sun

sea-stars typically retreat to deeper waters, or hide in shady crevices during low tide. Only five of the pictures placed sea-stars on rocks where that kind of habitat may be found.

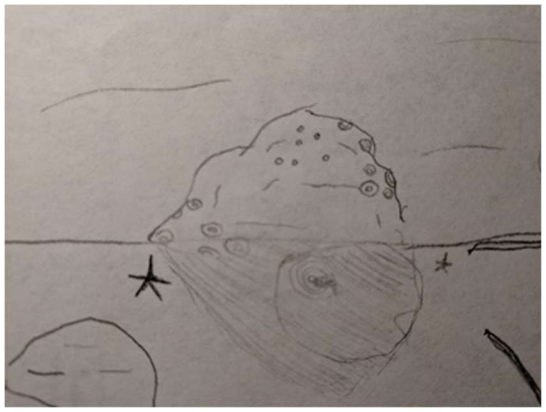


Figure 15: Sea Star near a rock

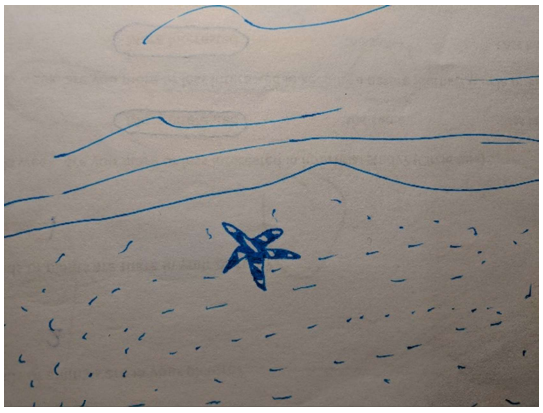


Figure 16: Sea Star on beach exposed to sun and air

In the post week drawings, only five pictures included sea stars. Of those, only one placed a sea-star on a rock (see figure 15), and one placed the sea-star in an underwater environment. While sea-stars were frequently observed in Shannon points touch tank, they were not seen frequently on the beach. In this case, a reduction in the amount of sea-stars may be seen as the pictures resembling the beach at Shannon Point.

- **Coast Guard Ships**

Only one pre-week and one post week drawing included Coast Guard vessels. The pre-week drawing featured the Coast guard vessel along side another type of boat. The picture is well detailed and shows some prior knowledge of coast guard ships (see figure 2).

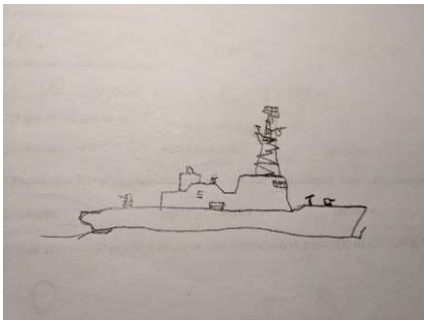


Figure 17: Detailed Coast Guard Ship

The post week drawing of a coast guard ship featured only the ship, with no other boats, or beach (see figure 17). The boat is well detailed. On the survey on the back of the drawing, the student has written “80 in ship” in response two “How

many kinds of animals are there in your drawing?" This shows that at least one student appreciated the beach because it gave them an opportunity to observe Coast Guard ships, for which they have a previously established interest. It also shows that not all students focus on the natural aspects of the beach environment.

- **Perspective**

The perspective of the beach that students drew was also counted categorized and recorded. In the Anacortes group, the most popular perspective for the pre-week drawings was water viewed from land. There were 12 drawings that featured this perspective, and only 5 that featured other perspectives.

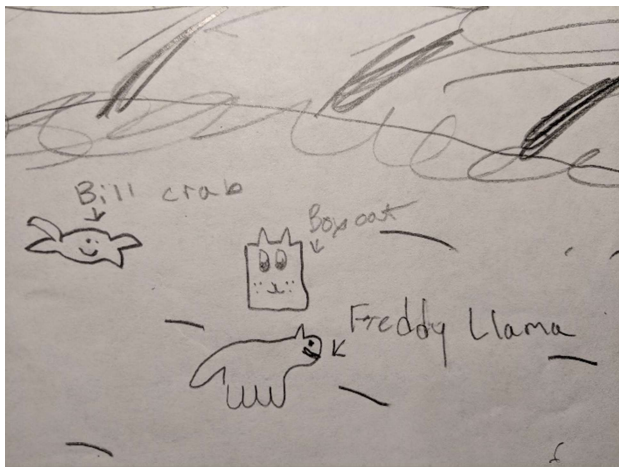
In the post week pictures, students diversified. Only two continued to feature a land to water perspective, with four choosing to do water to land, four choosing to use a top down view, and three drew a cross section of the intertidal zone. This shows that through the week the students may have become more comfortable drawing things in new and different ways. Their time to explore the beach and the lessons that they participated in may have helped them to see the beach in a way that made more sense to them or was easier to draw.

- **Labels**

Pre-week pictures included five drawings with labels used in them. Three of those drawings used the labels to correctly identify animals, plants, or other environmental features such as rocks or water. Only one of the drawings labeled more than one animal (see figure 1). There was one picture that labeled creatively interpreted animals with creative names.

Figure 18: creatively named animals

In the post week drawings there were five that included labels. The same amount of pictures contained quality labels for animals or environmental features(see figure 19), although one contained no animals. One drawing contained labels used to point out specific activities that student had engaged in throughout the week (see figure 20). Overall, there does not seem to be a major change in the use of labels for this group.



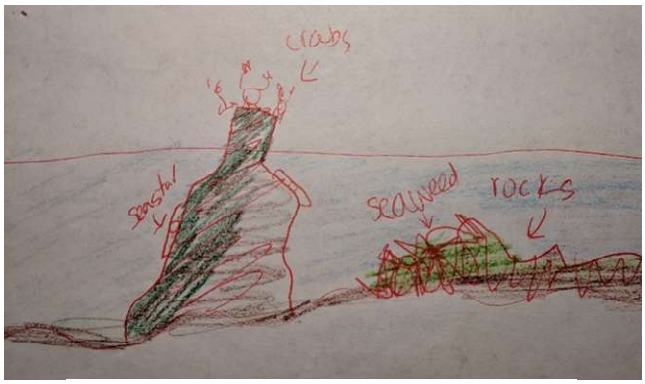


Figure 19: Labels used for animals

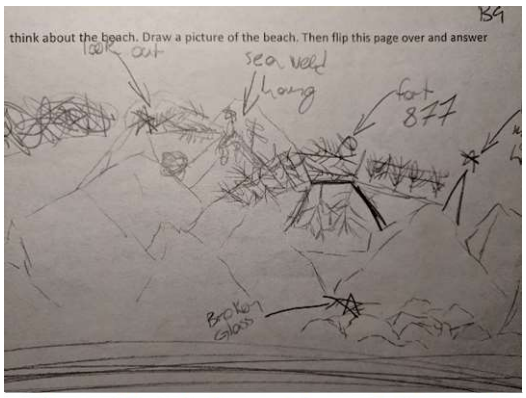


Figure 20: Labels used for activities and other beach features

Sedro-Wooley Group

- **Questionnaire**

In the 24 pre-week surveys, 19 students responded that they visit the beach less than once a week, with at least two students stating they had never visited a beach. Four of the students reported visiting the beach on a weekly basis.

In the post-week survey, 16 of the students indicated they were more interested in intertidal study, with five choosing “more interested,” and 11 choosing “much more interested.”

Students also seemed enthusiastic about nature journaling with five choosing “more interested” and 10 choosing “much more interested.” All students reported having fun, with seven choosing fun, and 15 selecting “very fun.” All students said they would recommend the program to a friend.

- **Water**

Of the 24 pre-week drawings, 23 depicted water. Nineteen of those pictures contained aquatic animals in the water (see figure 21), and nine of those showed detailed animals that were in their proper habitats (see figure 22). Fifteen of the pictures contained fish, which was by far the most common animal shown. Sharks, Dolphins, Whales, and sea turtles were also shown.

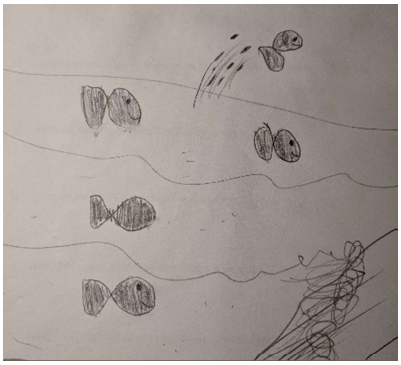


Figure 21: Fish depicted in water

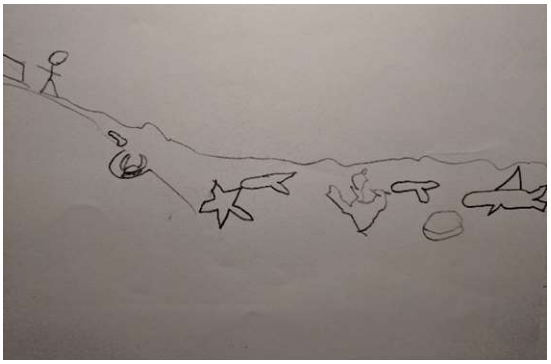


Figure 22: Various animals in water

In the post week drawings, nineteen included water, and only three placed fish in the water. No other animals were depicted as being in the water. It seems like students chose to focus on the features on the beach that they could observe for themselves. Also, the beach survey activity likely caused children to focus on the terrestrial aspects of the beach rather than the aquatic animals.

- **The Beach**

In the pre-week drawings, 13 students chose to use sand as the substrate for their beach (figure 25), and of those pictures, four students chose to include rocky features as well as sand. Only two pictures had beaches that were completely rock covered or cliff like (figure 23). Its

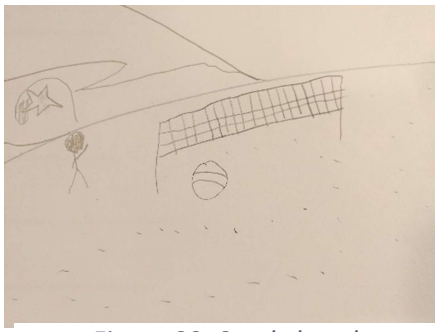


Figure 23: Sandy beach

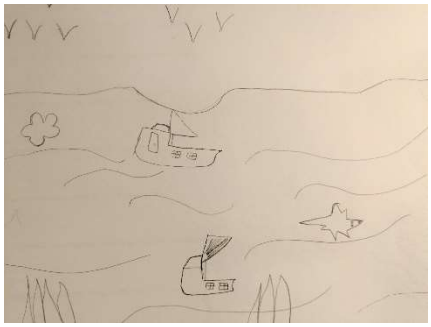


Figure 24: No Beach Present

Figure 25: Rocky Beach

possible that most students recognize the beach as a sandy place due to television, and other forms of media. seven of the pre-week drawings didn't include a beach, and instead focused entirely on water (figure 24). One reason for this could be that some students focus on the aquatic features of a beach and see them as separate from nature on land.

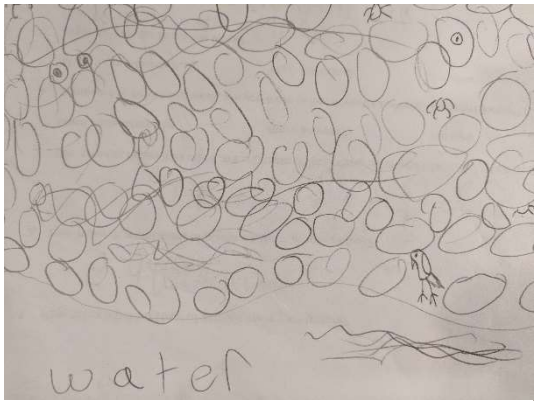


Figure 26: Rock Covered Beach

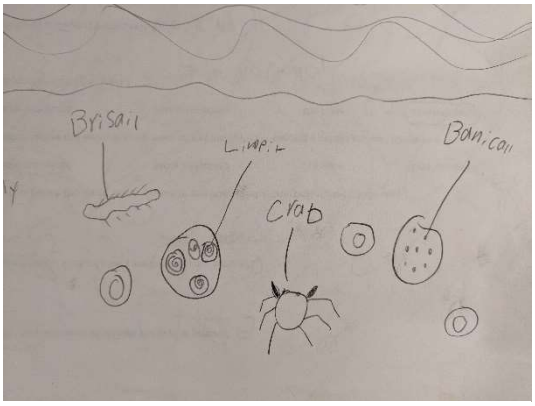


Figure 27: Rocks as Habitat

In the post week drawings, 20 of the pictures included rocks. While two of the pictures featured rocks as being present on the beach, the remaining 18 pictures depicted beaches that were covered by rocks (figure 26). This shift from sandy or no beaches to almost exclusively

rocky beaches indicates that students drew beaches more like the beach at Shannon Point in their post drawings. 11 of these pictures showed that students understood how rocks on a beach can provide habitats for crabs, anemone, and barnacles (Figure 27).

- **Trees**

In the pre-week drawings, there are five occurrences of palm trees (figure 28), and two other broad leafed trees. This is likely due to the influence of media portrayals of beaches or vacations with family, which may have shaped the way some of these students see the beach. Palm trees are not native to this local area, and are unlikely to have been observed here.

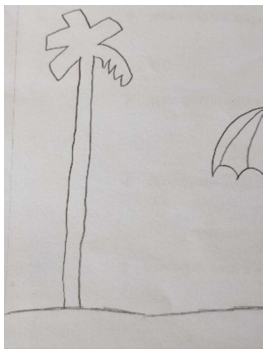


Figure 28: Palm Tree

The post week drawings feature no palm trees at all, which may show that the students have a better understanding of the local plant life in their area after the two week program. Also, two drawings contained broad leafed trees, and one drawing contained conifer trees (figure 29), types of trees which do occur naturally in this ecosystem. This does mark a reduction in the amount of trees drawn, which may be because students chose to focus on the rocky beach surface, which they had explored earlier just before taking the post week survey.

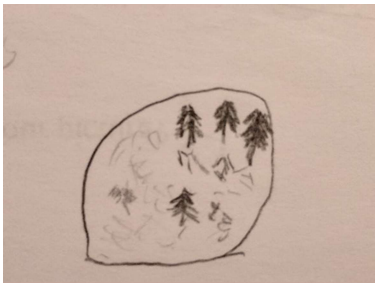


Figure 29: Conifer Trees

- **Seaweed**

Five of the pre-week drawings contained Seaweed or other aquatic plant life. Four of those drawings depicted the sea-weed in the water, usually growing off the ocean floor. Two of

the drawings depicted seaweed that had washed up on the beach, although one of the drawings seemed to portray the sea-weed as a snake pretending to be seaweed.

Eight of the post week drawings contained Seaweed, and of those eight, six of them depicted the beach as being mostly covered by seaweed (figure 30), like the beach at Shannon Point while the tide is low. This increase in the amount of seaweed, as well as the change in how the seaweed was depicted is likely due to the beach survey activity which showed students how much seaweed covers the rocks on the beach at low tide.

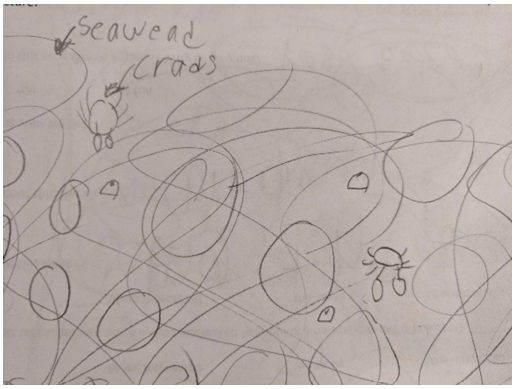


Figure 30: Seaweed Covering Rocks

- **Crabs**

Only four of the pre-week drawings contained crabs. Two of the drawings placed the crabs inside tidepool habitats, and one placed the crab on a sandy beach. One picture depicted hermit crabs, identified by shells (figure 31). This hermit crab was placed on a sea floor.

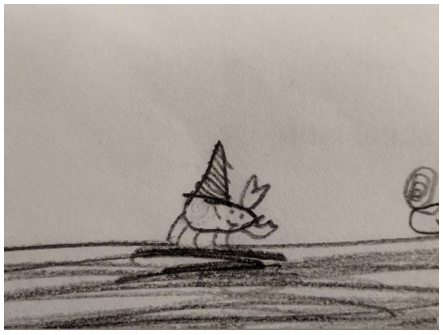


Figure 31: Hermit Crab

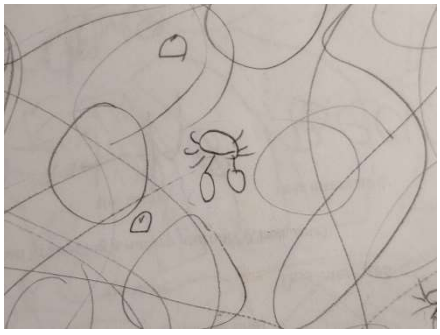


Figure 32: Crab among rocks

Sixteen of the post-week drawings contained crabs. 13 of these pictures placed crabs among the rocks on the beach, like how the crabs can be found on Shannon Points beach (figure

32). The marked increase could be associated with how many crabs were observed during this groups beach survey. During the beach survey, crabs were the most frequently observed animals found on the beach.

- **Anemone**

Only one pre-week picture contained a sea anemone. This student placed the anemone in a tidepool, which is a proper habitat for this species (figure 33).

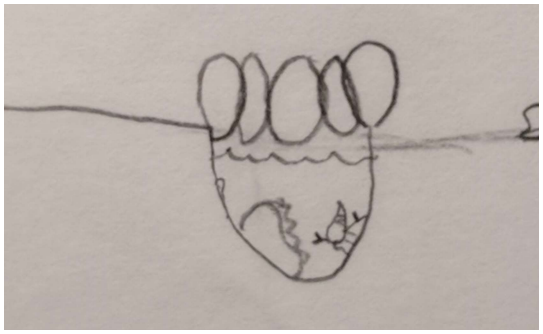


Figure 33: Anemone in Tide Pool

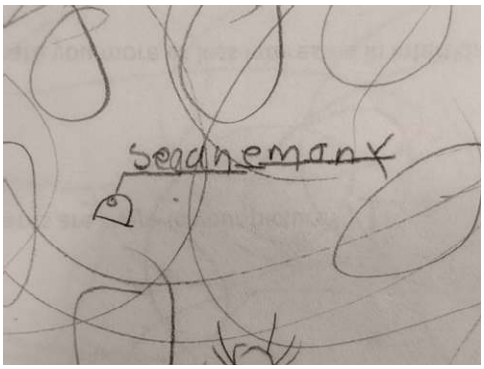


Figure 34: Anemone closed on beach

In the post week drawings, eight different pictures included sea anemones. All eight pictures portrayed the anemones exposed to air and closed on the beach (figure 34). While anemones are frequently seen in tidepools, they can also be seen in this closed state at low tide. It is likely that by participating in the beach survey activity, students may have learned new ways in which these animals can be found, and how they survive during low tide by closing up and saving moisture.

- **Sea Stars**

Six of the students in the Sedro-Wooley group included sea stars in their drawings. Three of the drawings depicted sea stars completely in the water, and three depicted them out of the water on rocks. Sea stars do not commonly place themselves on rocks during low tide due to the risk of sun exposure and drying out. While it seems all six of the students recognized sea stars as

an aquatic animal that can be seen at the beach, only half of them understood what it is sea stars need to live.

None of the post week pictures included sea stars. No sea stars were observed on Shannon points beach during the beach survey activity. Once again, this shows that the students focused their post drawings on what they learned at Shannon Points beach during the beach survey.

- **Perspective**

While land to water was once again the most popular perspective in the pre week drawings, there was some diversity in the Sedro-Wooley group. There were also 5 cross sections that students drew and submitted.

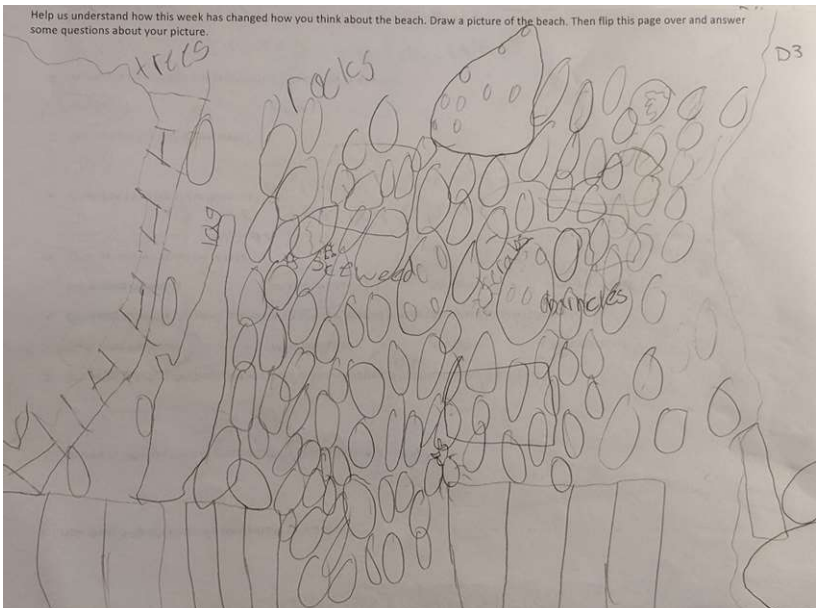


Figure 35: Top Down View of the Beach

In the post week drawings Sedro-Wooley students favored the top down approach (figure 35), which 10 students choosing to use this perspective. This is likely due to the students having just participated in the beach survey activity, which involved sketching quadrats in a top down point of view. This is also supported by the fact that four students chose to include the quadrat activity in their drawings (figure 36). Once again, the post drawings featured seven cross section beaches. Based on how cross sections were favored in the pre-week drawings, it is likely that other factors for this group led to the high amount of cross sections rather than the influence of the Beach Investigators program.

- **Labels**

Only one of the students used a label for the pre-week pictures. This picture depicted characters from a popular children's movie, and each character, as well as a depiction of the student themselves, was labeled appropriately (figure 37).

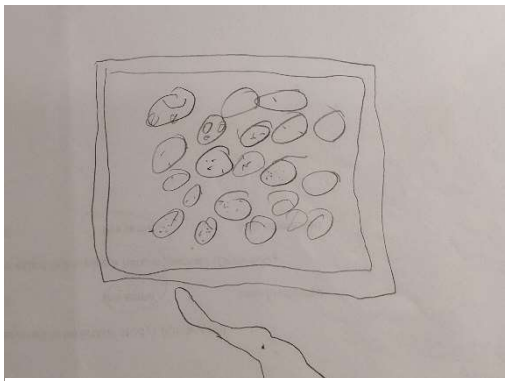


Figure 36: Quadrat from Survey

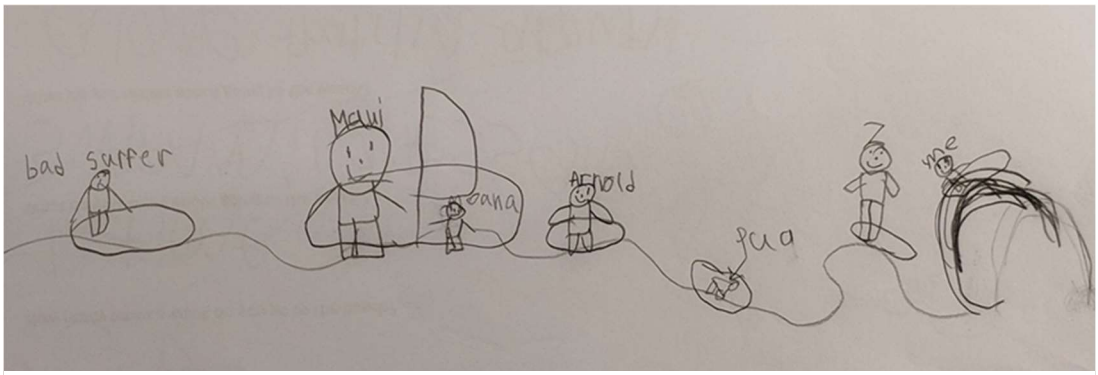


Figure 37: Movie characters labeled

Thirteen of the post week drawings contained labels for the animals in the picture. One of the pictures contained a depiction of the student who drew it which was labeled as themselves. The other 12 used labels for animals that they had placed on their beach (Figures 27, 30 and 34).

Labels were encouraged during lessons in sketching as ways to clarify what a sketch was if a student was not as confident in their artistic abilities. The large increase in the amount of students that used labels shows that information from the nature journaling lessons was retained. Unlike the beach survey activity which took place on the same day as the post week survey, the sketching lesson happened a few days earlier in the program.

Discussion

Because of the variation between the ways in which the two version of this program were run, comparisons between them would likely not reveal any realistic conclusions. Instead, each program version is discussed separately in their own section below. Other student feedback expressed in the surveys is also addressed.

Shannon Point

In surveys, the Anacortes students reported that most of them visited the beach on a weekly basis. Because of this, these students were already familiar with local beaches and were likely to already have knowledge of local beaches. It is also important to remember that many of the students in this program had previously participated in programs at Shannon Point and were familiar with the location. There were even some pre-week drawings that included specific features of the beach at Shannon Point.

The Anacortes group showed small amounts of knowledge gain, as observed in their pictures. The overall difference between the pre and post week drawings was small. Most categories showed a reduction in the number of occurrences from pre to post-week drawings. This is encouraging in categories like sand or sea stars which were rarely observed on the SPMC beach. But it is less encouraging for categories like crabs, barnacles, and seaweed, which were frequently observed. If student driven exploration were to lead to a better understanding of the ecosystem at SPMC, I would expect to see these animals appear more frequently in the post-week drawings.

One of the most interesting results is how students diversified the perspectives of their post-week drawings. Almost all students chose a land to water perspective in their pre-weeks, but

there was a more even spread of perspectives in the post week pictures. It could be that as students were encouraged to explore the beach in a way that was meaningful to them, they found new ways of looking at the intertidal zone. It is also possible, though admittedly speculative, that the program de-centered the students from a land based perspective to one more like the world that they had been immersed in. Though the data from this evaluation cannot assert that this is what happened, it could be worth further investigation in future research.

The results to not indicate that SDT programming lead to a substantial increase in ecological knowledge for the Shannon Point group. However, it is important to note that the pre-week drawings were already fairly like local beaches, and in some cases, the beach at Shannon point. Many of the participants in this program had either participated in other Shannon Point education programs or were children of employees at Shannon Point. Also, this group of students live mostly in Anacortes, which is located on an island small and undisturbed enough for shorelines to be frequently encountered. These factors may have contributed to some pre-existing knowledge about the ocean, the intertidal zone, and the location of Shannon Point itself.

In the post-week surveys, most students indicated that they were more interested in intertidal study, and about half the students indicated that they were more interested in nature journaling. All students indicated that they had fun during the program. Based on this information, I believe most of the students had a positive experience during the program. It would also seem that while SDT based programming did increase students' motivation to learn about local ecosystems, as well as continue exploring their environment through the use of a nature journal in the short term.

Sedro-Wooley

Sedro-Wooley pre-week surveys indicated that many of the students had visited a beach on less than a monthly basis, with some indicating only visiting the beach once a year, and some having never visited a beach at all. This is most likely because the school is further inland, and beaches are not as easily accessed, but could also be due to factors such as income, demographic, or family background. Because of this, these students may be more likely to have had initial conceptions of the beach based on school and media sources rather than firsthand experience.

The Sedro-Wooley Group showed a greater increase in knowledge based on the drawings. The post-program pictures displayed more local ecosystems, and less misconceptions. There was a large reduction in the number of sandy beaches, and an increase in the number of rocky beaches. While some of the pre-week pictures included palm trees, none of the post-week pictures contained palm trees. It is also clear that the beach survey activity had an impact on their post week drawings as well. There was an increase in the number of crabs, barnacles, and anemones, as well as a decrease in the number of fish. Many students may have chosen to focus on the animals that they were able to observe during their time at the beach. Also, most of the students chose to focus on top down perspectives for their post-week drawings, which are similar to the types of sketches they made during the beach survey activity. Students were not required to sketch the beach in this way, though it was suggested as part of the activity.

This group's residential distance from the beach may have contributed to their misconceptions about the beach. Students in this area likely rely on media and school for information about the beach. Based on the drawings, they walked away from this program with better understanding of intertidal ecosystems closer to home. These results support the idea that

SDT based outdoor nature programming and self-driven exploration of an environment could be associated with increased ecological knowledge.

In post week surveys, most students indicated that they were more interested in both intertidal study and in nature journaling. Along with this, all students indicated that they had fun and would recommend the program to a friend. Based on this, the students in the Sedro-Wooley program had a positive experience during the program. Also, these results indicate that SDT-based programing fostered intrinsic motivation for students to continue exploring their environment in the short term, as would be predicted by SDT.

Other Student Feedback

Students did have some comments that hint at ways the program could improve. For one, the trails and conditions on the beach are not maintained for constant traffic. The beach itself can be slippery and has sharp rocks or shells. To ease travel from one section of the beach to another, there is a trail available. However, this trail is not frequently maintained or traveled. While many of the students didn't seem to mind the slight overgrowth, some students had grass allergies, which made the trail unpleasant for them. It would be a good idea before running the program again to clear this trail and make it easier to walk on.

Students from Shannon Point also indicated that the day was long or that it started too early. This is a difficult issue to maneuver because parents appreciate certain start and end times that are coordinated with their work schedules, or other activities the students participate in. Half day programs at Sedro-Wooley seemed more in tune with student's attention spans, however, it is important to remember that at Sedro-Wooley, students were younger and were provided with a

different setting for their program. There is no guarantee that shortening to a half day program at SPMC would have the same effects as it did at Sedro-Wooley.

One idea that has been discussed amongst SPMC staff since my programs conclusion is to have students walk to Washington Park, a local State Park just outside SPMC's property. At Washington Park there are fields that students could run and play in, while still having access to intertidal systems. This would allow for more diverse free activities during the afternoon and would restrict lecture time to the morning. My hope is that this type of activity will act as an intentional break or recess and reduce possible lethargy from so many lessons, and that it may provide students with more time for social interaction, which can promote aspects of SDT.

One of the exciting parts about working at Sedro-Wooley was the wetlands available near the school. However, with only a half day, getting there and back while staying on schedule seemed strenuous for some of the students. Some students had trouble keeping up with the group if they were not used to long walks. On top of this, I observed that students who were falling behind became discouraged when teachers would tell them they needed to catch up with the group.

Future Program Recommendations and Conclusions

There were some challenges between this program and the full implementation of SDT based programming. For one, students were required to attend all lessons, including ones they may not have been interested in. One way to possibly alleviate this issue would be to create activity groups where students are invited to participate in one of the activities presented in the lesson plan over the course of multiple days. This way, students are still presented with tools they can use to explore their surroundings but are offered the choice to explore an activity they like. Each day, the teachers would guide students through one aspect or part of a skill or activity, moving into deeper lessons each day. If students wanted, they could choose different groups each day, but continue with one if they had a passion for it. This implementation would require a larger staff that can teach each activity effectively.

In the future, this type of work could investigate how the autonomy supportive environment can be catered to help internalization of environmental values. Because students are participating in an autonomy supportive program, SDT has the potential to teach students environmental behaviors that could be internalized and carried beyond the scope of the class. There is also the added factor of community. Students in this program often formed groups and made friends. They also had multiple opportunities to engage with a mentor who was knowledgeable on the environment they were exploring. This small social community can also contribute to internalization as students change their ideas to fit more with their peers, and a mentor can encourage specific ideas that are related to environmental action. The evaluation of this program did not investigate this line of thinking deeply, making this suggestion mostly speculative. But future research could show that this method of encouraging internalization using autonomy support and community would be beneficial to the larger aims of EE.

Another route future research could address is the use of more value-oriented EE alongside SDT. Students showed during this program that they had the ability to observe and teach themselves about their environment. A potential use of this creative and explorative thinking could be focusing more on environmental action instead of ecological knowledge. As students explore an environment, they could also be encouraged to develop their own conservation projects or practices that they could present at the end of a week-long program. With guidance from a mentor, students could experience the same internalization described above but with pro-environmental behaviors. Again, this is speculative, and this program did not attempt to follow through on this specific type of programing. But it is a potential way future programs could further the goals of EE through SDT based programming.

Recommendations for Evaluation

Earlier in the evaluation section, some weaknesses of the evaluation were discussed. Improvements could be made to the evaluation to address these weaknesses. Collating anonymized pre- and post- responses in the evaluation would allow a deeper look at individual student learning. A strong addition to this programs evaluation would be to survey the students a month or even a year after the program had concluded to measure long term behavior change. Also, recording students age, gender, and other demographic information could allow us to see if SDT based programming effects these demographics in different ways. Also, the survey for Sedro-Wooley was the same as the survey given to Shannon Point. In the future, the surveys could be designed for the specific group currently in the program.

The knowledge gain observed during this program may not be greater than the knowledge gain that students can experience in a classroom setting or in another outdoor - education program. The program could also be run along side a program that teaches similar

material in a widely excepted format. This would allow for comparisons that could say with more certainty if SDT based programming was responsible for the changes in student knowledge. The data my methods generated were useful for establishing a plausible pattern, but the methods themselves were not grounded in SDT. Working to develop an evaluation method that tests for specific outcomes described by SDT would be extremely valuable to understanding how SDT as a learning tool works.

Recommendations for Shannon Point

All around my partnership with SPMC was valuable, as well as critical to this field project. They provided me with a budget as well as a location. Their previously established education programs made finding participants a smooth process. Because they are a dedicated research base, they were also able to provide specimen for students to observe both in existing touch tanks and the microscope lab. The resources provided to me by SPMC would have been difficult to come by had I tried to implement this project on my own. SPMC has to potential to become a valuable partner to Huxley's EE graduate program. They are interested in expanding their education programs and need instructors as well as new lessons. These needs are match up with the needs of some Huxley EE graduate students who may be looking for partner organizations.

The education efforts of this program and the day to day research work that takes place at Shannon Point could be coordinated better. The program was moved to another classroom area midway through the week due to complaints over noise. There was also concern expressed that students could potentially disturb research equipment, or sections of the building that they shouldn't have access to. This issue was made worse by the fact that some students knew how to navigate the building because of previous programs or visiting with their parents. These students

would often complain about not being able to take shorter routes through the building that they knew of. However, once the program had been moved to the second classroom the sense of conflict seemed to lift. The new room was a lecture hall designed for teaching classes that was separate from the main SPMC building. Because it was housed in its own separate building, students could talk freely without being concerned with noise restraints. This room also contained all the technology and teaching resources the previous room had. In the future, I recommend basing most if not all youth education programs out of this room to prevent students from interfering in important research. Students would be able to see just as much of the day to day research in this new room as they were able to in the old room.

Recommendations for Sedro-Wooley

Working in Sedro-Wooley was different than working on the beach itself. First, the intertidal zone theme seemed weaker as time for students to explore the ocean was replaced with more ocean focused lessons. The school does have local wetlands nearby that could become the focus of the program and give students more of a chance to explore an environment close to home. On one visit to these wetlands, some students had difficulty with the long walk. It may seem silly given how close the wetlands are to the school but having a bus to take the students there and back could alleviate some of the time constraints and allow for a more relaxed pace in the park.

Schools provide many advantages including facilities, tools, and sometimes teacher or volunteer staff with whom the students are already familiar. At the same time, this program aims to allow students to explore an environment freely. Children know that when they are in a school, they must follow set rules and listen to recognized authority figures. Many times, students would attempt to hand in papers after an activity, even though they were told their

journals were theirs to keep. Students expect to be graded on the work they have done. This can make the free exploration seem less autonomous. It is possible that small amounts of structure in the activities could help ease the students into more fee exploration. And while badges were offered, other small forms of extrinsic motivation such as stars or stickers could be used to let the students know when their engagement in the program is showing.

Lastly, at Sedro-Wooley, SDT seemed harder to implement. This was not necessarily due to the space or the activities themselves, but more to do with the culture that surrounds the school atmosphere. Teachers seemed less willing to let students wander off on their own if it seemed like they were not engaging in the activities. On more than one occasion I found students discouraged about participating due to a teacher's reprimanding them for not following the rules rather than taking time to discuss the rules and their purposes with the student. The social environment that exists around an individual is a key part of regulating self-motivated behaviors. Social enviornments with rigid structure and pre-existing expectations for work and activities could be detrimental to the idea of self-driven learning and exploration. A short module could be used to help teachers understand what roles they should be playing in SDT-based lessons, and what roles they should be avoiding.

Future Adjustments to the Curriculum

Quite a bit of the curriculum context section (see Appendix A) discusses the idea of flow, which in the end was not as critical to the final version of the project as I had imagined. Flow is difficult to implement in the short span of a week, and this program never fully achieved that goal. In the end, making sure that students had the ability to freely explore and choose they activities that they participated in ended up being a more key aspect of this project than flow. In

future versions of this curriculum, I would change the contextual intro to focus more on the experience of choice and supporting autonomy than on working towards flow.

Conclusion

Overall, participants in both iterations of the Beach Investigators program reported having fun, being more interested in intertidal study, and being more interested in keeping a nature journal. This is encouraging because one of the aims of this program were to help motivate students to explore their local environment. This may suggest that SDT programming does have the potential to develop student motivation for continued exploration of their local environment, which would make SDT a powerful tool for EE. SDT worked great alongside the other theories that informed this program, such as outdoor education and place based education. This is important because EE is an interdisciplinary field, and should never depend on one theory to heavily.

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Appendix A

The Beach Investigators curriculum

BEACH INVESTIGATORS

Summer 2017

Designed by Mark Bryant

Table of Contents

Beach Investigators

DESIGNED BY MARK BRYANT

Introduction

This curriculum is designed to be a 5-day long program for 5th through 9th graders that will encourage students to explore the intertidal zone and related ecosystems of the American Pacific Northwest. The program aims to help students develop their own motivations and desires to explore the natural world around them using gameplay theory and self-motivated learning.

Beach Investigators operates under the imaginative idea that the students are new arrivals to the area and are there researching new animals and plants for the place they come from. They will be encouraged to examine and take notes on species they see, photograph or create sketches, and work on creative projects.

The *Beach Investigators* program uses two overarching and alternating learning modalities. The first half is comprised of guided lessons that introduce students to activities that they can use to learn more about their outdoor environment. The other half of the program is based around free exploration time, during which students will have the opportunity to use the activities they have learned to engage in their own self driven outdoor learning. During this time, there will be staff members on hand who will provide guidance, safety, supervision, and a fun learning atmosphere.

Motivation to learn

One current theory in environmental education explores ways in which students can be motivated to learn, and develop. While extrinsic forms of motivation often succeed in motivating students to participate in activities, research finds that this form of motivation can prove problematic (Darner, 2009). Intrinsic motivation, a motivation that comes from within the student's sense of values and identity, can be more beneficial to growth and ability to learn.

Part of motivational theory also discusses the experience of choice, and how it can support internalization (Deci 2008). Support for experience of choice allows students to select opportunities and lessons that are in tune with their own identities and values. By supporting an experience of choice teachers can encourage a process of internalization where students will incorporate values associated with an activity or social group into their own world view (Deci 2008, Joussarnet 2008). *Beach Investigators* aims to use this to help students develop intrinsic motivation for exploring their natural environments. Through this exploration we hope students will form a more connected relationship with nature.

While the experience of choice supports a student need for autonomy, there is also a need to support a student's sense of competence. Support for a student's sense of competence is also key to the internalization of values and new world views (Deci 2008). Students who are frustrated with the difficulty

of a task will be less inclined to continue that activity. To prevent initial frustration with the activities in the *Beach Investigators* program, each activity is started at a very basic level. Also, there are no grades or assessments of the students products or journals, so that the only standards the students journals need to meet is their own. The staff that is present for supervision will also be available as mentors, to assist the students if they become frustrated with a task. These mentors will include undergraduate volunteers who are from science and art backgrounds who can assist the students in observation and journaling techniques.

Part of this growth and ability to learn is associated with a state of optimal activity called flow (Schweinle, 2009). When someone chooses to participate in an activity that they enjoy, they may also seek out greater challenges in that activity as they become bored with previous experiences. As the participant continues to seek more difficult challenges, they are pushed towards Flow (Csikszentmihalyi, 1990). Flow activity is characterized by tasks that require just beyond the participants current ability, but is not too difficult for the participant to succeed in. When people participate in an activity structured to offer an advancing series of such challenges, they show intense focus and greater growth and learning.

Our program has been designed to introduce new activities and skills to students over the course of a week. During free exploration time they will be given the chance to choose which activities they want to pursue in their free time and practice that skill during the week. Students are encouraged to continue working with and developing these skills through the offering of badges, which are explained in more depth in the assessment section. On Thursday, or the fourth day of the curriculum, a beach survey activity will give students a chance to apply their observation techniques in a new and more complex atmosphere. It is the main theory of this program that presenting the lessons in this way, along with mentorship from staff can promote flow activity for our students.

Our Vision

The aim of this program is to develop a desire for explorative learning in participating students. In a best-case scenario students participating in this program may discover a new hobby or interest through the skills and explorations experienced during their week-long session. It is our hope that these activities will help children form a deeper connection with the natural world around them, allowing for improved relationships with our world's natural environment. We recognize that this vision exceeds the scope of the *Beach Investigators* program. Hopefully, by working to reach the goals stated below, we can contribute in part to these visions.

Goals

Throughout the week-long session, staff members will teach various types of outdoor skills which will enable the students to explore the intertidal zone. The goals for this portion of the course is to introduce the basics of these skills, and for each student to find one or more activities that they wish to pursue during the more unstructured free exploration time.

These outdoor skills and activities have each been designed to work towards one of three goals. The first goal is ecological literacy where we teach students important information on what makes the intertidal zone a unique ecosystem. The second goal is skill building where the students will be introduced to various outdoor activities they can use to explore their environment. The third category is applying these new skills during the beach survey and free exploration time.

Objectives

The common theme to these objectives is to focus on basic understanding, not mastery, of the skill. The objective of each lesson plan will be to introduce the student to a skill or activity. When it is free exploration time, students will be given a choice as to what activities or skills they might choose to pursue during unstructured free exploration time. The objectives of each individual lesson are summarized below:

The Intertidal Zone: In this lesson students will learn about the unique adaptations expressed by organisms in the intertidal zone. At the end of the lesson students should be able to explain how the adaptations of certain organisms in the intertidal zone allow them to live in a habitat that is both terrestrial and aquatic.

Texture Impressions: Students will learn how to take impressions of rocks, leaves, shells, and more as they learn about recording texture. At the end of this lesson, students will have created 3 texture impressions.

Photography: Students will be shown some of the basics of photo composition. At the end of this lesson students should know the differences between artistic and scientific photography, the rule of thirds, and using lines.

Journaling: In this session staff will demonstrate various ways students can keep notes in the outdoors. We will talk about writing down observations as well as creative writing. At the end of this lesson, students should know what type of journaling appeals to them and have written one journal entry.

Observation: Students will be taught different methods of scientific observation. At the end of this lesson students will know three different methods of observation and will have participated in two observation session. As a part of this lesson students will also name an organism based on their appearance and behavior.

Sketching: This lesson will show students how to focus on clear identifying features and use of labels to create a useful sketch. At the end of this session students will have sketched one organism using identifying features and labels.

Beach Survey: By participating in a beach survey, students will learn how to measure tide levels, and observe the differences between organisms in the different tidal zones. They will make use of what they have learned in the photography, journaling, observation, and sketching lessons.

Indigenous knowledge: The lesson plan for this objective has not been designed yet. We hope work with indigenous groups to design a lesson plan that respectfully acknowledges first nations and indigenous knowledge.

Outcomes

At the end of this program, students should have a basic knowledge of the previously discussed outdoor skills and activities. Students will be given time to explore and practice at least one of these activities or skills throughout the week. The intended outcome of this is that the students might be introduced to the outdoors in a new way that will encourage self-motivated exploration of ecosystems and their relationships with the outdoors. Badges (explained in more detail in the assessment section) will be used

as a way of assessing whether or not students have chosen to pursue any of the activities or skills that have been introduced throughout the week.

Facility and Tools

Shannon Point Marine Center (SPMC) has a mission of educating leaders in science, education, policy, and stewardship through experiential learning that is integrated with marine and environmental research. SPMC is associated with Western Washington University, but offers K-12 programs and opportunities for the public.

SPMC is in Anacortes, Washington and holds 78 acres of wooded area along the south east end of Rosario Strait. The space serves as a biological reserve that protects smalls mammal and bird populations. There is also a freshwater pond on the campus that increases biodiversity. SPMC is an excellent location to host the [Beach Explorers] program due to its access to marine intertidal habitats and other types of ecosystems.

Within the facilities there are labs and indoor teaching space available for use. There are live animals on in labs and in natural habitats for education and research purposes. There are also video recording equipment with some underwater capabilities, and a remote operated vehicle for collecting underwater observations. Opportunities to use underwater observation equipment will allow students in this program to see the terrestrial side of the intertidal zone and make observations of the underwater portion of this ecosystem as well.

Facilities at SPMC include two research vessels. There are also dormitories available which allows for students to stay overnight. For the purposes of this program such accommodations will not be necessary. However, opportunities like this are good to have in case the opportunity for program improvement and growth should occur in the future.

Strong programming that encourages learning in a fun and exciting way will be appealing to both students and parents, the two most important shareholders in any education project. By incorporating this curriculum into their current programming, Shannon Point can gain more business which would allow them to gain more resources for future growth. It is my hope that collaborating with the SMPC will be beneficial to both this program and their organization.

Geography and Place

For the purposes of this curriculum we have chosen to focus on the intertidal zone. This is in part due to the accessibility of the intertidal zone for most age groups and abilities. Another reason for choosing to focus on the intertidal zone is to put a local ecosystem focus on the program. Intertidal zones are a prominent and unique feature in the Whatcom County area. Focusing on an ecosystem close to home will encourage kids to draw from prior knowledge, as well as continue their exploration past the conclusion of the program.

As part of addressing the importance of the space we are in, and as a part of respecting the groups of people that have historically lived in this place, we hope to involve indigenous knowledge in this curriculum. As part of this process we will reach out to local indigenous groups in hopes of collaborating with them to design lesson plans that respectfully acknowledge Indigenous culture. It is our hopes that this

process will help to decolonize the science education that our students are receiving. At this time these efforts are still in progress. The curriculum will be updated to include these lessons and activities at a later date.

Assessment

For the purposes of assessing student's motivation to explore beyond the skill sessions badges will be awarded for completion of certain tasks. These tasks will be extensions of the activities they are taught during the formatted lessons. This might include adding extra texture impressions to a journal, keeping a journal each day, sketching extra pictures, or taking extra photographs.

Students will not be judged on the quality of their work but on the completion of tasks. The emphasis will be on the continued improvement of skills in the future rather than immediate mastery of the skill. Students will be told that they can earn all the badges if they wish, however, they can choose which badges they want to earn. If a student enjoys photography more than sketching, they should be encouraged to work on what they enjoy more. Choice has been linked to support of autonomy, a basic psychological need that supports flow and internalization of values (Darner 2009). Offering students this choice may allow them to focus on their own interests, and develop stronger intrinsic motivation.

Each badge relates to one of the activities that the students have participated in during the week. After the activity is concluded, if the students wish to continue these activities during their free exploration time, they will be rewarded with a badge. The Badges available are:

Available Badges for Beach Investigators

- Texture impressions
  - Complete 10 total texture impressions
  - Take notes on what you are making impressions of so you can keep track of them later
- Photography
  - Take 10 unique photos
  - Write about each photo in your journal OR discuss them with a staff member
- Journaling
  - write in your journal 5 times
- Observation
  - Write observation notes on 6 organisms in your journal
  - Name the 6 organisms according to the naming scheme learned in the observations activity
- Sketching
  - Create 5 sketches with labels
  - Write about the animals you sketched in your journal OR discuss them with a staff member

Logistics

Schedule

Below is a brief chart of the schedule to be followed during the week-long *Beach Investigators* program. The mornings and afternoons are each split into two halves, one half lessons and guided activities, and the other half free exploration time.

One exception to this is Thursday, which is dedicated to the Beach Survey, which is expected to take the entire morning. Thursday has been selected as the Beach Survey day because it is towards the end of the week, and the students will have an opportunity to use all the activities learned during the week to make observations of the organisms found during a beach survey.

	Monday	Tuesday	Wednesday	Thursday	Friday
Morning 1	Introduction to the Intertidal Zone	Observations in nature	Texture impression	Beach Survey	Indigenous Knowledge
Morning 2	Free Exploration				Free Exploration
Lunch					
Afternoon 1	Journaling	Sketching	Photography	Beach Survey Lab Time	Sharing and Badges
Afternoon 2	Free Exploration				

On Friday, before the final free exploration time, there will be a time for the students to share any journal entries, pictures, or sketches they have been working on with their groupmates. It will also be the time that the badges are awarded to students who have earned them.

Risk Assessment

As with any outdoor education program the safety of both students and staff is a top priority. Attention to safety will protect the students and staff involved and allow for a stronger and more beneficial learning environment. For the *Beach Explorers* program there are a few risks that we have identified where special attention should be paid.

Supervision: Despite the encouragement of what is called "Free Exploration," kids below a certain age should not be allowed to explore the area without a staff member present. To ensure this happens, free exploration time will be run in groups. Staff members will start free exploration time by stating which areas (beach, pond, trail, ect.) they are going to, and allowing students to choose which staff member they want to explore with. This allows the students to still choose the areas they want to explore without allowing them to wander off into potentially dangerous situations.

Weather: There is a potential for the loss of outdoor time due to adverse weather conditions. In order to prevent this from happening, students and parents will be told they must bring proper clothing. This includes rain coats, close toed shoes, and clothing appropriate for the temperature. Sunscreen is also recommended for days on which there is a risk of sunburn. In the case of severe weather, there will be an indoor back up space available for each activity. In case of a weather-related emergency, Shannon Point Marine Center emergency weather procedures should be followed.

Plants and Wildlife: Although the wildlife at Shannon Point is low risk, there are sometimes large animals such as deer, or birds of prey such as eagles, that can be dangerous if not approached with caution. Staff, as has been stated, will always be present with the youth should any wildlife which could be considered dangerous appears. These staff will be trained how to approach these plants and animals in a safe and respectful way that will allow the students to observe with safety and wonder.

Beaches and Water: The intertidal zone is both terrestrial and aquatic. To allow students to explore the aquatic portion of this ecosystem, students should be allowed to venture into the water. However, they should do so carefully and only with supervision. They should also be required to only be in water they can stand in. If you wish to let students swim we recommend the implementation of a life guard system to ensure the safety of every student involved.

Lesson 1

Introduction to the Intertidal Zone

Before the students are set free to explore the intertidal zone, it will help to give them a basic understanding of what the intertidal zone is. During this lesson, we will take students to the intertidal zone in person to give them a better understanding of this complex environment.

This lesson is related to some Next Generation Science Standards, which have been acknowledged in the learning Objectives box. This program chooses not to focus heavily on these standards, but knowing related standards can be helpful for program growth.

Learning Objectives

Context: Encouraging students to explore the natural environment around them

Lesson Objective: Students should be able to explain where the intertidal zone is, and how it is both a terrestrial and aquatic environment, and how that has shaped the organisms that live there.

NGSS: 3-LS4-3

Activating Prior Knowledge

[5-10 min] Start by asking the students if they have been to the beach before. While it is possible that all students will have attended a beach, especially in the Pacific Northwest area, it should not be assumed. Some students may be from outside the local area, and others may not have the same opportunities due to their abilities or socioeconomic status. If this is the case try asking students about media they might have seen that relates to the beach to keep them included. Also, those who have been to a beach before might not have been to a salt water beach or one that shows tidal patterns. Stories about these types of beaches should not be dismissed as that might discourage students from sharing in the future. Ask the students what they like about the beach? What types of things do they like to do at the beach?

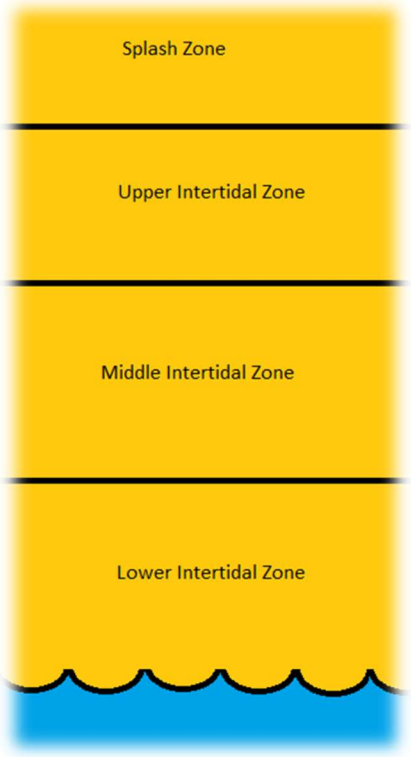
If a student says they like looking at tide pools use this to move into the intertidal zone. Try finding a tide pool on the beach. If not ask if they have ever looked at tide pools and start to move the lesson in that direction yourself.

Communicating Learning Targets

[Less than 5 min] Before moving further in the lesson we will help the students to understand that they should be focusing on the differences between the upper and lower sections of the intertidal zone and recognizing the different types of organisms that have adapted to live there. Helping the students to understand this goal will keep them from focusing too much on individual species or other ocean mechanics. A way to do this might be giving the students rhetorical questions that mirror the objectives of the lesson. For this lesson, we suggest “How are the upper and lower intertidal zones different?” or “What to animals that live in the intertidal zone worry about for survival?”

Learning Experiences

[10 min] Start out by defining where the intertidal zone is. Have one staff member stand in the lowest part of the intertidal zone (there may be water there), and another staff member stand in the splash zone. Explain to students how, at the highest tide, the water will be all the way to the splash zone and, at the lowest tide, the entire area will be exposed beach. During this time students can participate in the conversation if they have personal experiences related to the topic.



1.1 A MAP OF THE INTERTIDAL ZONE SECTIONS

[15 min] The staff will begin separating the students into the zones of the intertidal zone. Some students will end up near (not in) the water as part of the lower tidal zone, some in the middle, and some will be in the upper tidal zone. Ask the students which of their groups will get the most water? Which will get the least? The students should take this time to observe the section of the beach they have been placed in. Based on their observations the students should come to an understanding that they higher part of the beach receives the least water and the lower section receives the most.

[15 min] Based on how much water each tidal zone gets start having the students think about what adaptations they might need to live in that section of the beach. Have them look at the beach itself: what organisms can they find? What adaptations do those organisms have? During this time address how some animals can end up out of place due to tide pools. Before having the students answer questions have them take some time in their groups to look closely at the beach and talk amongst themselves for a few minutes. Then give them time to share what they have observed with the entire class.

[30 min] Towards the end of the lesson, take the students to the second beach, mix up the groups, and have the students do the same activity. Would different animals live on this beach? How does the geography of the beach affect what can live there?

Closure and Assessment

Staff should be checking for comprehension during the conversations they have with students as students talk about what animals they think would live in various sections of the intertidal zone. Students should be able to locate and describe the intertidal zone. Also, students should be able to describe the adaptations of some organisms in the intertidal zone.

[5-10 min] At the end of the lesson talk to the students about how they will have a chance throughout the week to make their own observations about the organisms that live in and around the intertidal zone. Use this time to explain some of the activities they will be doing during the week and how they can earn badges.

Addressing Learner Diversity

Older students in the class may already know or be familiar with the information you are teaching in this lesson. For these students engage them by complexifying the idea of the intertidal zone. This can be done with questions such as “What predators do organisms in the intertidal zone need to protect themselves from?” or “What do animals in the intertidal zone do for food?” These questions will help the older students start thinking about relationships between organisms.

Many of the younger students might understand and be ready for this more complex way of thinking about the intertidal zone which should be encouraged. However, some students at the younger end of the age spectrum may not be ready for this complexity. For those students focus on the adaptations that help organisms live in an environment that is both terrestrial and aquatic. This can be encouraged with questions like “What do you think this organism does when the water is higher or lower?”

Lesson 2

Journaling

Now that the students have a basic understanding of the intertidal zone and its functions it is time to help them start their own self driven exploration. To start this, we will now introduce the students to journaling, a way to record their observations for later. Each student may want to write journal entries in their own creative way and this should be encouraged. The journal entries might be as simple as bullet point observations but also might be as complex as long poetry. The most important thing is that students find a journaling style that best helps them connect to the natural environment.

Learning Objectives

Context: Encouraging students to explore the natural environments around them

Lesson Objective: Introduce the students to different types of journaling. Students will complete one journal entry.

Before this class we will create some example journal entries that mimic some different styles of journaling in nature. These examples might show simple notes that have been jotted down during an observation or they might show a story about finding an organism. There should be a few examples of creative writing in order to support as many learning styles as possible.

Activating Prior Knowledge

[5-10 min] Some of the students in the group may already keep journals and it is likely (though you should never assume) that most of the students have taken notes in class. If students are willing they can share about some of the things they write down in their journals.

Communicating Learning Targets

[5 min] After a bit of conversation show the students your example nature journals. Ask them if any of them look like things they have written. Let them know that they are going to be given time to write their own journal entries, and if they want, they can write an entry like one of your examples.

Learning Experience

[5-10 min] Start a conversation about the example journals by going through a few of them. Read a bit from each journal aloud to the students. After each reading you can ask if anyone liked the passage. If anyone wants to share thoughts about one of the example entries invite them to do so.

[15 min] After you have gone through a few of the example journal entries tell the students to form a circle facing outwards. Once they have done this, have everybody take 10 steps and sit in their new location. When the students are sitting, give them 10 minutes to write down all the things they hear, smell, see, and feel. When time is up, have everybody stand up and reform the smaller circle and discuss their

journal entries. While reviewing what the students have written, ask questions that help expand the range of details they are observing.

[30 min] Now assign everyone into partner groups. Then, have each person individually find an object they would like to observe. Once the students have all found something, give them 5 minutes to write a journal entry about that object. Once the 5 minutes are up, have the pairs switch, and write a journal entry about their partners object. When time has run out again, have the partners sit with each other on the beach and compare notes. What are the differences between the entries? Did their partner notice details the student missed? How do their styles compare?

Closure and Assessment

[15 min] After the students have had time to compare journal entries, gather the students back into a circle. Ask the students to share about their journaling session. They can share as much or as little as they want. Ask the students questions like "How did you feel while you were writing your journal?" or "Did writing in your journal help you feel more connected to nature?" Use the answers to these questions to see what students might be getting out of their journaling time.

Also, take this time to let the students know that while they have the option to write in any style they choose they still must show effort to earn the badge. To check for this the students will discuss their journal entries with staff members. During this time the staff members can talk to the students about how they might get the most out of their writing helping to improve their writing over time.

Addressing Learner Diversity

Students as individuals will have different goals, values, and ideas about what they want to get out of journaling. This includes writing creatively or analytically. For some learners it may also include differences in ability to write. Your job as an educator in this environment is to encourage each student to follow their own writing needs. Allowing the students to choose their own writing styles will support their needs for identity and autonomy.

Lesson 3

Observations in Nature

So far students have been given a brief introduction to the intertidal zone and some of its unique functions. Students have also learned about ways they can record their thoughts in journals, which will help them to document their observations in ways that are meaningful to them. Now, we will turn our focus to the student's ability to observe the nature around them. You may find that many of, if not all, the students in the program are already making keen and insightful observations about nature . We will now take these observations further by introducing questions the students can use to learn to deepen the observations they are already making.

Learning Objectives

Context: Encouraging students to explore the natural environments around them

Lesson Objective: Introduce students to new forms of observation. Students will name one organism based on the activity name equation.

It is a good idea to have staff members participate in this activity beforehand. This will help the staff to understand the activity, improving its facilitation. Also, this will generate example observations for the students to look at which will help them to understand what is expected of them.

Activating Prior Knowledge

[15 min] Having just previously participated in the journaling lesson you can easily use this lesson to begin talking about observations in nature. Have the students look through their journals at the observations they made while writing. Using questions start a conversation about their journals. Did they focus on one organism or multiple? Did they focus on sights or sounds? Did they focus on appearance or behavior? Use these questions to start a conversation about observations in nature.

Communicating Learning Targets

Learning Experience

Scientific Observation

[15 min] the first activity is designed to show the students different methods of observing animal behavior for scientific research. Tell the students to find an animal, hopefully there are birds in the water or crabs on the beach. If you are having trouble finding actual wildlife, you can involve any staff you have and be creative. Give the students 5 minutes to write down everything that the subject does.

Then, have the students observe their animal again for another 5 min. This time, keep an eye on a watch and tell the students every time 30 seconds passes. At each 30 second mark, have the students write

down what the animal is doing. At the end of this activity, there should be 10 bullet point statements of what the animal was doing at each 30 second mark.

A fun way to build on this activity is to show the students how their observations can be turned into useful data. By taking their bullet list of behaviors, a scientist can start to gain an idea of how an animal spends its time through the day. Using their bullet pointed lists, you can create simple pie charts of what an animal does throughout the day. Remind the students that the more data they collect, the more accurate their chart would become.

Artistic Observation

[15 min] This activity focuses on challenging the way the students look at an object. Have the students find something on the beach to observe. Once they have their object selected, give them 10 minutes to write about the objects personality. Since the object doesn't have a real personality, this activity will help challenge the students to write in a more symbolic and abstract style. After they have completed the activity, talk about how authors and poets have spent time in nature to gain inspiration for their writings.

Putting the Pieces Together

[10 min] Tell the students that for this activity their task will be to name an organism they have found. However, they should take the time and energy needed to find a name appropriate for the organism they are observing. Tell the students that there are certain questions they should answer before naming their organism. The questions will help the students come up with a name for the organism they are observing. Show the students the examples your staff created when performing their own observations. These questions are:

- Where is the organism?
- What does your organism look like?
- What is your organism doing?
- How does your organism get places?

Using these questions, the students will find the observations they need to create an organism name that follows the naming scheme:

(Location OR appearance) + (action OR movement) = Organism Name

This naming scheme is designed to activate and inspire observations that take the experience deeper than recognizing two organisms are different, and should help the students start looking at what makes two organisms different.

[30 min] For the activity itself the students will be given time to find an organism on the beach. If you wish, you may choose to have another staff member visit the second beach so that students can choose which beach they want to explore. Give the students time to find an organism on the beach. It can be any type of organism; however, animals will exhibit more behavior. If a student chooses to observe a plant or algae, they may need some mentoring assistance to find answers to more behavioral focused questions. For example, if the student chooses to observe algae in the splash zone of the beach, you might help them to find answers to the question "How does your organism get places?" One possible answer may be that the organism does not go places, which might result in a name like "Fuzzy Green Rock Clingers"

which would be a perfectly acceptable name. Work to support the choices that students make before encouraging them to make another choice.

Closure and Assessment

[15 min] At the end of the activity take time to allow your students to share a bit about the organisms they observed and how they chose their organism's name. Ask the students if these questions could be used in any other locations and help the students to understand that these are questions and observation tools that they can use in forest preserves, other beaches, and their own back yards. Also, let the students know they can name as many organisms as they like throughout the week or they can choose to focus on the one they have already found.

Addressing Learner Diversity

While older students may take to observations quickly, and may have done observation based assignments in school, the youngest members of this program may not have as much background. Younger students should therefor focus on the already provided questions. These questions focus on the "What" observations, which are more obvious, and often easier to observe. For older students, you will want to encourage asking questions that complexify their observations. Older students may want to start asking "Why?" questions that connect their observations of one species to that of the larger ecosystem.

You may have noticed that this lesson has the natural tendency to focus on visual observation. Should any students be visually impaired, they might feel left out in this activity. However, this activity can incorporate other senses such as hearing, touch, smell, and when safe, taste. For students who cannot observe their organism visually, staff should help to encourage the use of other senses to complete the task. Instead of using behavior for their names, which may be hard to observe without visual observation, they can use texture, smell, or sound.

Lesson 4

Sketching

Many young journalists would like to fill their pages with sketches of their observations. Some of the students in this program will have already been sketching in their journals, and will have created detailed and impressive drawings. However, while many students in this age range wish to sketch, many are reluctant due to frustration with their own skill level. This lesson is designed not to improve that skill, but to convey that sketches do not need to be highly detailed works of art to function in a nature journal.

Things like labels and descriptions alongside a sketch can help clear up any ambiguity caused by lack of skill. Sometimes a rough sketch with detailed labels can be more useful to certain people than a more detailed but unlabeled sketch. In this activity, we will take focus off of how good a sketch looks and place the focus on how useful the sketch is to its creator.

Activating Prior Knowledge

[10 min] As was stated earlier, many of your students will already have been working on sketches during the week. Now is a good opportunity to share any sketches. As the instructor, you should bring a few different examples of sketches. Some of your examples should be more artistic, some be very scientific, and some should be low skill but have lots of labels and descriptions written into the page. Discuss different types of sketches with your students. Do they prefer certain styles? Do they have a type of sketch that they want to try? Have they seen sketches that differ from the examples provided?

Communicating Learning Targets

[5 min] The most important thing for the students to know going into this lesson is that the detail and quality of their sketches is not the objective of the lesson. The objective of this lesson is to help the students find a way of sketching that works for them and their journal style.

Learning Experience

Warming Up

[45 min] Before setting out to create a full sketch, there are some sketching warm up activities that will help students. These warm up activities are fun and simple, and meant to improve skill while warming up the muscles in the hand. For the warm up activities, have the students find a small item on the beach. It can be a rock, a shell, or somethings similar. Once they have their item, have every one sit in a large circle with their items in front of them. Give them less than five minutes to closely examine the object they have found. What is the objects texture? What is the objects shape? What is the objects color? After they have studied the object, have them put it down in front on them.

For the first warm up have the students try to draw their object without looking at their paper. They should try as best they can to not look at the paper, or lift their pencil from the paper. They should not look at their paper, lift their pencil, or stop until they are sure they have drawn the whole object. Let them know it helps to move slowly and carefully. This should take between 1-2 minutes.

For the second warm up, have them repeat the activity from above, but this time allow them to look at their paper. Once again, they should use one continuous line and not lift their pencil. This sketch should be finished between 1-2 minutes.

Now, letting the students look both at their paper and at the object, tell them they should try to draw the object as fast as possible. They can now lift their pencil from the paper freely if they wish. Tell them you will give them 5 second to draw their object. Once they are ready, start the timer and let them sketch for 5 seconds. Then, have them try again with 10 seconds, and then with 15 seconds. This technique is useful in nature because animals will move frequently.

Choosing a Subject

[45 minutes] Give the students time to work on a sketch of their own choosing. They may choose any subject they like so long as they remain in a safe supervised area of the beach. Give the students about 30 minutes to draw and write about their subject. Remind them that they can use labels and writing to help clarify their picture.

Closure and Assessment

[30 min] Bring the students back into a circle, and invite the students to share their sketches. You may go around the circle if all students are willing to share, or just open for a discussion. Why did they choose their subject? Did they enjoy drawing their subject? Did they use labels and descriptions? Remind them that even if they never become a master artist, practice and patience will still let them draw useful sketches in their journals.

Addressing Learner Diversity

Always remember that different students have different interests. What is important here is that there is not “wrong way” to do a sketch. Some students who are more science inclined may prefer rough sketches with labels. Some students who are more arts inclined may have more abstract representations of their subjects. The important thing is to provide the students with the support and assistance they need.

Lesson 5

Texture Impressions

Texture impressions is an outdoor activity that will enable the students to further their own self-motivated exploration of the outdoors. Although it seems like a simple and easy task information can be gained through observing the texture of objects in different ways. Many of the students will have already done similar activities to this one. Your task during this adaptation of the activity is to show that even simple outdoor activities can lead to many insightful observations. Throughout the rest of the week-long curriculum, the students will be given the opportunity to do more texture impressions for their journals.

Learning Objectives

Context: Encouraging students to explore the natural environments around them

Lesson Objective: Teach students how to make texture impressions. Students will create 3 texture impressions.

For this lesson, you will need spare paper, crayons, and either have previously gathered items to for the students to create nature impressions of, or be prepared to let them find the items on their own.

Activating Prior Knowledge

[10 min] Bring in a few items for the students to touch and feel. Pass the items around the group, giving students a chance to feel the item, and describe its texture. This will help the students start thinking about words and language that describe the texture of objects. Then ask the students if they notice any patterns in the items. Students may find that it is easier to look for patterns rather than feel them out, although not every student may feel this way. Let them know that in this activity we are going to find another way to look at texture that may help them in their observations.

Communicating Learning Targets

[5 min] Show the students some examples of texture impressions. The examples should show different types of objects such as rocks, leaves, or shells. Let the students know that during this activity they will be creating their own texture impressions and finding what new observations they can make using this method.

Learning Experience

[60 min] Have the students find three objects. The objects can be gathered ahead of time or the students can be encouraged to find them on their own. Once their objects are selected have them create three texture impressions. Impressions are made by placing the paper as flat as possible on the textured surface of the object. The student will then rub a crayon flat across the paper creating an imprint of the object on the page. After the students have completed their impressions have them describe the objects.

They can write down their descriptions next to the impression on the page. These descriptions shouldn't be too long, just short bullet points.

Students might try collecting the texture of both smaller and larger objects. Encourage the students to try any object they choose, even if they think it might not work well. This way the students will get a chance to find what situations texture impressions are useful in.

Supervise the students making sure they are safe. Make sure they have not used any dangerous plants for their texture impressions. If a student is having trouble offer your assistance. Make sure that you are not doing the task for them, but are enabling them to complete the task themselves.

Closure and Assessment

[10 min] Give the students time to show their impressions to staff and each other. Ask them what their favorite object to collect an impression of is and why they like it. Ask if certain patterns and observations were made easier by using this method. Were certain items easier to collect texture impressions from? Were some items not good for texture impressions? Encourage the students that as the week continues, they can add other textures that they find to their journals. If they complete a certain number of extra texture impressions, they earn a badge.

Addressing Learner Diversity

As was stated in the introduction to this lesson, this is an activity that is commonly associated with younger audiences. There is value to revisiting old activities with new perspectives. In this way, I believe that both the younger and older students have something to gain from this activity.

Texture impressions are a simple activity that most students should be able to enjoy. If there are visually impaired students, these students should be encouraged to focus on the textures of the objects instead. These students may be allowed to gather the physical item rather than make an impression of it, so that they can visit the texture again later.

Lesson 6

Photography

Technological advances in recent years have made high quality cameras and photo-editing software available to most hobby photographers. Due to the ease and accessibility of modern photography equipment, many of the students will already have a device/camera that they already know how to use. Students should be encouraged to bring their own devices for this lesson, as these are the devices they would most likely be using when they continue exploring nature. Camera availability is further discussed in the *Addressing Learner Diversity* section below.

Learning Objectives

Context: Encouraging students to explore the natural environments around them

Lesson Objective: Introduce students to different styles of photography. Have the students take 10 pictures in at least 3 different styles.

However, simply having access to a camera does not create a photographer. In this lesson, you and your group will discuss the different purposes and styles of photography. This includes photos taken at deliberate angles to provide scientific readings, photos used in advertising and communication, and photos taken for aesthetic or artistic purposes.

Activating Prior Knowledge

[10 min] To start out, have a conversation about photographs. Do any of the students take lots of pictures? Do they have any favorite pictures or photographs? Then, before moving on, show the students some photographs taken for different purposes. These pictures might be ads, famous photos from the news, artistic shots, or profile shots taken for science records. Talk about how the pictures differ from each other, and how they are the same. Ask the students what kinds of pictures they might like to take.

Communicating Learning Targets

[5 min] Let the students know you are going to teach them about composing shots in photography. Tell the students they will be expected to take at least 10 pictures by the end of this lesson. They should experiment with at least 3 different styles, but those styles don't have to be limited to styles that have been discussed.

Learning Experience

The "Rules" of Photography

[30 min] Show the students two photos that you have taken, one with the subject directly in the center of the photograph, and the other taken according to the rule of thirds. Ask the students which photo seems

more appealing, or which one they like more. Their answers may vary, as photography is subjective. This means the rules can be broken if they think the resulting picture is more appealing.

At this point, you can give examples of some other photography rules. These rules may include leading lines, proper exposure, and framing. You shouldn't go deep into detail when explaining these rules. The more important activity is giving the students a chance to use their cameras. Any questions about these rules can be asked in the field, while the students are participating in the activity.

Taking Pictures

[60 min] Give the students a while to wander and take photos. Lead them up and down the beach letting them take pictures of what they see. Accompany the students to make sure they are being safe and to answer any questions they might have. If any students are using a camera they may have borrowed, you may need to assist them if learning how it works.

Students will more than likely take more than the required number of photos for this activity. Digital cameras offer no film shortages and the ability to delete anything they don't like. If a student is using a film camera, offer to help them get it developed for the next day, so you can talk about their pictures.

Closure and Assessment

[10 min] Gather the group back into a circle, and let them share their photos with you and each other. Discuss the styles they used, and what worked and what didn't work. Let the discussion take its course, allowing any students who want to share to have their chance. After this is over, remained the students that the pictures they take are their own, and they should take pictures that are meaningful and valuable to them.

Addressing Learner Diversity

Technology has indeed made cameras widely available. However socio-economic status can often provide barriers between populations and technology. It is very likely that in your class you will have one or more students who do not have access to their own camera device.

To ensure that all students are enjoying the activity and experiencing the lesson to its full potential, it is best to make sure each student has their own camera. To provide cameras to students who do not have their own, it may be good to have your own set of inexpensive digital or polaroid cameras the students can borrow. Another option is to purchase disposable cameras and have the students turn them in to be developed. Disposable and polaroid cameras have the added benefit of providing a physical photograph that the student keep and place in their journal. Physical photos, especially for youth, can often be more meaning full than digital copies.

Lesson 7

Beach Survey

The beach survey acts as a cumulation point for the week. During this activity, students should be encouraged to use the skills they have been practicing through the course of the week to document the observations that they make of organisms in the intertidal zone.

Learning Objectives

Context: Encouraging students to explore the natural environments around them

Lesson Objective:

One desired outcome for this part of the program is to encourage flow like activity. Through the week students have been introduced to various outdoor skills they can use to observe nature. They have also been given free exploration time to practice these skills. It is our hope that the Beach Survey will give students a chance to participate in an activity where they will need to use all skills they have been developing throughout the week to complete a task.

Another important aspect of this activity is that it cannot be overly challenging. If a task is too difficult, participants will show frustration and anxiety. Instead, the activity should be challenging but doable in order to best encourage flow.

Activating Prior Knowledge

[10 min] At the beginning of the week, during **Lesson 1**, students will have learned how organisms distribute themselves in unique ways through the intertidal zone. Ask students if they remember why this is, and discuss this for a short while. Then, when you are satisfied the students understand this concept, you can begin the beach survey.

Communicating Learning Targets

[10 min] Explain to the students that today they will be conducting a beach survey so they can get a better idea of how different organisms survive in the intertidal zone. They are each going to be placed in groups that will each be assigned a section of the beach. Their group will observe the organisms and conditions at their tidal level, and will take pictures, make notes, or sketches of the organisms they find. Afterwards in the lab, they will be given a chance to share what they learned with the other groups.

Learning Experience

[30 min] Before the students can start their survey, they need to know which spots hey are surveying. Start by marking out transects, or lines on the beach that are perpendicular to the water. They should be

straight lines that move up the incline of the beach. There should be about 5-10 feet of space between each transect.

Next you will need to mark out tidal levels. This can be a fun activity to have been working on during the week, or it can be completed now. If you are doing this now, you will need **string, a level**, and a **pole or ruler that is a foot long**. When the water is at the lowest tidal level, mark this water level with the appropriate tidal level (such as -2 or -1). Then using the foot tall stick, indicate where the top of the water would be if it were a foot higher. Then, using the string and level, find out where on your transect the water level would be. Then mark that point on the transect as the next tidal level. Continue this until you reach where the water would be at high tide.

[60 min] After each of the groups is at their assigned tidal zone, give them a quadrat made of PVC tubing. This quadrat should represent a consistent amount of area to be observed at each level. Students may carefully move rocks to see organisms hiding underneath them, but should not touch the organisms themselves without guidance and help from staff. Students should also replace any moved rocks gently into their original position.

During their observation time, the students should sketch, take photos, and write down observations. They can divide tasks between themselves however they may like. During this time, staff should be present to make sure students are handling the environment in a safe and non-harmful way, and to serve in a mentor capacity. As mentors, the staff can offer tips on sketching, writing, or photos during the beach survey activity.

[60 min] After the survey, students will be given time in a lab to take a closer look photos, sketches, and organisms that they have brought into the lab with them. Here there are microscopes and other lab equipment available for the students to use. Using the new equipment, students can make closer observations to be documented in their journals. As a mentor, you should be present to assist with the microscopes and other lab equipment.

Closure and Assessment

[30 min] After the survey and lab time, the students will be given time to share what they found. They are welcome to share photos, sketches, and any conclusions they may have come to during the process. As the educator, you should be listening for key topics such as adaptation, and species interaction. If these topics come up, help the students to focus in on this discussion. If these topics do not arise, then bring them up yourself by addressing one of the student's observations.

Addressing Learner Diversity

Fifth through ninth grade is a wide age range. Grouping older students with younger students during the beach survey will provide the older students an opportunity to lead and mentor the younger students. This will help the older students to feel engaged while also helping to form a sense of community amongst the students.

Lesson 8

Indigenous Knowledge

Learning Objectives

Context: Encouraging students to explore the natural environments around them

Lesson Objective:

Activating Prior Knowledge

Communicating Learning Targets

[10 min] explain to the students that learning about native cultures is about listening and respect. Because our cultures and beliefs are different, it can be difficult to understand how another group of people live. But this does not mean that another group lives in a wrong way. Another thing to remind students of is that indigenous groups are still alive and present in our world today. While much of the world talks of indigenous culture as the thing of the past, this is not and has not been the case. By acknowledging this, and admitting what we don't know, we are already taking the first steps towards better understanding.

Learning Experience

[30 min] Have the students sit on the beach, with their journals, ready to write. Have them close their eyes and read them the following passage:

> "Imagine you are in the past. You have not traveled to the past in a time-machine or portal, but you have always lived in this time. You have never heard of grocery stores, cars, computers, or plumbing. Here in the past, these things do not exist yet. You must then, of course, survive without them. How do you live?"

Have the students open their eyes and write the following questions down:

- What will we eat? How do we gather and prepare it?
- Where will we live? How will we find shelter?
- How will we interact with people we don't know?
- How will we move around?

After the students have written these questions down, allow them to spread out and think about the questions. Have them write their answers down in their journals. Remind them to draw upon what they have learned and observed through the week.

[30 min] After they have had about 20 minutes of time to write their answers down, gather them into groups of about 5 to discuss their answers amongst themselves. As an instructor, be ready to listen in on

conversations so you have an idea of what they understand. If you find space to interject with helpful information, then do so. But remember to let the students drive their own conversations. After about 20 minutes of small group discussion, gather all the students and prepare for a final large group discussion.

Closure and Assessment

Addressing Learner Diversity

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Joussemet, M., Landry, R., & Koestner, R. (2008). A Self-Determination Theory Perspective on Parenting. Canadian Psychology/Psychologie Canadienne, 49(3), 194–200. https://doi.org/10.1037/a0012754

About the Author

Mark Bryant is currently a Masters Candidate at Western Washington University. He had worked at two Boy Scout Summer camps, has acted as outreach coordinator for the Bowling Green State University Marine Lab, and has volunteered for 2 years at the Shedd Aquarium in Chicago.

As a Masters Candidate, Mark is fascinated by the ways people find motivation learn, and how we can inspire students to form more connected relationships with nature. This program has been designed as a Masters Project designed to explore these ideas. This is the first curriculum that Mark has designed, and through this process he hopes to learn about the process of designing and implementing educational programs, as well as investigate student's motivation to learn.

Mark hopes to write more programs like this in the future for groups and organizations dedicated to promoting stronger and more sustainable relationships with nature.

Appendix B

Pre-Program Surveys

Please help us understand how you think about the beach. Draw a Picture of the Beach. Then flip this page over and answer some questions about your picture.

1. How many different kinds of animals are in your picture?

2. How many different kinds of plants are there in your picture?

3. How many times a week do you go to the beach?

4. What do you enjoy about going to the beach?

5. What do you dislike about going to the beach?

6. When you are at the beach, what activities do you like to do?

Appendix C

Post-Program Surveys

Help us understand how this week has changed how you think about the beach. Draw a picture of the beach. Then flip this page over and answer some questions about your picture.

1. How many different kinds of animals are in your picture?

2. How many different kinds of plants are there in your picture?

3. Compared to before this week, are you more or less interested in intertidal study? (Circle one)

   Much more interested More interested the same Less interested

4. Compared to before this week, are you more or less interested in keeping a nature journal? (Circle one)

   Much more interested More interested the same Less interested

5. What did you like about this week?

6. What didn't you like about this week?

7. Did you have fun during your week?

   Very fun fun not fun

8. Would you recommend this program to a friend? Why or why not?

Appendix D

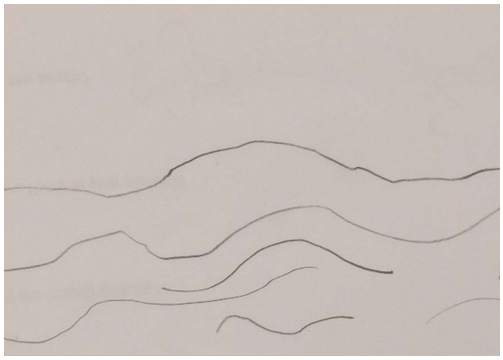
Coding Guide

Beach Investigators Coding Guide

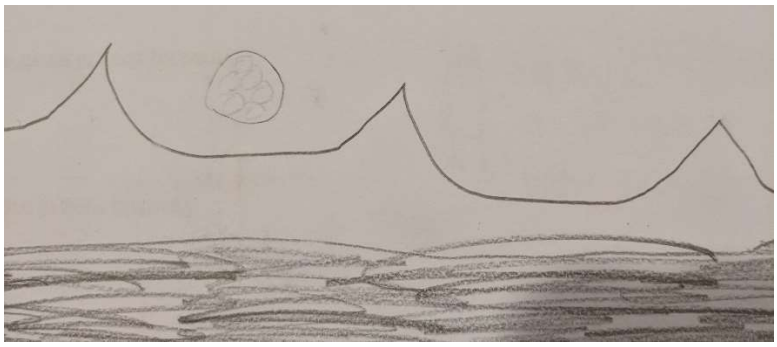
Water:

The coder should be looking for the following patterns when considering a drawing to contain water:

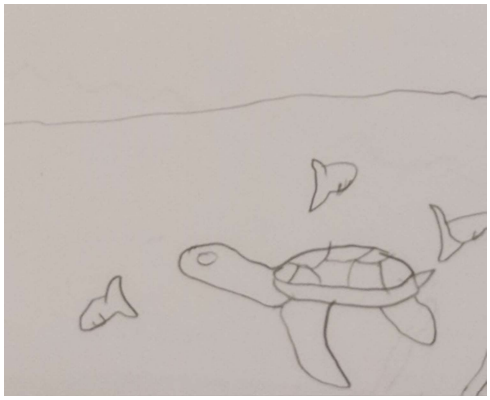
- A squiggling line:

- A squiggling line with pointed corners

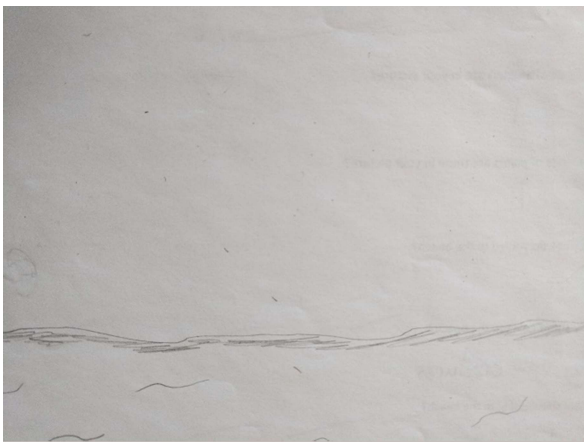


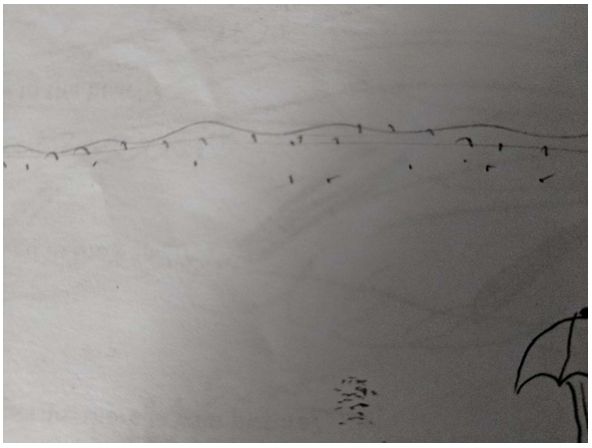
- Context that confirms the line as water such as the presence of aquatic animals



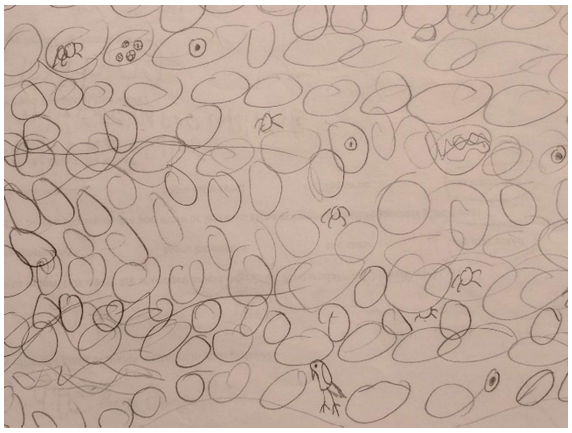

Sand vs Rocks:

A sandy beach is represented by a ground that either has no texture, or a speckled pattern made from small dots. Sandy beaches are flat.





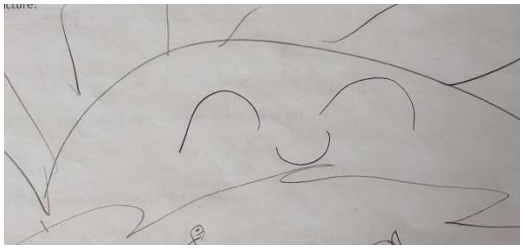
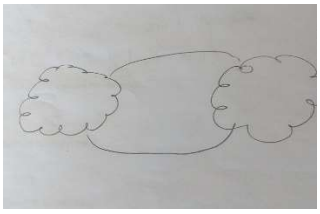
A rocky ground is made up of small circles or squares that cover the ground. Another way to decide if a student has drawn a rocky beach is if their beach expresses non-flat or clifflike elevation.



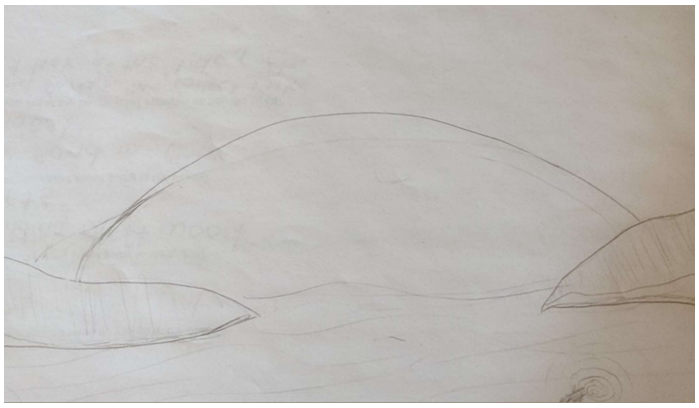
Sun:

Suns are represented as circles with at least one of the other following features:

- Rays drawn as either lines or triangles pointing out from the edges of the circle
- A face with sunglasses as is often depicted in popular culture
- A contextual location in the sky, either being the upper section of the page above perceived land, or behind other things in the sky such as clouds.

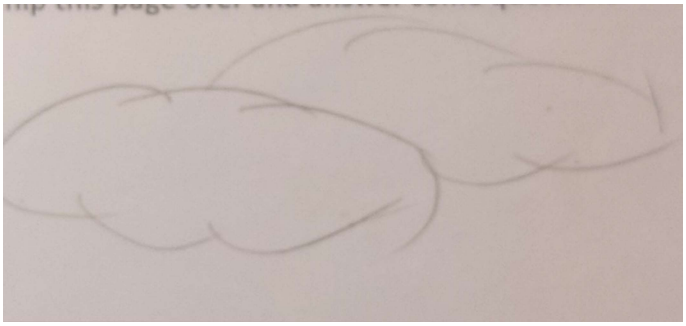




- The following image would not be considered a sun, as there is not enough context to differentiate it from the hill around it.

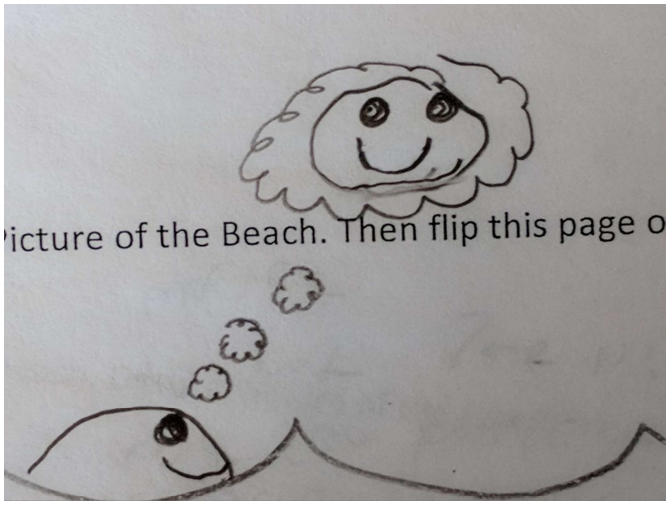


Clouds:

Most students will have drawn clouds in a classic cloud shape.

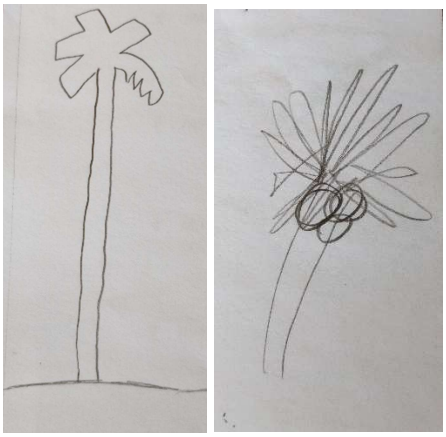


This is an example of an image that is like a cloud, but would not be counted. There is enough context here to make this image a “thought bubble” instead of an actual cloud, despite its similarities.



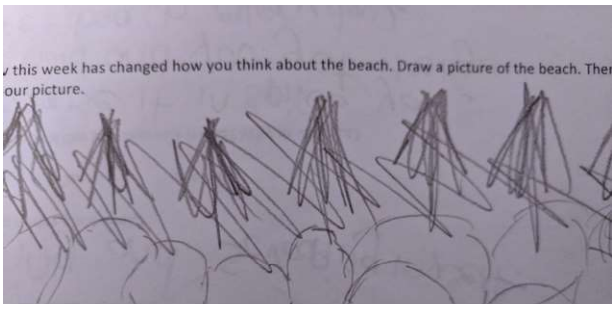
Palm Tree:

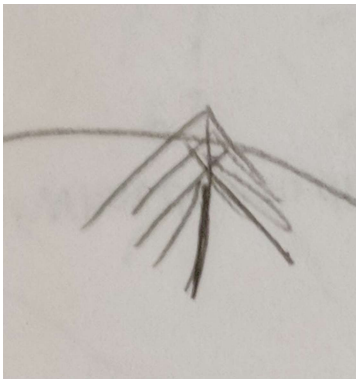
A palm tree can be represented by a tall branchless trunk that is toped with palm trees. Palm trees may include but not always have coconuts, which are represented by circles near the top of the tree.



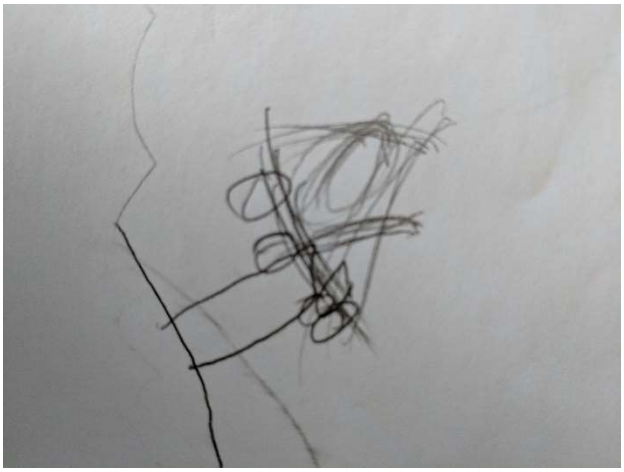
Conifer Trees:

Conifer trees are represented by a trunk with branches that form a triangular shape.



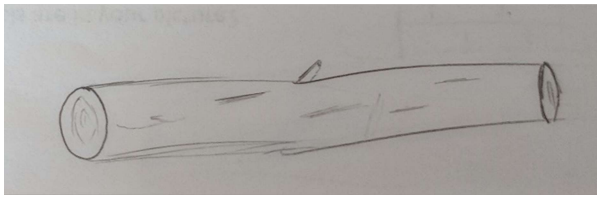


This is an example of a tree that may be a conifer, but due to extra elements in the picture, will not be counted as one.



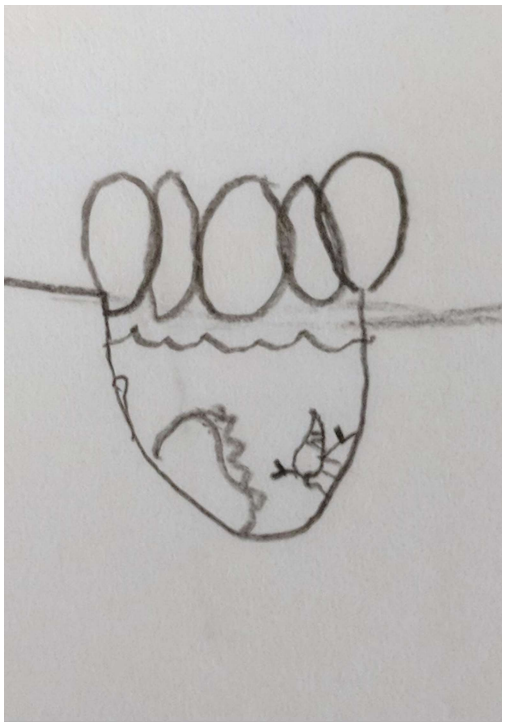
Drift Wood:

Drift wood is represented by a log laying on its side on the beach, rather than standing up like a live tree.



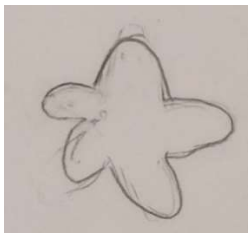
Tide pools:

Tide pools are represented by a small hole or circle on the ground which contains water and some animals.



Sea Stars:

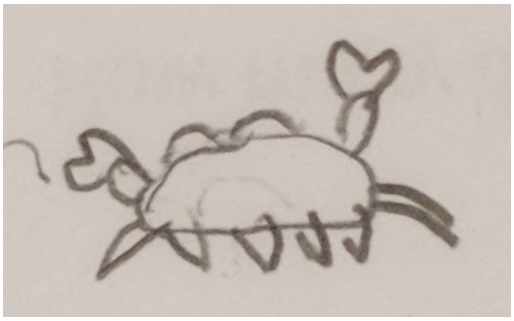
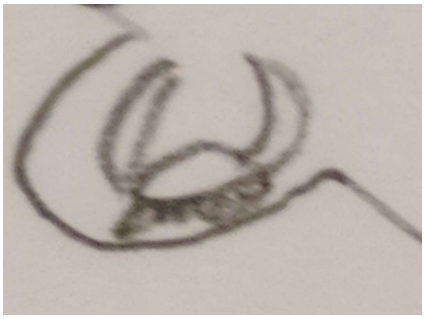
Sea stars have a very simple but very recognizable shape. Acceptable sea stars appear as 5 pointed stars.




Crabs:

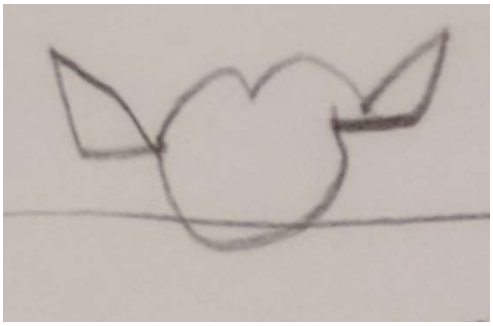
For a drawing to be accepted as a crab, it must contain the following:

- Claws
- A shelled body
- Legs on the bottom

If a crab does not appear to have these three details, it will not be considered a crab

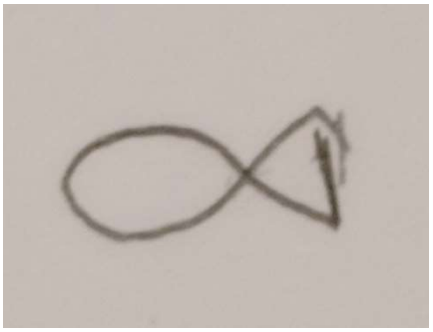
- Examples of images that would not count as crabs.



Fish:

For a drawing to be accepted as a fish it must contain the following:

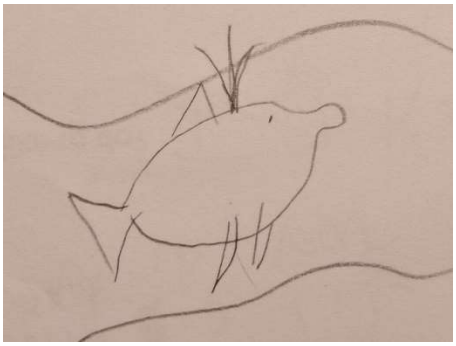
- A body
- A tail

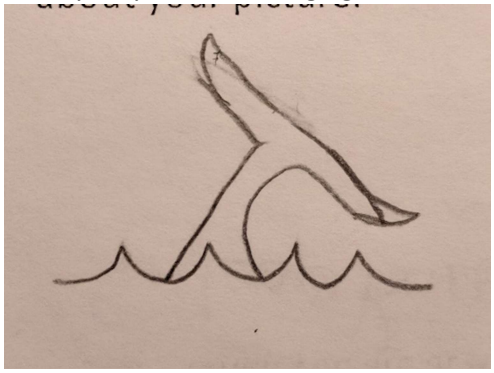


Whales and dolphins:

For a drawing to be accepted as a whale or dolphin it must contain the following:

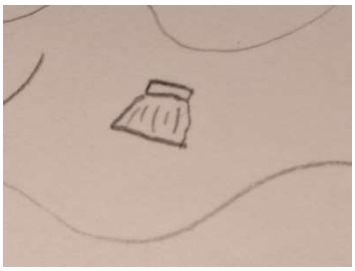
- A body
- Pectoral fins
- Horizontal Tail
- Dorsal fin (for dolphins only)
- Some Whales may be represented by only the tail emerging from the water





Clams and muscles:

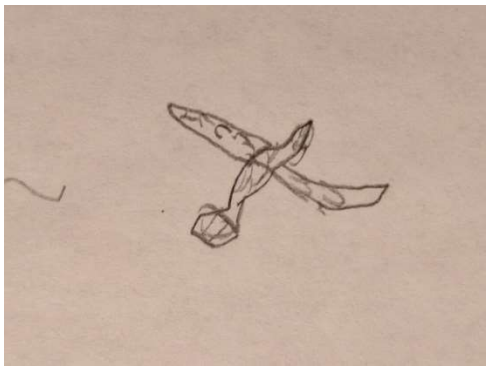
Clams, mussels, and other bivalves may be represented by shells on the beach or in the water.



Birds:

There are three different categories of bird that may be observed in participant drawing.

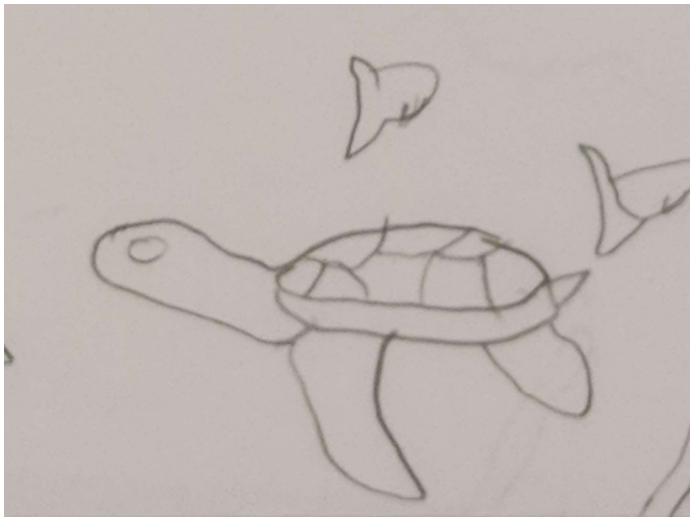
- A simple flying bird represented by a “V” or two bumps connected by a central corner
- A detailed swimming bird with a beak
- A detailed Shore bird with thin legs and a beak



Need a v shaped bird

Sea Turtles:

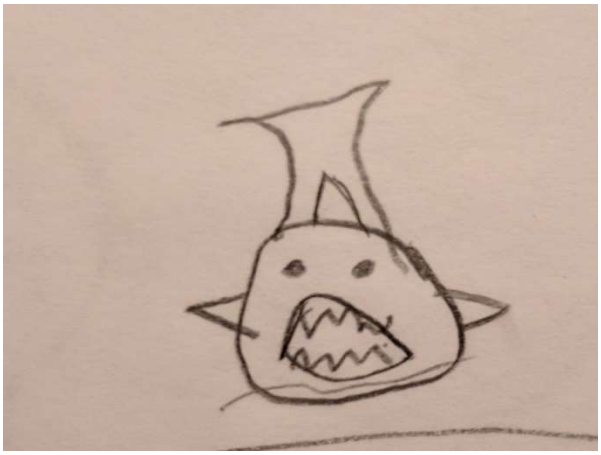
Turtles must have a Turtle like shell with both fins and a head

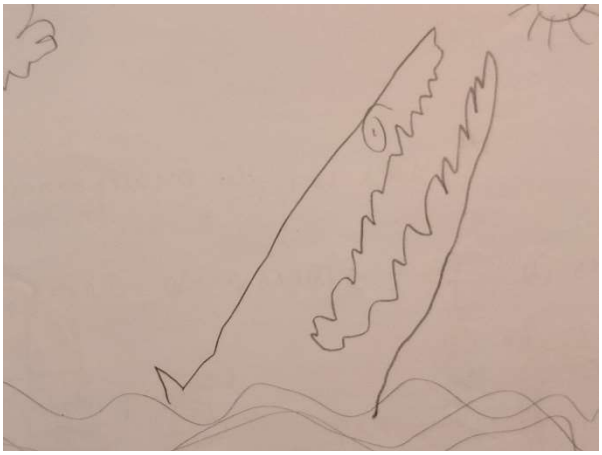


Sharks:

Sharks must have a dorsal fin and at least one of the following

- Many sharp teeth
- Gills
- Pectoral fins and a vertical tail

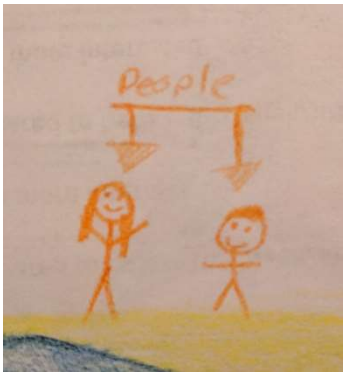




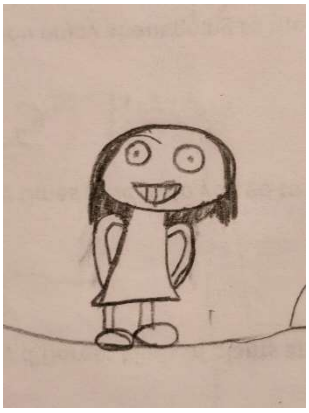
Human Impact

Presence of humans:

Some students will have simply drawn stick figure people.



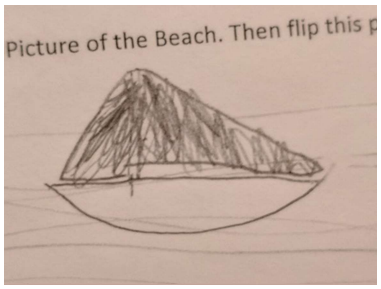
Other students may have more detailed drawings of people. Most of these drawings will portray a person with a head, two legs and two arms.

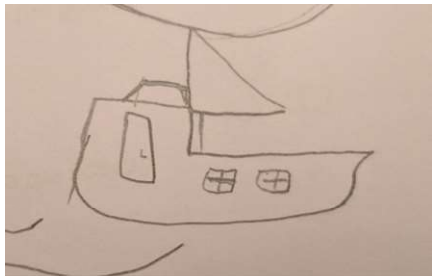


Some of the drawings of people may contain speech bubbles. Often times the things that the people are saying are reflective of the students views of the ocean.

Sail Boats:

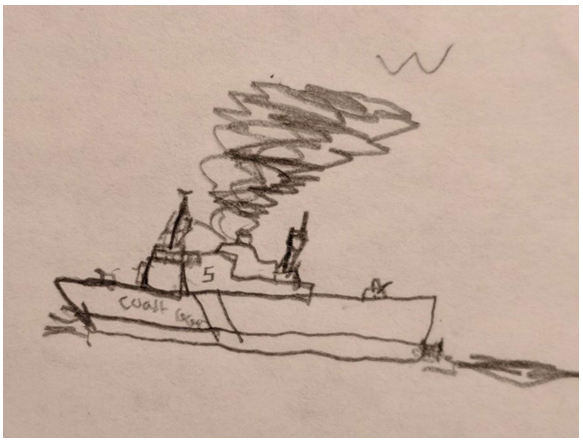
Sail boats contain the hull, and a triangular or square sail.

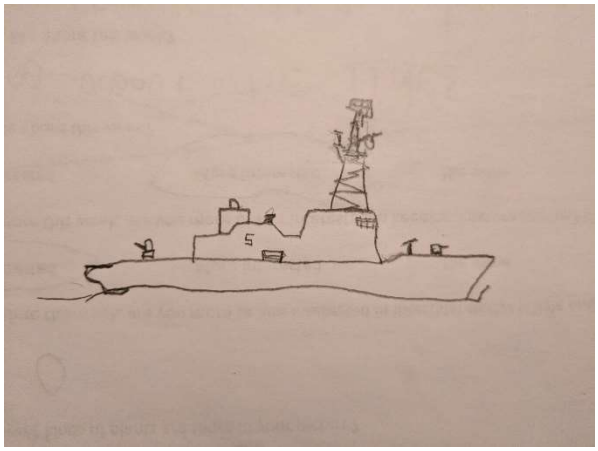




Military ships:

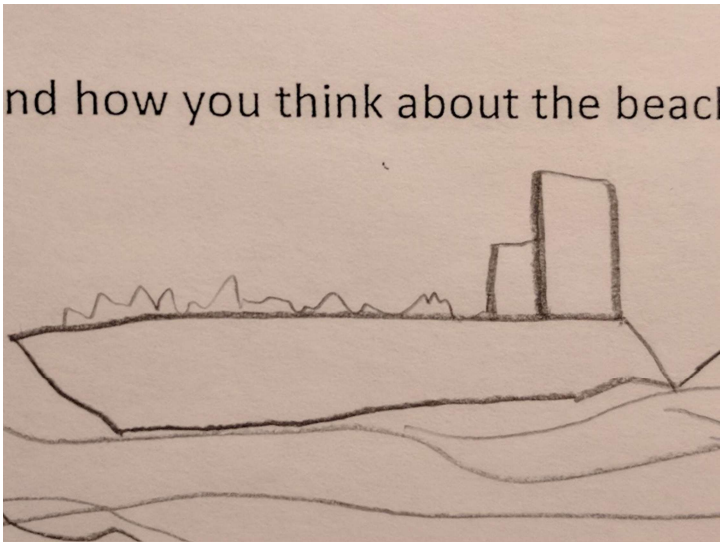
Military ships are drawn as normal ships, but contain some kind of radar equipment extending from a tower on the ship.





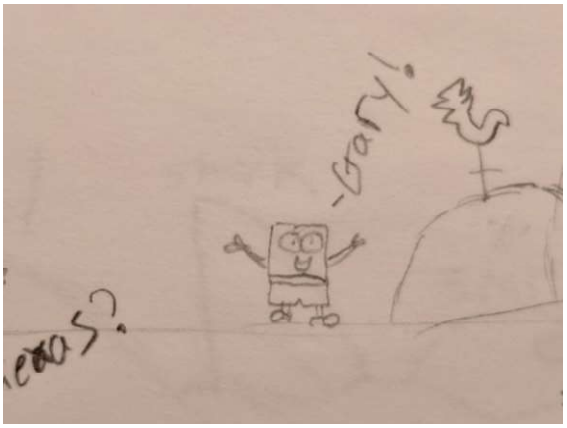
Barges:

Barges have tall tower like structures in the back with a large open flat area on the front, where containers or other cargo would be loaded.



Culture and Media Influence

Some students may have included characters from television shows or movies that they associate with the ocean or with the beach. In these cases the student will have drawn one or more characters or locations from a television show.



Other Students may have drawn mythical creatures expressed in cultural stories or fairy tails.

Local vs Non-local Ecosystems:

Below is a chart describing items that would be considered part of the local ecosystem that students were able to explore though out the week, and what would be considered non-local to this area.

Local Ecosystem	Non-Local Ecosystem
Environmental - Rock covered beaches - Cliff like beaches - Coniferous trees - Seaweed and kelp - Tidepools - Islands Animals - Sea stars - Clams and muscles	- Palm trees - Absence of islands