Summer 2016

The Convergence of A Framework for K--12 Science Education and Place--Based Education

Micah S. Herrboldt

Follow this and additional works at: http://repository.uwyo.edu/smtc_plan_b

Part of the Science and Mathematics Education Commons

Recommended Citation
http://repository.uwyo.edu/smtc_plan_b/48

This Masters Plan B is brought to you for free and open access by the Science and Mathematics Teaching Center at Wyoming Scholars Repository. It has been accepted for inclusion in SMTC Plan B Papers by an authorized administrator of Wyoming Scholars Repository. For more information, please contact scholcom@uwyo.edu.
© 2016 Micah S. Herrboldt
The Convergence of A Framework for K-12 Science Education and Place-Based Education

By

Micah S. Herrboldt

B.A. University of Wyoming

Plan B Project

Submitted in Partial fulfillment of the requirements for the degree of Masters in Science in Natural Science in the Science and Mathematics Teaching Center of the University of Wyoming, 2016

Laramie, Wyoming

Masters Committee:

Kate Muir Welsh, Associate Professor, Chair
Brian Barber, Biodiversity Institute
Maggie Bourque, Haub School Academic Programs
Joel Pontius, Assistant Professor, Merry Lea Environmental Learning Center of Goshen College
Abstract

The goal of this literature review was to look at what the literature says about place-based methods and how they relate to *A Framework for K-12 Science Education* (NRC 2012) as well as the *Next Generation Science Standards* (NGSS) (Achieve, 2013). Place-based education (PBE) aims to connect students to their local community and environment by using them as educational starting points and contexts through which to learn in school (Sobel, 2004). However, with recent standards-based reforms teachers find little time to give to place-based methods in the classrooms (Gruenewald, 2003b). The NGSS (Achieve, 2013) were created using the recommendations laid out in the *Framework* (NRC, 2012). Although considered a standards-based reform, the *Framework* (NRC, 2012) is clear to recommend that standards developed are more than just content.

The literature shows a strong correlation between *A framework for K-12 science education* and place-based education methods and theories. Demarest (2014) as well as Lieberman (2014) give recommendations that allow for educators to incorporate PBE into their classrooms in meaningful ways while still meeting the NGSS (Achieve, 2013). The correlations present in the literature indicated place-based methodologies may be preferable pedagogical practices to best implement the research driven conclusions of the *Framework* (NRC, 2012).
Acknowledgements

Many thanks to the Science and Math Teaching Center Faculty and Staff. Thank you also to my masters committee members; Joel Pontius, Maggie Bourque, Brian Barber, and of course, chair Kate Muir Welsh. Special thanks to Kate for your patience, guidance, and understanding throughout the entire process. I would like to acknowledge my teaching partners Tina Greener, Amanda Lopez, and Tyler Loyd for picking up the extra workload while I was away writing and meeting with committee members. Also, I would like to say thanks to Ana Houseal for her help during the beginning stages of this project.

My deepest gratitude goes out to my wife, SaraJane and three children Clarence Gemechu, Elsa Meskerem, and Calvin Mihretu. SaraJane, you made it possible for me to do this with your many nights parenting without me and extra responsibilities you picked up with no complaint. Gemechu, Meskerem, and Mihretu, you are the inspiration for my desire to help children connect with their place.
Table of Contents

LIST OF FIGURES ........................................................................................................................................... VI

CHAPTER 1 INTRODUCTION ........................................................................................................................... 1

Statement of Problem ...................................................................................................................................... 2
Purpose ............................................................................................................................................................ 4
Questions ....................................................................................................................................................... 5
Significance ..................................................................................................................................................... 5

CHAPTER 2 REVIEW OF THE LITERATURE ..................................................................................................... 8

Introduction ................................................................................................................................................... 8
Methods ......................................................................................................................................................... 9

History of Science Education in the United States and the Development of a Framework for K-12 Science Education .................................................................................................................. 10

Place-Based Education .................................................................................................................................. 14

  Foundations of Place-Based Education ........................................................................................................ 14
  Constructivism .............................................................................................................................................. 16
  Definition of Place ...................................................................................................................................... 17
  Place-Based Education Today ...................................................................................................................... 18
  Place-Based Education and Science Education ............................................................................................ 22

Principles of A Framework for K-12 Science Education .................................................................................. 24

  Framework Principle: Children are Born Investigators ............................................................................ 25
Framework Principle: Understanding Develops Over Time ................................................. 41
Framework Principle: Science and Engineering
Require Both Knowledge and Practice ............................................................................. 44
Framework Principle: Connecting Students’ Interests and Experiences ......................... 46
Framework Principle: Promoting Equity ........................................................................... 51

CHAPTER 3 DISCUSSION ........................................................................................................ 56
Conclusions From the Literature ......................................................................................... 56
Correlations Between the Six Principles of
The Framework and Place-Based Education .................................................................... 57
Framework Principle: Children are Born Investigators .................................................... 57
Framework Principle: Understanding Develops Over Time ............................................. 60
Framework Principle: Science and Engineering
Require Both Knowledge and Practice ............................................................................. 61
Framework Principle: Connecting Students’ Interests and Experiences ......................... 62
Framework Principle: Promoting Equity ........................................................................... 63
Implications .................................................................................................................... 64
Recommendations for Further Research ......................................................................... 65
Using PBE Methods for Meeting the NGSS ..................................................................... 65
Personal Reflections ......................................................................................................... 66

REFERENCES ...................................................................................................................... 68
## List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Organization of the Literature Review</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Disciplinary Core Ideas</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>Disciplinary Core Ideas Organization</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>Correlation Between Framework Principle: Children Are Born Investigators and PBE</td>
<td>57</td>
</tr>
<tr>
<td>5</td>
<td>Correlation Between Framework Principle: Focusing on Core Ideas and Practices and PBE</td>
<td>58</td>
</tr>
<tr>
<td>6</td>
<td>Correlation Between Framework Principle: Understanding Develops Over Time and PBE</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>Correlation Between Framework Principle: Science and Engineering Require Both Knowledge and Practice and PBE</td>
<td>61</td>
</tr>
<tr>
<td>8</td>
<td>Correlation Between Framework Principle: Connecting to Students’ Interests and Experiences and PBE</td>
<td>62</td>
</tr>
<tr>
<td>9</td>
<td>Correlation Between Framework Principle: Promoting Equity and PBE</td>
<td>63</td>
</tr>
</tbody>
</table>
Chapter 1

Introduction

Recently, I was on a field trip with my fifth grade students in a favorite place of mine. Vedauwoo is an area located in the Medicine Bow National Forest that is 10 miles outside of Laramie, Wyoming. This area has a large array of granite formations that offer many opportunities for outdoor experiences. Activities at Vedauwoo are many and can include rock climbing, mountain biking, hiking, camping, picnicking, and even hunting. It is a place I have enjoyed on many occasions by myself and with my family.

Having personally enjoyed a place so fully had me excited to share it with my students. Vedauwoo has so much to offer for learning. Students are able to experience the interactions between animals, the land, and people so close to their homes. However, I was surprised to listen to and be involved in many conversations with students who thought that being at Vedauwoo was boring or that they would rather be doing something else. The students seemed to show a lack of desire to be where they were.

As a Wyoming resident, it has been my general observation that many people who live here have a deep connection to the land. It has also been my assumption that if asked, most residents of Wyoming would name any number of activities from a long list of experiences outdoors as their favorites because of this deep connection to the place they live. Because of this, as an instructor, I have been surprised by students who voice their opinion that they would rather watch television than be in any number of the outdoor spaces that I have taken them to.

I have often wondered what I can do to help students develop a stronger sense of engagement with the place that they live. Proponents of the educational method place-based
education (PBE) argue that when students learn through the context of their local community and environment, a deeper and more meaningful connection is made to that local place. They would say that when students use what surrounds them in their local place, rather than textbooks teaching of an ecosystem hundreds or even thousands of miles away, the learning is more authentic and meaningful. A leading writer in the area of place-based education, David Sobel (2004), writes of a student verbalizing this connection in his book, *Place-Based Education*. At a curriculum meeting in a New Hampshire community a third grade student asked, “Why are we using textbooks that focus on landforms in Arizona when we have such amazing resources right in our backyard?” (p. 4) Gregory Smith (2002) has also written extensively about how using place-based education (PBE) can better engage students in their local environment and community. Smith and Sobel, in their book *Place-and Community-Based Education in Schools* (2010), describe models for engaging children in place using environmental and natural resource issues that they suggest offer students motivation to learn and develop a deeper connection to their own place because they are learning through issues that are personally meaningful.

**Statement of Problem**

As a public school teacher, I do not see students engage in relevant or meaningful ways with the place they live. They show a lack of concern with their surrounding area and even community. Simone Weil (1952) once described that humans have a fundamental need for roots and place and community. Students are losing their ability to have connection with their
place. In the forward to David Hutchinson’s book, *A Natural History of Place in Education* (2004), David Orr describes of the importance of learning how to be in a physical place:

> We will need help, beginning with the kind of education that fosters the skills, aptitudes, and wherewithal to live well in specific places. As alert observers of contemporary education know, this is not the direction in which we are heading. Education has been whittled down to a more prosaic and technical thing unrelated to the specifics of place, ecology, and a situated personhood... There is a better vision for education and the life of the mind that is rooted in place. (p. x)

In his landmark work, *Last Child in the Woods*, Richard Louv (2008) sums up a void that has developed between children and the environment with a quote from a fourth grade student; “I like to play indoors better, ‘cause that’s where all the electrical outlets are.” (p. 16)

In his book, Louv coins the phrase “nature-deficit disorder” to help describe this disconnect. It is a problem, he argues, that is detrimental to children and our society (2008). According to Louv, the surprise I have experienced during my fieldtrips, in which I have seen my students enjoy being in an outdoor classroom no more than an indoor classroom, is not a surprise to him.

Additionally, as a public school teacher, I find opportunities to design instruction and connect students in meaningful ways to the places they live difficult to prioritize due to pressures to meet standards as shown on high stakes tests. Gruenewald (2003b) has argued that conversations around accountability in education are so powerful that they cause for the focus in education to be almost solely on meeting a set of narrow and uniform skills and standards.
With teacher accountability and standards-based instruction at the forefront of education policy and professional learning, teaching in any manner that does not directly work toward the learning of subjects that are assessed in high-stakes tests can be difficult to justify. Educators find little to no opportunities for teaching subjects through place when they are consistently pressured to show student growth and achievement with high stakes testing (Gruenewald, 2005).

Purpose

The purpose of this paper is to review the literature in place-based education and to see how it correlates to A Framework for K-12 Science Education (referred in this paper also as the Framework) (NRC, 2012) as well as the Next Generation Science Standards (NGSS) (NGSS Lead States, 2013). Place-based education (PBE) uses a student’s physical location and personal experiences to teach content as well as skills. It is a way to instruct by trying to connect students with the world outside of the classroom. Sobel (2004) defines place-based education as, “...the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science, and other subjects across the curriculum” (p. 7). For the purposes of this literature review, when referring to place-based education, it will be primarily with Sobel’s definition in mind.
Questions

The guiding question behind this inquiry is as follows:

1. How does A Framework for K-12 Science Education (NRC, 2012) create opportunities for place-based methods to be used to teach science in the public school classroom?

For this question to be answered, a subsequent question also needs to be answered:

2. How do A Framework for K-12 Science Education (NRC, 2012), the Next Generation Science Standards (NGSS Lead States, 2013), and place-based methods overlap?

Significance

Public education in the United States is a massive web of institutions that affect millions of students. Currently, it is at a point where, as Gruenewald states (2005), schools must show in quantifiable ways that their students are meeting standards. Standards are a more prominent issue than ever before with states across the country adopting the Common Core State Standards (CCSS) (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010), and subsequently, the Next Generation Science Standards (NGSS Lead States, 2013). However, Gruenewald (2005) argues that educators who use place-based education tend to view standards as merely a basic level of what students can achieve. He states that those teachers who employ place-based methods realize that the standards will be easily met when focusing on the social and ecological aspects of the place that they and their students live.

The NGSS were created using the Framework for K-12 Science Education (NRC, 2012). The framework is clear that science learning should be much more than a set of content
targets. It calls for a markedly different set of standards than seen in the past. In fact, the Framework (NRC, 2012) states its purpose is to set a foundation for standards to be written that:

Ensure that by the end of 12th grade, all students have some appreciation of the beauty and wonder of science; possess sufficient knowledge of science and engineering to engage in public discussions on related issues; are careful consumers of scientific and technological information related to their everyday lives; (and) are able to continue to learn about science outside school (p. ES-1)

According to this statement, the NGSS standards should be more than a set of content targets for students to meet or practices to engage in. The Framework (NRC, 2012) is laying a foundation of science education that is much more than book knowledge and lab experiments. It is calling for a learning that, as Smith (2002) describes, “permeates” through school walls into the broader community and back (p.593) as he explains characteristics of place-based education. Further, the Framework (NRC, 2012) states that when students are engaged in learning science, it should “...engage them with fundamental questions about the world and how scientists have investigated and found answers to those questions” (p. 9). This call for learning beyond the classroom looks to have a clear connection to PBE methods that would engage students deeper to their place as well as help them learn important ideas of science.

In chapter two of this paper, I will cite what the literature says in regards to how the Framework (NRC, 2012) came to be written in the context of the history of science education in the United States. I will also reference the research behind what the authors recommended as the foundation for a next generation of science standards within the structure of the guiding
principles of the *Framework* (NRC, 2012). Within these recommendations, I will explore any correlations between the recommendations and the literature pertaining to place-based education, its principles, and its efficacy in helping students learn.
Chapter 2

Review of the Literature

Introduction

The goal of this literature review is to investigate the existing literature on place-based methods and how it relates to A Framework for K-12 Science Education (NRC 2012) as well as the Next Generation Science Standards (NGSS) (Achieve, 2013).

This literature review is organized into four sections (see Figure 1). The sections are titled methods, history of science education in the United States and the development of A Framework for K-12 Science Education, place-based education, and the six principles of A Framework for K-12 Science Education.

Figure 1. Organization of the Literature Review. There are four sections in the literature review: methods, history of science education in the United States and the development of A Framework for K-12 Science Education, place-based education, and principles of A Framework for K-12 Science Education.
Methods

This literature review utilized books, articles, web-pages, and brochures that were related to *A Framework for K-12 Science Education* (NRC, 2012) as well as place-based education theory, methods, case-studies and educational practices related to it. After looking at the two distinct topics under review I made comparisons to search for themes and commonalities.

**The Framework for K-12 Science Education**

When looking at the *Framework* (NRC, 2012), the document itself was heavily used as well as other relevant NRC documents related to it, most notably *Taking Science to School: Learning and teaching in grades K-8* (NRC, 2007) and *Ready, set, SCIENCE!: Putting research to work in K–8 science classrooms* (NRC, 2008). I also used sources cited in the NRC documents to help expand and understand the research behind the ideas that were the focus of this paper, most important being the principles of the *Framework* (NRC, 2012).

**Place-Based Education**

In looking for key ideas and themes in the realm of place-based education, I began with a focus on three primary authors who have shown to be the most referenced in the topic. Those authors are David Gruenewald, Gregory Smith, and David Sobel. With these authors’ multiple works as the foundational understanding of PBE, I then read sources cited by them in their own work including but not limited to John Dewey, David Orr, and Gerald Lieberman. The three primary authors also directed me to grant projects using as well as studies on PBE and
place-base related programs. These projects included the State Education and Environmental Roundtable, Rural Challenge Research and Evaluation Program, and Rural School and Community Trust. Along with these sources, I also looked at more recent literature that looked at curriculum development using PBE and related methods.

**Correlation**

When looking for a convergence between *A Framework for K-12 Science Education* (NRC, 2012) and place-based education theories and methods, I focused specifically on its six guiding principles as my major themes. The purpose behind this focus being that these guiding principles were the lens through which the framework was written based on what the *Framework* calls, “…a large and growing body of research on teaching and learning science.” (NRC, 2012 p. 23) It was with these principles, built on the assumptions made from that body of research that I looked for commonalities in the place-based literature. This was with the purpose being that when and/or if correlations were found it would suppose effective learning methods on the part of place-based education methods.

**History of Science Education in the United States and the Development of the Framework for K-12 Science Education**

The events that brought about the development of *A Framework for K-12 Science Education* (NRC, 2012) are many, varied and indirect. White (2001) states that the end of World War II and subsequent development of the Cold War caused a heightened awareness of the need for quality and widespread science education in the United States. Shortly thereafter, the
effect of the Russian launch of Sputnik caused the nation to put more focused and urgent attention on instruction in science. One of the results was that government funds through the National Science Foundation (NSF) as well as other organizations were increased to develop projects in science education and curriculum (NRC, 2007).

Throughout the 1960s and 70s, a central goal of these projects was to heighten K-12 students’ interest in the sciences so as to increase the number of individuals who would consider a career in the advanced sciences. The projects used techniques that were aimed at getting students to learn science as scientists rather than memorize facts from books (NRC, 2007). This was a shift from traditional teaching methods and learning theories. This was also a change in how science education was viewed as it was the first time that there was a push to influence curriculum nationwide (NRC, 2007). Due to the fragmented and federalist educational system in the United States, as well as a growing and vocal resistance from some people to anything that could be considered akin to a national curriculum, the success of these projects varied widely in implementation and success (Rudolph, 2002).

In 1983, The National Commission for Excellence in Education issued its report, A Nation at Risk, concluding that the US economy was at risk of losing its global dominance due to a lack of rigor in science and mathematics education (National Commission on Excellence in Education, 1983). Once again, the country was looking for ways to increase the reach and efficacy of science education and learning. This spurred on national and local systemic initiatives for positively impacting K-12 science throughout the country (NRC, 2007). Stakeholders came together to create frameworks and standards for state and local organizations which helped to guide class offerings and content taught at specific grade levels.
as well as define what it meant to be a proficient learner in different areas (NRC, 2007). In science, standards that were developed and influential were *Benchmarks for Science Literacy* (American Association for the advancement of Science, 1993) and *The National Science Education Standards* (National Research Council, 1996). These initiatives showed some positive effects but the results were varied and inconsistent due to a complicated mix of variables including difficult implementation, political and structural factors, and insufficient professional development (Berliner, 2006). Despite these inconsistencies, it was clear that schools and districts that participated in these initiatives for a longer period of time, were able to see positive results (NRC, 2007). This was also true in schools and districts that were traditionally considered low performing and/or in areas where students were also considered underserved (Boyd, Banilower, Pasley, & Weiss, 2003). However inconsistent, the benefit of a more clearly defined and focused set of standards for learning and content had been established.

In 2001, with the passing of the No Child Left Behind Act (No Child Left Behind [NCLB], 2002), the federal push for educational change in science continued. This time, the federal government required schools to assess their students yearly, even in science (NCLB, 2002). However, although NCLB brought federal education influence to new heights, specifically in the area of accountability and assessment, standards-based reform became the forefront of the national conversation with the development of the *Common Core State Standards in Language Arts and Mathematics* (CCSS) (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010).

When the CCSS were released in 2010, they were shortly after adopted by a majority of states (National Governors Association Center for Best Practices & Council of Chief State School
Officers, 2010). Having these standards developed and implemented on such an influential level created an interest in similar standards to be released in science (NRC, 2012). In 2012, the National Resource Council (NRC) released *A Framework for K-12 Science Education* (NRC, 2012).

Prior to the Framework’s release, the National Resource Council published *Taking Science to School* (NRC, 2007); an effort to synthesize for teachers, administrators, and other stakeholders what years of research said about how students learn science. The subsequent publication by the NRC, *Ready, Set, Science* (2008), showed what the implementation of the research from *Taking Science to School* (NRC, 2007) looks like when put into practice in the classroom.

*Taking Science to School* (NRC, 2007) and *Ready, Set, Science* (NRC, 2008) had set the stage, so to speak, for the development of a framework so that standards could be written. It was with the recommendations laid out in these two documents that *A Framework for K-12 Science Education* (NRC, 2012) was written. However, unlike past initiatives there was a clear shift in focus from making U.S. students more competitive. The goal of *A Framework for K-12 Science Education* (NRC, 2012) is not solely to lay out a recommendation for standards and practices with the hope of increasing the number of students that will eventually be interested in a career in science. The Framework was written also in response to a need for every citizen of the country to be scientifically informed at a basic level (NRC, 2012). In its summary, the Framework explains that there is a need for all people to have knowledge of science and engineering as it relates to global and national issues of policy as well as to help inform our everyday decisions (NRC, 2012). This broader interpretation and recommendation of science education that the Framework (NRC, 2012) offers opens the door to methods of learning
science that previously may have been considered novel or unconventional such as place-based education.

**Place-Based Education**

**Foundations of Place-Based Methods**

Place-based learning is not a recent or unique development in education. Although the methods have not always been formally referred to as place-based, it is and has been seen in many educational settings in an informal sense. For example, anthropologists point to the importance of learning within the context of place in hunter-gatherer societies. In these societies, the likes of which all of humanity descends, boys and girls are taught from a young age the different species of animals they are to hunt and plants that should be gathered for food (Thomas, 2006). This information is taught, not as a disconnected list of facts, but as vitally important knowledge that contributes to their health and wellbeing. The “student”, in this case, is deeply invested in the information being taught to them and is therefore assumed to be strongly connected to their place as well as have a deep appreciation for their role in the community as a providing member. This has been seen in societies that would be considered more traditional causing for social scientists to develop the phrase Traditional Ecological Knowledge to explain the idea of knowledge, practices, or beliefs passed down from generation to generation (Berkes, Colding, & Folk, 2000).

One doesn’t need to look to ancient civilizations for use of methods that can be thought of as having place-based tendencies. In his article, The Genius of Place (1998), author Ben Williams describes the early development of schools in the United States as an effort to teach
local traditions and trades to students when families and local tradesmen were unable to do so. Williams uses this example to point out that the local community was the starting point for how schools developed their curriculum (Williams, 1998). To make the point about how engrained the local place was in how schools taught, Williams writes, “Originally, skills like mathematics, reading and writing were intended to be enhancements of agrarian life, rather than alternatives to it” (Williams, 1998, p. 3). Again, the student has a high stake in the information being taught to him or her, as it contributes directly to the wellbeing of his or her family.

Even though many early or even prehistoric educational examples could be referred to as being place-based in their approach to teaching, John Dewey is often referred to as a foundational figure in place-based education thinking and philosophy (Jayanandhan, 2009). The core tenets of Dewey’s philosophy of education were environment, experience, and democracy (Jayanandhan, 2009). Although he doesn’t explicitly refer to place-based education or methods, these tenets are clearly seen in modern day definitions of place-based theories. Smith (2002) points out that Dewey often referred to a disconnect between the classrooms of the early 1900s and students’ lives; an important reason for advocating place-based methods. Levin (1991), points out that Dewey was concerned that schooling was moving in a direction that would not prepare students to be full members of society, and that the only way to effectively do this was to integrate the world outside of the classroom into the curriculum. In his publication, Experience and Education (1938), Dewey claims that students desire real-world application from education and states, “How many found what they did learn so foreign to the situations of life outside of the school as to give them no power or control over the latter?” (p. 15). Modern place-based educators have used Dewey’s ideas and expanded them to argue that
one role of education is to prepare and encourage students to lead socially and ecologically sound lives (Jayanandhan, 2009).

**Constructivism**

Constructivism is an educational theory that is closely tied with place-based education. It is based off the theory that children construct their own meaning and therefore understanding of subject matter through their own experiences (Brooks & Brooks, 1999). Constructivist writers also point to Dewey’s writings as an historical basis for their ideas. They often refer to Dewey as a figure arguing that students’ background knowledge, previous experiences, and fundamental worldview profoundly impact how students learn; the theoretical precedence to the educational idea that students ‘construct’ their own meaning of information (Theobald & Curtiss, 2000). Theobald and Curtiss (2000) point out that constructivism and place-based education are closely related. In his article, “The best of both worlds: A critical pedagogy of place” (2003a), David Gruenewald writes that in fact place-based education is often connected to a wide variety of educational frameworks and theoretical ideas including constructivism, experiential learning, problem-based learning, outdoor education, and community-based education.

A constructivist tie also points toward what Jayandanhan (2009) considers a second branch of place-based education; one that focuses on the struggles and experiences of urban youth. This second branch points beyond definitions of place-based education that solely focus on the local community and environment for the experiences that students build on to develop meaning when learning. David Gruenewald, argues that a focus on these urban situations,
where the goal of education is to put into perspective local injustices, is an essential extension of place-based education (2003a). Gruenewald refers to this extended focus on injustice, or what can be referred to as not just a look at what is present in a local community or environment but what is missing as a “critical pedagogy of place” (2003a). Theobald and Curtiss (2000) write that when students engage in these meaningful and authentic problems of community it is an intrinsic motivator for learning as this moves students toward being part of a solution.

The Rural Challenge Research and Evaluation Program (1999) was a project that worked toward implementing curriculum that is highly focused on place while giving students opportunities to be problem solvers in their communities. It describes using place-based education as well as constructivism to move students from learning outside a subject to not only being involved in a subject but understanding that their involvement has an impact on the direction or outcome of an event or issue (Rural Challenge Research and Evaluation Program, 1999a).

**Definition of Place**

To understand place-based education, it is helpful to have clarity in an understanding of what advocates refer to as ‘place’. Semken and Freeman (2008) refer to place as a combination of physical spaces and what a person brings to that space. Moreover, this physical space expands to include many different aspects and emotional attachments that form a person’s ‘sense of place’ (Semken & Freeman, 2008). These aspects can include ceremonial, aesthetic, economic, familial, historical, political, spiritual, and scientific aspects (Semken & Freeman,
2008). Tuan uses the term topophilia to describe human’s connection to place (1974). He defines topophilia as, “...the affective bond between people and place or setting” (1974, p. 4). Orr (1992) refers to place as being an important integrative element in education as a way to combine intellect with experience. With this description on mind, students’ interests and experiences have very close connections to place-based advocates’ understanding of place. Also, how a person develops their own ‘sense of place’ can include different aspects of that place (Semken & Freeman, 2008).

Haas and Nachtigal (1998) expand this definition of place by describing it as the “...history, ecology, and social and physical infrastructure that surrounds (students)” (p. 3).

Vitek and Jackson (1996) describe the sense of connection people in rural areas have with the places they live: “Here the land becomes part of people’s lives, intermingled buying and selling, working and playing, living and dying. It is both history and future. In rural communities is an opportunity for the land’s rhythms” (p. 3). Hutchinson (2004) also explains that place is different to each person. He points out that place is significant in specific ways as it relates to the person who inhabits it (Hutchinson, 2004).

**Place-Based Education Today**

An agreed upon and overarching understanding of what place-based education is and how it is implemented can be difficult to find as there are many definitions and even names that can be given to it (Nespor, 2008). Place-based education can often times be referred to as place-conscious education, consequential learning, community-based learning, teaching to the commons, environmental education, and rural education to name a few (Nespor, 2008). In that
same vein, it should also be noted that Place Based Education and the theories, practices, and perspectives authors suggest and advocate for are diverse and broad (Nespor, 2008). Often times, it is clear that authors show a hesitancy to suggest a model to use as a template for how to implement PBE into the classroom. However, there are some authors who continue to be present in the literature as agreed upon authorities in the subject. David Sobel, David Greenwood (formally Gruenewald), and Gregory Smith are often cited in the literature of place-based education. Sobel (2004) gives an explanation of place-based education as a way of connecting students with their world outside the classroom. It is a process and theory in which the local community and environment are the basis for learning educational concepts (Sobel, 2004). Sobel (2004) is also careful to point out that place-based education is multidisciplinary and does not only lend itself to one subject area. He goes even farther in his explanation of PBE to not simply refer to it as a methodology of teaching or even a broader pedagogy, but rather he refers to it more as a worldview (Sobel, 2004).

Place-based education has been closely tied or even considered synonymous with other educational principles (Gruenewald, 2003a). However, because place-based education often involves time spent outside of the classroom in natural settings, it is common for place-based methods to be used to teach scientific, or more specifically environmental concepts. To those who are proponents of PBE, to primarily view it as interchangeable with environmental education is too narrow and constricting (Gruenewald, 2005). By its very nature of being driven by the local community and environment, place-based education must be customized to fit the needs of where it is being carried out (Sobel, 2004). Whether those needs are environmental or social is wholly dependent on the place.
David Gruenewald is sure to make the distinction between place-based education and environmental education. Although either educational practice could be considered a sub-field of the other, he makes it a point to let readers know that there is a difference. In his article, *Accountability and collaboration* (2005), Gruenewald states:

Place-based education, on the other hand, has not yet been widely institutionalized and potentially appeals to a broader range of participants in communities and schools. Whether people identify with or are alienated by ‘environmentalism’, they can still appreciate and care about the places where they live... Many people from diverse backgrounds love their places whether or not they identify as ‘green’. Consequently, I view place-based education as the discourse with more potential to impact on the future of schooling on a broad scale. (p. 263)

In what could be considered loose guidelines, Sobel (2004) discusses four instructional shifts that lead toward a more place-based approach to education from what would be considered a more traditional approach. These shifts are 1) creating an environment of sustainability, 2) finding connections in all learning to other subjects, 3) keeping learning relevant to the local place and time of the school and students, and 4) acknowledging and using the diversity of the students and their learning styles (Sobel, 2004). Gregory Smith (2002) identifies five themes that Place-Based education can fall into: cultural studies, nature studies, real-world problem solving, internships and entrepreneurial opportunities, and induction into community processes.

Beyond these broad guidelines and themes, place-based Education is many times presented as a theory surrounded by examples in which it has been implemented in specific
settings. This is shown in Gruenewald and Smith’s collection *Place-Based Education in the Global Age* (2007). The book presents examples in which practitioners discuss that a focus on place can be used to successfully teach important concepts in an increasingly globalized world (Gruenewald & Smith, 2007). In the book’s introduction, Gruenewald and Smith present place-based education as a fix for what they consider the problem of not thinking about the earth (Gruenewald & Smith, 2007). They write, “Place-based education takes us back to basics, but in a broader and more inclusive fashion. Desirable environmental education, or what we’re calling place-based education, teaches about both the natural and built environments” (p. 9). Also, Gruenewald and Smith (2007) give a picture of place-based education as being a way of learning in which the teacher can integrate curriculum that emphasizes project-based learning, collaboration with other teachers, and is able to use community resources and volunteers. Another example of this is the Rural Challenge and Research Evaluation Program (1999b). In the case of this initiative from the Annenberg Rural Challenge, exemplars are given of sites throughout the country in which place-based methods have been employed. Rather than give prescribed steps for carrying out place-based education in a school or district, key elements are shared from each site to show what the Challenge views as the “richness and diversity of the work being done...” (Rural Challenge and Research Evaluation program, 1999b, p. 2).

The primary reason that authors will point to for not providing more clear and prescribed methods for implementing place-based education lies within the fact that it is supposed to be fluid and dependent on the place it is being implemented (Smith, 2002). Smith explains, “Place-based education can take a wide range of forms. One of its primary strengths is that it can adapt to the unique characteristics of particular places, and in this way it can help
overcome the disjuncture between school and children’s lives that is found in too many classrooms” (p. 593). Gruenewald (2003a) explains this ability to adapt not as a downfall of the methods, but as a positive aspect. He says the challenge that educators face when implementing place-based in the classroom is to think about how to explore their local place more and view education as way to develop the well-being of where they teach and their students learn (Gruenewald, 2003a).

**Place-Based Education and Science Education**

As discussed earlier, PBE has not traditionally been exclusively associated with science instruction or even environmental education. However, with the continued focus on standards, and specifically the development of the *Next Generation Science Standards* (Achieve, 2013), educators are at a point where the method of place-based education may be a viable and even preferable way to teach to national standards (Gruenewald, 2005). *A Framework for K-12 Science Education* (NRC, 2012) states a goal of science education as helping students understand and appreciate that science has been a historical process that has helped to form the world that they live in currently. It is also clear to point out that science, engineering, and technology permeate all aspects of our society (NRC, 2012). The practicality of science and use of it and the knowledge that it gives us is essential for students to be engaged and productive members of society (NRC, 2012). With these statements, the writers of the *Framework* give a picture of science education that reaches beyond a subject or discipline. Deep and genuine understanding of science is necessary for citizens to be engaged in solving the problems presented to them every day (NRC, 2012).
As shown earlier, place-based education is concerned with practical application and real-world problem solving (Theobald & Curtiss, 2000). Place-based educators strive to have students engage in meaningful and authentic problems partly as a motivator for students to learn and even be part of how that problem is solved themselves (Theobald & Curtiss, 2000). Place-based educators strive to bring this effort to have students be a part of local solutions to problems to another level by developing connections to a place (Semken, 2005). Semken (2005) suggests that using local problems, rather than global issues in geoscience can use a connection to one’s place to involve students in solving those local problems. He even goes on to suggest students can be motivated to pursue science as a career to be a positive force in their community as professionals (Semken, 2005). This desire to bring more students into science as careers to help with understanding and solving modern issues is stated in the introduction of A Framework for K-12 Science Education (NRC, 2012).

Semken and Freeman (2008) state in the article Sense of place in the practice and assessment of place-based science teaching:

Thus, conscientious, effective place-based science teaching must be informed not only by the sound scientific knowledge of the places of study (such as would underpin any good mainstream pedagogy) but also by a respectful if not mutual understanding of the diverse meanings and attachments affixed to these places. These meanings and attachments provide context for the scientific knowledge, and enrichment of the senses of place of students and instructor should be an expected learning outcome of a place-based science lesson, course, or curriculum. (p. 1044)
Even though place-based education authors and theorists are careful to not pigeonhole PBE methods into one particular educational subject such as science, it is seen from the previously cited literature that it is still considered to be an effective tool for instruction in science.

**Principles of *A Framework for K-12 Science Education***

*A Framework for K-12 Science Education* (NRC, 2012), has a structure and content developed through the research it drew from *Taking Science to School* (NRC, 2007), and *Ready, Set, Science* (NRC, 2008). It also drew from work done in previously released standards documents such as the *Benchmarks for Science Literacy* (American Association for the advancement of Science, 1993) and *The National Science Education Standards* (National Research Council, 1996). This structure and content were developed through the lens of six guiding principles (NRC, 2012). For the purpose of this literature review I will use these principles as my major themes to look for convergences between place-based education and the *Framework*. The principles are as follows given in the order presented in *A Framework for K-12 Science Education* (NRC, 2012, pp. 24-29):

1. Children are born investigators
2. Focusing on Core Ideas and Practices
3. Understanding Develops over time
4. Science and Engineering Require both Knowledge and Practice
5. Connecting to Students’ Interests and Experiences
6. Promoting Equity
I will introduce each theme by first synthesizing the principle and connections it has to place-based education. I will then present the reasoning behind why it was chosen as a principle for *A Framework* and then citing works related to that theme that are related to place-based education as well as its related educational practices.

**Framework Principle: Children are Born Investigators**

The *Framework* principle children are born investigators is referring to the understanding that when children come to the classroom they already have many developed ideas of scientific concepts (NRC, 2012). This is different from previous beliefs that children come to the classroom with little knowledge of the natural world. This principle is similar to the belief in place-based education that children are naturally curious about the world around them (Smith, 2002). Place-based advocates also take this idea deeper to advocate for the use of students’ curiosity of their local place to learn scientific concepts.

**Reasoning and research behind principle.** The notion that children are born investigators comes from *Taking Science to School* (2007). The document states that,

In contrast to the commonly held and outmoded view that young children are concrete and simplistic thinkers, the research evidence now shows that their thinking is surprisingly sophisticated... Children entering school already have substantial knowledge of the natural world, which can be built on to develop their understanding of scientific concepts... By the end of preschool, children can reason in ways that provide helpful starting points for developing scientific reasoning. (NRC, 2007, p. 53)
A Framework for K-12 Science Education (NRC, 2012) uses this research to claim that these early understandings can be used for learning and even correcting misconceptions. This is also not just in the earliest grades, but throughout the elementary years as a progression of understanding of natural phenomena (NRC, 2012). This also means that students are able to learn at deeper levels of understanding rather than simply have mere exposure as previously thought (NRC, 2012). The further implication of this is that students learn from experiences and not from simply being mature enough to be introduced to a topic (Houseal & Ellsworth, 2014).

Connections to constructivism. That children are born investigators confirms what constructivist thinkers have been calling for in education for many years. Brooks and Brooks present five principles that guide constructivist teaching in a classroom (1999). One of the principles is that teachers are to seek and value their students’ point of view (Brooks & Brooks, 1999). This is very similar to the principle in the Framework in which educators are reminded that children are born investigators (NRC, 2012). As stated earlier, many place-based education writers point out how closely constructivism is related to PBE (Rural Challenge Research and Evaluation Program, 1999; Theobald & Curtiss, 2000; Gruenewald, 2003a; Jayanandhan, 2009).

Connections to place-based education. Place-based education writers have made this point previously in advocating that children are naturally inclined to investigate scientific phenomena. Gregory Smith, (2002) discusses that children have an “inborn curiosity about the physical world” (p. 588). Smith encourages teachers to take advantage of this curiosity and advocates curriculum to have these studies of the local natural and human communities as way
to harness it (Smith, 2002). He builds on this idea as well in which he states that place-based methods can be the catalyst from which teachers use local natural phenomena, in which he gives many examples, as a foundation to build on and learn about distant and abstract phenomena (Smith, 2002). He takes this idea further to state that beyond just having the ability to understand abstract and complicated scientific concepts and having a curiosity toward them, students create their own learning (Smith, 2002). Rather than merely learning knowledge others give to them, students develop their own understandings. Smith likens this approach to graduate level learning, an experience and opportunity he argues that younger students shouldn’t be denied (Smith, 2002).

**Framework Principle: Focusing on Core Ideas and Practices**

The *Framework* principle of focusing on core ideas and practices is referring to research that shows students are expected to learn too much information in too little time (NRC, 2012). In an effort to remedy this it lays out four domains of disciplinary core ideas, as well as science and engineering practices (NRC, 2012). The core ideas, which traditionally would be thought of as content, are what people often have in mind when they think of standards. Although the *Framework* is not specifically a standards document, it is the guide for developing the *Next Generation Science Standards* (NRC, 2012). When standards are written, assessments that teachers and students are accountable to soon follow. Many place-based writers have expressed their opposition to standards-based reforms such as standards and high-stakes assessments. They write that these reforms remove the focus of schools and teachers from the local community and environment and instead cause for increased time and energy to be
directed to passing a test based on a narrow set of standards that have little to do with what is local.

However, there are place-based writers who say that standards are easily met using the local community and environment. These writers point to methods of planning such as Understanding by Design (UBD) (Wiggins & McTighe, 2005) and the Environment as the Integrating Context (EIC) (Lieberman, 2013) for teaching standards within the context of the local place.

The scientific and engineering practices in the Framework refers to the practices that scientists and engineers engage in when answering questions and solving problems (NRC, 2012). Place-based education shows many clear connections to this in the many ‘hands on’ ways that it advocates for students to engage in learning as well as the often described desire of place-based educators to have students identify, explore, and solve problems in their community.

Reasoning and research behind principle. In A Framework for K-12 Science Education (NRC, 2012), an effort is made to focus on a smaller group of what it terms core ideas and practices to develop a deeper understanding of what is considered to be the most important concepts. In How People Learn (NRC, 2000), the description is given of experts in particular fields understanding the connection of the important foundational facts of a topic in order to gain a deeper understanding of that topic (pg. 239). Therefore, in learning, understanding of the core ideas and practices will allow students to be ready for a broader understanding in later experiences (NRC, 2012). This principle feeds directly to the Framework’s goal of students
having knowledge that can allow them to be a part of public discussions of science (NRC, 2012).

When it states that it wants to lay out a pathway to, “Ensure that by the end of 12th grade, students have some appreciation of the beauty and wonder of science.” (NRC, 2012, p. ES-1) it is pointing back to the research on the importance of deeper understanding of a small set of standards.

**Disciplinary core ideas.** The core ideas of A Framework for K-12 Science Education (NRC, 2012) are grouped into four domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology, and application of science. Each domain has core ideas (see Figure 2).

![Disciplinary Core Ideas](image)

*Figure 2. Disciplinary Core Ideas. The disciplinary core ideas of the Framework are categorized under four domains (NRC, 2012 p. 3).*

The core ideas are broken into smaller component ideas (NRC, 2012). Each component is developed around an essential question that frames the main concept (see Figure 3). Each component idea has grade endpoints for grades 2, 5, 8, and 12 (NRC, 2012).
Standards-based reform. The principle of focusing on core ideas, could be viewed as the Framework’s most stringent as it lays out the suggested content students should learn from kindergarten through twelfth grade (NRC, 2012). Although these are not standards prescribed to be learned, they are laying out the framework for the work to be done for those standards and is using recommendations from previous documents that also pointed toward standard or explicitly laid out standards (NRC, 2012). The writers of the Framework also point out in its forward that it is intended to be a document to drive the creation of new science standards (NRC, 2012). The standards that were derived from the Framework are the Next Generation Science Standards (Achieve, 2013). So although the Framework is not a standards document, it

---

**Figure 3.** Disciplinary Core Ideas Organization. Each domain has core ideas that are broken into smaller components connected to essential questions to be answered by different grade level “endpoints” with increased complexity. This example shows the organization for one component in physical sciences. (NRC, 2012 p. 106).
is closely related and seems appropriate to include standards and standards-based reform in the discussion of disciplinary core ideas.

When standards are discussed, it is usually alongside discussions involving accountability and high-stakes testing (Gruenewald, 2005). This accountability causes for much focus to be on preparing students for a test and becomes the dominant purpose for much of education (Gruenewald, 2005). These focuses on student achievement which is quantifiable in some way, causes for little to no focus to be put on methods in education that may have more of a place-based methodology (Gruenewald, 2005). Gruenewald, (2005) even goes as far to state that educational reforms around standardization are so pervasive and powerful in education that they are becoming institutional ways for societal and governmental institutions (such as schools) to control the population, or what he calls, “coercive normalization” (p. 266).

Similarly, Smith and Sobel (2010) discuss that since the end of World War II, the purpose of education can be thought of as the path for developing “society's human capital”, or what could be described as a way to develop students’ abilities to be economically productive (p. 31). Smith and Sobel (2010) go on to state that this purpose of education is in contrast with place-based education values. They argue that a focus on economic productivity causes for schools to focus attention on the nation rather than local community and environment (Smith & Sobel, 2010).

**Place-based education.** A core tenant of place-based education is that the local environment and community drives the curriculum (Gruenewald, 2003a; Sobel, 2004). This is seemingly opposed to standards driving the curriculum. Place based advocates argue that if
standards are written, they should be rooted in local place, knowledge, and communities (Rural School and Community Trust, 2000) rather than given from a national level. David Gruenewald (2003a) also states that both experiences and objectives for learning a teacher works toward achieving “depends on the distinctive characteristics of the places they inhabit” (p. 8).

This contrast between the fundamental principles of place-based education and the purpose of standards has caused place-based writers to not only be wary of standards-based reform, but state that it is contradictory with the purpose of place-based education (Stevenson, 2007). Gruenewald (2004) states that any educational reform that focusses on standards is unable to be compatible with place-based education due to an overreach of corporate interests into public education. He also states that standardization reform, which he connects directly to business and economic development goals, has completely taken over previously held aims of education such as, “democracy and humanistic development” (Gruenewald, 2004 p. 78).

Gruenewald (2005) also writes that the system of accountability disregards place-the local cultural and natural environment. Similarly, the Place-based Education Evaluation Collaborative (PEEC) point out that place-based education is contrary to the trend brought on by standards-based reforms that it sees as being non-local and too one-size-fits-all (2003).

Smith & Sobel (2010) discuss the importance of looking at place-based education in a time where standards and standards-based reform is such a focus. They ask the question of why it is important to consider place-based education in a time where legislation such as no child left behind creates such difficulty to do so (Smith and Sobel, 2010).

The answer to these questions is fourfold. First, educational practice largely divorced from children’s direct experience of the world is failing to engage large numbers of
students. Second, the absence of an institution aimed at drawing young people in to the experience of social affiliation is resulting in a form of civic withdrawal that threatens the long-term viability of democratic institutions. Third, the sustainability of contemporary societies requires the development of an ethic of environmental stewardship that places the welfare of future generations and natural systems over short-term profits. Finally, the economic, social, and environmental challenges of the twenty-first century are unlike those known in any earlier period of human experience. Addressing them will require the multiplicity of diverse responses from people where they live rather than from large centralized institutions unable to adapt with enough speed or specificity to changing economic, political, or environmental conditions. (p. 32)

Some organizations in which their primary goal is to foster and develop place-based methods, have steered away from working in districts and school where a primary focus is on increasing student achievement on standardized assessments (Rural Challenge Research and Evaluation Program, 1999a). The Rural Challenge Research and Evaluation Program (1999a), noted that they were more likely to work with sites that had a goal of developing relationships with the local community and environment to develop curriculum to revitalize a community rather than focus primarily on increasing test scores.

There are writers who argue that more recent standards-based reform (of which the Framework is viewed to be a part of) and place-based education may not be as incompatible as previously believed. One view is that standards are easily met through place-based methods as they are what writers would consider to be a bare minimum of understanding of content.
Gruenewald (2005) makes an argument that when teachers use place-based methods, standards are the minimum of what students learn. It should be noted though, that he still feels that standards are limiting to teachers interested in using place and community as the guide for instruction (Gruenewald, 2005). However, he also writes that the discussions surrounding standards-based reforms, rather than being just a departure from the values of place-based education, can offer “entry points” for teachers to create change in the school setting that is more in line with ideas that are centered around teaching with place in mind (Gruenewald, 2005). Demarest (2014) also writes that standards are a way for entire schools or even districts to develop a stronger focus on the local environment and community.

Lieberman (2013) speaks explicitly to his belief that standards-based instruction and methods including the local community and environment are not incompatible. He notes that:

By connecting instruction to a school’s local environment, teachers can engage students with authentic lessons that directly support their efforts to help students become proficient in academic content standards. By interweaving academic content through interdisciplinary instruction and connecting it to environmental themes, or “contexts,” environmental study becomes not simply add-on to academic studies, but an engaging, integrating medium for multiple subjects. (Lieberman, 2013 p. 3)

Gruenewald (2005) goes further to argue that the increased focus on community-school partnership that has emerged through accountability measures is an opportunity for schools to create a more meaningful relationship focused on place and local issues. He states that if there is a shift away from using collaboration as a way for communities to punish local schools for perceived “poor performance” (i.e. publishing poor test scores in the local paper) to a
partnership in improving children’s participation in their local community then powerful learning can happen (Gruenewald, 2005). Also, Gruenewald (2005) argues for a move from collaboration being used to enforce educational practice that meets a narrow set of standards, to supporting students learning in the context of what is valued at the local community level as well as the local environment (2005). He states that this would be a powerful partnership that could actually demonstrate effectiveness and accountability (Gruenewald, 2005). Gruenewald also discusses that in order for this collaboration and accountability to be effective while still advocating for place-conscious education, then a process is needed that, “...directly connects educational planning and assessment to local cultural and ecological analysis and to local community action.” (Gruenewald, 2005, p. 280).

Demarest (2014) speaks directly to this process that Gruenewald (2005) calls for in his work. Demarest speaks of using design tools for learning from Understanding by Design (Wiggins & McTighe, 2005) to purposefully bring together standards, students, and the community. It is primarily through the understanding by design model that Demarest (2014) suggests place-based education is able to be used to meet the demands of standards and accountability.

In their framework for understanding by design (UBD), Wiggins and McTighe (2005) lay out a three stage planning process for what they term “backwards design”. This three stage process involves first, identifying desired results (i.e. standards) second, determine assessment evidence, and third plan learning experiences and instruction. It is during this third stage that Demarest (2014) suggests community and the environment are integral parts of how students learn. It should also be noted that Wiggins & McTighe (2005) state that within the first stage of
backwards design, teachers focus desired learning within an “essential question” that provides a focus for all learning. This is very similar to how the Framework (NRC, 2012) gives guiding questions for exploring the different components of the disciplinary core ideas.

Wither (2000) writes from a study of a school system working to incorporate place-based methods into the curriculum noted that standards were an important part of making the PBE program more consistent with what community members and educators had goals of achieving. She writes that it was when the teachers and community members both were aware of the standards that it was easy to achieve their goals (Wither, 2000).

Demarest (2014) discusses specifically how teachers can work toward meeting standards through place-based methods. She writes,

In general, the world of standards and the heavy burden that it places on teachers, runs counter to the view of their creative capacity as artists. However, standards when used appropriately are not antithetical to excellent teaching and deep learning. (Demarest, 2014, p. 16)

Demarest also states that when teachers use place-based methods, there is no conflict between the pressures of needing to raise students’ test scores or increase student achievement, and expanding their learning to outside of the classroom (Demarest, 2014). The way that teachers are able to meet standards with students as well as use methods that revolve around place is to clearly define assessment goals, Demarest argues (2014). She also states,

In the process, they find ways to not get lost in the diminished expectations that current calls for accountability represent. A larger purpose can house the mastery of the skills
and knowledge of the specific subjects – as well as bigger, more important questions.

(Demarest, 2014, p. 16)

**Scientific and engineering practices.** The scientific and engineering practices laid out in *A Framework for K-12 Science Education* (NRC, 2012) are in the following eight categories:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

In its introduction of the scientific and engineering practices, the *Framework* (NRC, 2012) points out that science education has had a goal from its inception of not only to help students learn content, but to “cultivate students’ scientific habits of mind, develop their ability to engage in scientific inquiry, and teach them how to reason in a scientific context.” (p. 41) Beyond practices being a focus of science education historically, the *Framework* (NRC, 2012) points out the importance of practices to avoid students having an underdeveloped understanding of science simply as only disconnected scientific facts.

Driver, Leach, and Millar (1996) also point toward what has been previously mentioned as a goal of the *Framework* (NRC, 2012) of developing scientifically literate students who are
able to participate fully in scientific conversations as an important component of being part of a democratic society. In the book *Young people’s images of science* Driver, Leach, and Millar (1996) state:

> There is an important argument that school science, if it is to contribute effectively to improved public understanding of science, must develop students’ understanding of the scientific enterprise itself, of the aims and purposes of scientific work, and of the nature of the knowledge it produces. Such an understanding, it is argued, is necessary for students to develop an appreciation of both the power and limitations of scientific knowledge claims, an appreciation which is necessary for dealing appropriately with the products of science and technology as informed citizens who can participate fully in modern democracy. (p. 1)

In the explanation of the scientific and engineering practices, the *Framework* (2012) is sure to delineate between practices that are specific to science (geared more toward asking questions and developing explanations) and practices that are specific to engineering (geared more toward identifying problems and designing solutions). (p. 49)

The importance of being exposed to these practices is important for students’ development of an understanding of how scientific communities work (Driver, Leach, & Millar 1996). Driver, Leach, and Millar (1996) point out that previous experience students will have with how scientists work will be primarily shaped from exposure through media or conversations with adults and peers. However, it is important to be taught for clarification and to remove misconceptions in the science classroom (Driver, Leach, & Millar 1996). The *Framework* (NRC, 2012) discusses specifically that when students are engaged in “the actual
doing of science or engineering” they will be motivated for further study and develop a heightened interest in what they are learning (p. 42). The Framework (NRC, 2012) also points out that when students engage in the practices, they are able to see that science and engineering are the primary method that we have to meet the major challenges that face society today.

It should also be noted that the Framework (NRC, 2012) is clear to explain that the recommendation of these practices are much more than simply teaching students about the “Scientific Method”. The Framework (NRC, 2012) recommends that an effort should be made to help students understand that scientific investigations can take many forms and that in order to understand phenomena and solve problems there are many avenues to take. It is through learning about and engaging in the eight practices, that students can see which ones are appropriate for different challenges (NRC, 2012). The Framework states, “...the notion that there is a single scientific method of observation, hypothesis, deduction, and conclusion—a myth perpetuated to this day by many textbooks—is fundamentally wrong” (NRC, 2012, p. 79).

**Connections to place-based education.** Place-based education writers and advocates often speak of the importance of doing science. A large portion of the writing available in relation to place-based education is in the form of exemplars and vignettes explaining how teachers have used place-based education in their local setting. Many of these examples given, explain students involved in what can be described as the scientific and engineering practices.

Smith (2002) discusses multiple ways in which students engage in science questions and engineering problems. For example, he discusses classes investigating local watersheds in
Oregon (Smith, 2002). During these investigations, students are involved in asking questions, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, and obtaining, evaluating and communicating information (Smith, 2002). He also discusses after an understanding is developed through investigations, that students then become involved in solving ecological issues connected with the watershed (Smith, 2002). This extension of learning using the local watersheds to defining problems and designing solutions speaks to the engineering side of the scientific and engineering practices (NRC, 2012).

Another example is shown by Smith and Sobel (2010) in which students in a 6th grade classroom in Maine are involved in monitoring for red tide. Students work to collect data of oxygen levels, salinity, and temperature and then compare the data to population density in the area. After data is collected, students graph the data to look for trends (Smith & Sobel 2010).

A similar example as described by Shelton (2005) articulates how students in rural Alabama employ many of the science and engineering practices when they create an aquaculture program through the school. In this example, students collect data from the fisheries, report to others about the status of the fish, and perform investigations using the aquaculture. Shelton (2005) also explains that the aquaculture program’s director observed students use the project to ask and answer questions. In this incidence, the teachers connected with the aquaculture worked side by side with professional scientists allowing for the students to not only mimic the practices of scientists but to be involved with the scientists “helping them to carry out challenging science-based tasks” (Shelton, 2005 p. 109).
Place-based educators often write about what could be described as scientific and engineering practices when explaining how students define problems, design solutions, and engage in arguments from evidence. This is most likely due to the desire to have students be active citizens in their communities who contribute to finding answers to problems they perceive (Gruenewald, 2003a; Smith, 2002; & Sobel, 2004). Smith gives an example of this when describing a class using PBE methods:

Students in Senechal’s class gather scientific information, master it, and then explain it to their neighbors, to agency personnel, and to politicians. They are learning how to work and the intersection of science and politics in the service of their community.

(Smith, 2002, p. 592)

**Framework Principle: Understanding Develops Over Time**

The Framework principle that understanding develops over time was developed from research showing that in order for students to truly understand scientific concepts, learning needs to occur over a period of years rather than months (NRC 2012). This connects to times when place-based education writers have called for students to spend long amounts of time learning of specific areas as well as different aspects as they grow older. This is also consistent with Traditional Ecological Learning where children learn over their entire lives important concepts through hands-on learning, stories, and social norms.

**Reasoning and research behind principle.** Taking Science to School (2007), states that deeper understandings of topics occur, “...over a broad span of time (e.g., 6 to 8 years)” (p.
Science educators need to take into account how a concept being taught at one grade level is contributing to a broader understanding of the concept. *A Framework for K-12 science education* (NRC, 2012) lays out learning progressions to promote learning over time. It also works toward this by posing questions that work toward understanding of individual components of categories for each core idea (NRC, 2012). As stated earlier, these questions are answered in continued complexity as students move through the grade bands (NRC, 2012). This continued development of complexity through the grades allows for connectedness of concepts rather than the teaching of isolated facts (NRC, 2012).

**Connections to place-based education.** Place-based education writers have also noted the importance of learning over longer periods of time. Gruenewald (2003a) writes about this idea in the context of place and students’ connection to it. He points out that a large amount of time is needed in the out-of-doors in order to develop what he calls “long-term relationships with familiar, everyday places” (p. 8). Gruenewald (2003a) argues that this extended time is important for consciousness that moves students toward a connection that will develop a deep understanding of an area and its ecology. He takes it further, however, then the importance of a student’s understanding of concepts. Gruenewald (2003a) says that this long-term understanding of a place helps motivate students toward political action and involvement in solving local problems.

Sobel (2004) suggests what he calls “new directions” in how schools are organized to take on the characteristics of a place-based model. One of these new directions he describes as a developmental guide for designing curriculum (Sobel, 2004). This developmental guide for
curriculum design is based on the idea that students should expand on concepts learned in earlier grades as they are able to understand them in progressively complex ways as they grow older (Sobel, 2004). He gives the example of a curriculum developed by a school in which students gradually learn more and more about their local ecosystem and community by slowly moving outward from the school and spending more time learning about the area around them. Students begin by exploring a local park in kindergarten and move outward to exploring mountain ranges further away from their school in upper grades (Sobel, 2004).

**Traditional ecological knowledge.** The principle that understanding develops over time also points to a connection that place-based education writers often make to traditional societies. Berkes, Colding, and Folke use the term Traditional Ecological Knowledge to describe knowledge that is learned over periods of many generations (2000). In a Traditional Ecological Knowledge model, information is learned from a young age using apprenticeships, stories, cultural beliefs, and even the pressures of social norms (Berkes, Colding, & Folke, 2000). Marker also explains this idea of students learning through their culture connected to a specific place (2006). Tribal people have shown to have developed a sustainable connection with their local place through years of learning environmental and cultural histories (Marker, 2006). It is through the daily tasks they partake in from very young ages that students learn the ecological knowledge of their environment (Marker, 2006).
Framework Principle: Science and Engineering Require Both Knowledge and Practice

In the past, people have often thought of science as being a body of knowledge explaining the world around us. The Framework principle that science and engineering require both knowledge and practice comes from the recent understanding that science is also practices that are used to develop, test, and expand that knowledge (NRC, 2012). Place-based education connects well to this principle in that it advocates for students to be often out of the classroom interacting with the subjects they are learning about. In this sense, there is an encouragement to do science rather than solely to learn science.

Research and reasoning behind principle. A Framework for K-12 Science Education (NRC, 2012) argues that both knowledge as well as practices are important components to acknowledge and teach during science instruction. The same is true for engineering, an interwoven and important component of the Framework. The inclusion of engineering into the Framework is considered the application piece of science. Students understanding that the use of scientific knowledge to solve real-world problems is an important component in the teaching of science and closely related to engineering (NRC, 2007). This also shows that science and engineering both are processes that usually are social in nature and are rarely done in solitude (Houseal & Ellsworth, 2014). Acknowledging and teaching these practices in both science and engineering also helps students to understand the cultural and societal importance of these disciplines and allows for them to see them as viable career paths for students (NRC, 2012).

The Framework also states that it is important to note that it is referring to knowledge and skill simultaneously, not just practicing the skill (NRC, 2012). Abd-El Khalick and colleagues
(2004) cite Lederman expanding on this idea when he writes about the importance of not just using inquiry methods to teach science, but to also teach about inquiry methods.

**Connections to place-based education.** This is also an idea that place-based educators have understood. Gregory Smith (2002) gives the example of a school employing place-based methods when he describes the schedule of the week highlighting the balance between learning in the field using scientific practices and learning in the classroom. Smith (2002) writes:

> The school week is scheduled so that Tuesdays and Thursdays can be used for work in the community or in the field. Mondays, Wednesdays, and Fridays are reserved for more typical classroom activities. Once they have become knowledgeable about their own watershed, the students then investigate rivers in other parts of the United States and the rest of the world. (p. 589)

Smith (2002) is clear to point out that place-based learning is not advocating for the removal or even aversion of knowledge that would be referred to by place-based writers as “nonlocal.” Rather, he argues that using the entry point of local information and knowledge, students have a more grounded lens through which to understand phenomena that is not local but national, or international (Smith, 2002). As a counter example to this idea of using the local first, Sobel (2004) describes students learning about the rainforests, when they have not yet learned about the trees in their own area. Why, Sobel (2004) asks, wouldn’t students first explore the local hardwood forest near the school and the ecosystem they are a part of before learning about trees they may never see? It makes the most sense to take advantage of the nearby areas that students are more naturally drawn to at young ages (Sobel, 2004).
Framework Principle: Connecting to Students’ Interests and Experiences

This Framework principle comes from the understand that students learn scientific concepts better when they are able to connect them to their own interests and personal experiences (NRC, 2012). This principle is perhaps the most natural to show a connection with place-based education in that using students’ own experiences is often in many writers’ definitions of PBE. Also, there is often research showing the efficacy of using students’ interests and experiences for learning subjects including and beyond science.

Research and reasoning behind principle. Taking Science to School (2007), calls a link to personal experience “critical” for science learning. Because of this principle, core ideas recommended in the Framework are thought of as naturally linked to questions students would ask themselves at different ages as they experience and find themselves interested in different phenomena in the world (NRC, 2012). A study by Tai, Liu, Maltise, and Fan (2006), shows that when students have life experiences scientific in nature in elementary and middle school years, they are more likely to pursue a career in science or to take advanced science classes later in school. Renninger (2000) explains that students’ individual interests help to develop engagement in educational tasks and even a desire to master a subject. This engagement and desire for mastery helps to work toward the goals of the Framework (NRC, 2012).

Connections to place-based education. Many discussions around PBE focus on students’ interests and experiences. In fact, this idea of connecting educational experiences with students’ actual experiences could be considered a key or even foundational component
of PBE. Dewey (1900) is often referred to as discussing the importance of connecting school to real world experiences rather than ideas about those experiences.

From the standpoint of the child, the great waste in the school comes from his inability to utilize the experience he gets outside the school in any complete and free way within the school itself; while, on the other hand, he is unable to apply in daily life what he is learning in school. That is the isolation of the school, the isolation from life. When the child gets into the classroom he has to put out of his mind a large part of the ideas, interests, and activities that predominated in his home and neighborhood. (Dewey, 1900, p. 89)

Similarly, Demarest (2014) states that using local knowledge to create curriculum allows for guiding questions to be created that resonate with each student’s experiences. She says that when turning to things that students already know as the way to develop these questions it is engaging background knowledge and experience as well as the things that students already know (Demarest, 2014). This building from a point of what students already know is also an important part of constructivist thinking (Brooks & Brooks, 1999). Demarest also points out that whenever there is already an intimate connection to what is being studied, then learning is enhanced (Demarest, 2014).

Smith (2002), when defining place-based education, draws a distinction between curriculum developed from a national perspective and local perspective. It is by beginning with the local, Smith says, that students have a “vantage point” from which to learn about the larger world (Smith, 2002 p. 588). He also goes on to explain that when schools employ place-based education methods a commonality that is observed is that the separation between the
classroom and the community outside the classroom becomes less distinct (Smith, 2002). It is in this “permeability” of the walls of the school, as Smith refers to it, that students and even the adults develop stronger connections to the communities and even larger regions that they live (Smith, 2002 p. 593).

Gruenewald (2003a) discusses the importance of connection with the natural world, or students’ experiences as a key component and benefit of educational methods surrounding place. Gruenewald also points to place-based educators advocating that education should relate directly to students’ experiences. He also argues incorporating critical pedagogy in which students’ education allows them to be a part of improving the communities they live in when they see problems that need to be addressed (2003a).

*Environment as an integrating context.* A well-known example of integrating students’ experiences and interests is the Environment as the Integrating Context (EIC) model (Lieberman, 2014). The State Environment and Education Roundtable, or SEER, was founded with grants from The Pew Charitable Trusts to develop the EIC model to help use the local environment and community as a standards-based instructional strategy (Lieberman, 2014). Three of the instructional practices in the EIC model are: 1) Local natural and community surroundings as context 2) Community-based investigations with environmental service-learning and 3) learner-centered, constructivist approaches (Lieberman, 2014). In the executive summary of Closing the achievement gap: Using the environment as an integrating concept for learning, Lieberman & Hoody (1998), describe the use of the EIC model for teaching using the natural and socio-cultural environments as well as known best practices for teaching and
learning. Although more often referred to as environmental education rather than specifically place-based education, Lieberman & Hoody are clear to point out that the EIC model is not primarily focused on, “learning about the environment, nor is it limited to developing environmental awareness.” (1998 p.1) They also point out that it is more specifically, “using a school’s surroundings and community as a framework within which students can construct their own learning.” (Lieberman & Hoody, 1998 p.1)

**Efficacy of place-based education.** Sobel’s (2004) definition of place-based education, of which I am using as the definition for this paper, goes on to state:

Emphasizing hands-on, real-world learning experiences, this approach to education increases academic achievement, helps students develop stronger ties to their community, enhances students’ appreciation for the natural world, and creates heightened commitment to serving as active, contributing citizens. (p. 7)

Sobel’s extended definition points to the fact that using students’ interests and experiences is a major key in defining what place-based education is rather than just a component (2004). It also shows that some authors desire to show the benefits of PBE to student performance on standardized assessments. It is when looking at learning being connected to students’ interests and experiences that we can find research linking place-based methods with data showing its efficacy. Sobel (2004) explains that the big question on the minds of most school boards, administrators, and parents is if education that uses students’ place increases academic performance?
Despite this desire to know about how effective PBE is in its effectiveness in teaching scientific concepts, I find very little research in this area. This was confirmed in Semken and Freeman’s article: “Thus far the literature on place-based education...has offered mostly advocacy, case studies, and teaching resources, but little research on effectiveness. (Semken & Freeman p. 1043). However, in Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning, it does give examples and evidence of the efficacy of the EIC model (Lieberman & Hoody, 1998).

Closing the Achievement Gap (Lieberman & Hoody, 1998) describes that the Environment as an Integrating Context for learning has observable benefits. One of these benefits is increased student achievement on standardized measures of academic achievement in reading, writing, math, science, and social studies (Lieberman & Hoody, 1998). The report also points out that students who learn using the EIC model scored higher than peers who learned in traditional programs (Lieberman & Hoody, 1998). When teachers and administrators were interviewed regarding their observations when using the EIC model, they reported positive results. These results included increased understanding of scientific content, concepts, processes and principles (Lieberman & Hoody, 1998). They also reported that students were better able to apply science in situations in the real-world (Lieberman & Hoody, 1998). Along with these improvements, teachers and administrators reported that students showed a greater enthusiasm for learning science (Lieberman & Hoody, 1998). In their conclusion, Lieberman & Hoody (1998) explain that using the EIC model has the ability to not only strengthen academic skills, but to deepen understanding of concepts in a way that allows for
students to connect learning to the real-world that is extremely challenging to do within a traditional “classroom-bound” setting (p. 11).

The Place-based Education Evaluation Collaborative (PEEC) is a group of organizations who have come together to evaluate the effectiveness of place-based programs (Place-based Education Evaluation Collaborative, 2003). From those evaluations, PEEC has found that place-based educational practices do improve student achievement alongside its goals of improving “environmental, social, and economic vitality” (Place-based Education Evaluation Collaborative, 2010 p. 2).

**Framework Principle: Promoting Equity**

The *Framework* discusses that promoting equity in the context of learning science means that all students have equal access to adequate learning experiences, time, space, and instruction to be successful (NRC, 2012). Equity in education is often written as a major goal of place-based educators. PBE advocates are sure to point out that connections to place in learning means not only developing an affection for that place, but also learning of historical problems which can include social inequities. Also, because equity in teaching often means to allow for learning from a student’s unique perspective, PBE’s constructivist ties help to promote this.

**Research and reasoning behind principle.** Teachers, administrators, and other stakeholders in education can’t help but to acknowledge the growing range of diversity of learners in classrooms. But to simply acknowledge this diversity does not necessarily help in
ensuring learning for all in a science classroom. In *Taking Science to School* (2007), the authors conclude that diversity brought to classrooms in the form of ethnicity, race, culture, gender, and socioeconomic status can create opportunities for deepening learning by offering different views and experiences. When teaching diverse populations of students, making changes for all learners can create a rich learning environment (NRC, 2007).

When explaining the principle of promoting equity, the *Framework* also points out that when attention is given to an individual’s unique cultural background and customs there is deeper understanding that is developed (NRC, 2012). This is again showing a close relationship to constructivism (Brooks & Brooks, 2005). Additionally, in a connection to the previous principle, the *Framework* describes that when learning is connected to students’ interests and experiences, it promotes equity by broadening students’ participation in science (NRC, 2012). This is additionally discussed by Lieberman & Hoody (1998), in which they say that the EIC model has potential for closing the achievement gap in integrating all students into the science learning environment.

**Connections to place-based education.** The principle of equity in education is often found as a major goal of place-based educators. Gruenewald and Smith are clear to include equity as what they call a “core theme” in place-based education (2008, p. xix). They point out that PBE not only has a focus on diversity, multiculturalism, and teaching in a fashion that is culturally responsive but is far more genuine and effective in addressing these issues in the context of the immediate community and environment (Gruenewald & Smith, 2008). They claim that PBE takes into account the high value that race, class, and gender bring to an
educational setting in that they are not topics to include in a classroom discussion (Gruenewald & Smith, 2008). However, beyond simply taking into account those factors, Gruenewald and Smith argue that PBE is also grounded in the experience of the students (2008). These experiences and themes, as the definitions of place suggest, are important parts of what students bring to the classroom and important contexts through which learning occurs (Gruenewald & Smith, 2008).

Gruenewald & Smith (2008), also acknowledge that when the cultural experiences that students bring to are explored in the classroom that it is not always in a nostalgic or homogeneous tone. Rather, as Gruenewald suggests (2003a), students are invited to be honest about the injustices or inequalities of their past and present situations. This critical pedagogy, which Gruenewald considers to be a vital counterpart of PBE, empowers students to act on and work toward changing problems they see in their present situations and communities (2003a). Gruenewald (2003a) suggests place-based education as being a prime pedagogical method for developing awareness of injustices in a school’s community. This would help to empower students to be in charge of their own futures regardless of their situation (Gruenewald, 2003).

Smith (2007) describes place-based education as a method for moving whole communities to a place of equity, justice, and sustainability. He points out several examples in which PBE develops a deeper awareness and examination of what much of the world is beginning to understand as defining challenges of the era in which students live (Smith, 2007).

Sobel (2004) also points out several incidences in which PBE has been used to show not only learning through local environments but as a way of meeting the educational challenges of schools. He gives an example of a school in which a high percentage of students coming from
low-income families has caused for an increased challenge in helping to make academic progress with those students (Sobel, 2004). In an attempt to increase student performance, the school put into place a PBE model that focused on service-learning and environmental education (Sobel, 2004). The result was improvement on the state reading, math and writing skills achievement test (Sobel, 2004).

Sobel (2004) gives an example of another school in a rural area that was primarily Hispanic with the majority of households making less than $10,000 and parents lacking a high school diploma. This school was a Rural School and Community Trust site for almost ten years in which they integrated the local community and environment into their curriculum (Sobel, 2004). Students at the school saw incredible academic achievements over the years in which 45 students went on to learn at Ivy League colleges and universities as well as developing a rate of 65 percent of its students going on to some form of higher education (Sobel, 2004). Sobel (2004) also points out that many of these students who go on to higher learning do not use it as what could be considered a “ticket” out of an economically depressed area, but instead come back to have a positive effect on their local community and environment.

This idea of students becoming change makers in their own community as a result of PBE is also related to an aspect that Smith (2002) points out. He gives examples in which residents in rural and urban areas with economic and situational challenges don’t view their problems as being only remedied by outsider investments or decision makers (Smith, 2002). Rather, these residents take an active role in revitalizing their communities (Smith, 2002). Place-based learning, Smith argues creates a situation where students not only explore the challenges and possible solutions to those challenges, but rather develop a sense of ownership
in that community so deep that keeps them there to create their own economic opportunities rather than leave to seek them elsewhere (Smith, 2002). This sense of self-reliance, innovation, and problem solving is developed through a learning approach that takes into account students’ experiences and acknowledges their ability to change their situation for the better along with a sense of pride that engages students in learning so they will have the tools to create that change (Smith, 2002). This idea shows a direct connection to what Dewey argued as one of the important reasons of integrating schools and their communities: to help students become involved more in the civic process, which is essential to a healthy democracy (Dewey, 1900).
Chapter 3
Discussion

Conclusions from the Literature

The literature is showing a strong correlation between *A framework for K-12 science education* place-based education methods and theories. The original questions of this paper are as follows:

1. How does *A Framework for K-12 Science Education* (NRC, 2012) create opportunities for place-based methods to be used to teach science in the public school classroom?

2. How do *A Framework for K-12 Science Education* (NRC, 2012), the *Next Generation Science Standards* (Achieve, 2013), and place-based methods overlap?

There are multiple opportunities within the *Framework* (NRC, 2012) for place-based methods to be used as well as much overlap between the *Framework* document’s principles and place-based methods. It is also shown in the literature that overlap between the *Framework* (NRC, 2012), NGSS (Achieve, 2013), and place-based methods is present. Although some PBE authors express opinions of concern when standards-based reforms are brought into the discussion of education, there are authors who have found successful ways for them to work together. In fact, certain planning models allow for strong PBE pedagogy when implemented.
Correlations Between the Six Principles of the Framework and Place-Based Education

To show the correlations between the Framework principles and place-based education in the, I have included a graphic that illustrates those correlations for each principle. Each graphic is organized to show the principle as the overall concept above which the research, theories, and case studies from place-based education have been shown to be connected. The correlations are shown with the references from which they were found. The graphics are all followed by a short synthesis of the connections found between each Framework principle and place based education.

Framework Principle: Children Are Born Investigators

Figure 4. Correlations Between Framework Principle: Children Are Born Investigators and PBE.
The *Framework* (NRC, 2012) cites research from the document *Taking Science to School* (NRC, 2007) that shows children come to the classroom having already engaged in scientific investigation. This is opposed to what is now considered an outmoded view that children are concrete thinkers who are not capable of sophisticated thinking (NRC, 2007). This principle confirms constructivist learning theory as well (Brooks & Brooks, 1999). Constructivist learning theory is an important principle of place-based learning in the way it approaches student learning (Smith, 2002). There are multiple examples of students using their prior knowledge to engage in scientific investigations as shown by Gregory Smith (2002).

**Framework Principle: Focusing on Core Ideas and Practices**

*Figure 5. Correlations Between Framework Principle: Focusing on Core Ideas and Practices and PBE.*
In *A Framework for K-12 Science Education* (NRC, 2012), an effort is made to focus on a smaller group of what it terms core ideas and practices to develop a deeper understanding of what is considered to be the most important concepts. These core ideas and practices have laid out the framework for the writing of the *Next Generation Science Standards* (Achieve, 2013). When standards are discussed, it is usually alongside discussions involving accountability and high-stakes testing (Gruenewald, 2005). Many PBE writers have discussed in the past the incompatibility between place-based education and standards-based reform, of which the *Framework* is a part of (Rural Challenge Research and Evaluation Program, 1999a; Rural School and Community Trust, 2000; Place-based Education Evaluation Collaborative, 2003; Gruenewald, 2003a; Stevenson, 2007; Gruenewald, 2007).

However, there are writers who have written lately that there are viable ways for place-based education methods to be used to meet standards (Lieberman, 2013; Demarest, 2014). The primary way that has been provided for using place-based methods to meet standards is with the use of a planning process called backwards design (Demarest, 2014; Wiggins & McTighe, 2005).

*A Framework for K-12 Science Education* (NRC, 2012) also lays out eight categories of scientific and engineering practices (NRC, 2012). These practices are often seen when place-based education writers present examples and vignettes (Smith, 2002; Gruenewald, 2003a; Sobel, 2004; Shelton, 2005; Smith & Sobel, 2010).
In order for students to truly understand scientific concepts, learning needs to occur over time periods of years rather than months (NRC 2012). Place-based education writers have also discussed what they feel is the importance of working through concepts developmentally, such as learning concepts through a local park in kindergarten and then through further away mountain ranges in later grades (Sobel, 2004).

Figure 6. Correlations Between Framework Principle: Understanding Develops Over Time and PBE.
Recently, we have come to understand science not as only a body of knowledge, but also as practices that are used to develop, test, and expand that knowledge. A *Framework for K-12 Science Education* (NRC, 2012) argues that both are important components to acknowledge and teach during science instruction. Norman Lederman discusses, however, that it is not practical to think all science knowledge can be learned using inquiry methods (Abd-El-Khalick, Boujaoude, Duschl, Lederman, Mamlok-Naaman, Hofstein, & Tuan, 2004). Place-based thinkers and writers have also advocated for this balance between knowledge and practice (Smith, 2002; Sobel, 2004).
Students learn scientific concepts better when they are able to connect them to their own interest and personal experiences (NRC, 2012). These interests and experiences can be closely linked to students’ sense of place (Semken & Freeman, 2008). PBE has shown to have a strong history of valuing connecting students’ interests and experiences. John Dewey (1915), is often referred to as discussing the importance of connecting school to real world experiences rather than ideas about those experiences. Beyond Dewey’s call for education to have a stronger connection to what students experience outside of the school, more modern PBE writers make a strong call for this principle to be more present in classrooms (Smith, 2002; Gruenewald, 2003a; Demarest, 2014).
Connecting students’ interests and experiences is also clear in established and studied PBE models such as the Environment as the Integrating Context or EIC (Lieberman, 2014). It is within this model, that the efficacy of PBE strategies have been tested to meet standards (Lieberman & Hoody 1998). A correlation was established in Lieberman and Hoody’s executive summary, Closing the Gap, between using the local community and environment and student achievement on standardized assessments (Lieberman & Hoody, 1998).

**Framework Principle: Promoting Equity**

![Diagram showing relationships between Framework Principle: Promoting Equity and other concepts.](image)

*Figure 9. Correlations Between Framework Principle: Promoting Equity and PBE.*

The *Framework* discusses that equity in the context of learning science means that all students have equal access to adequate learning experiences, time, space, and instruction to be successful (NRC, 2012). The *Framework* also points out that when attention is given to an individual’s unique cultural background and customs there is deeper understanding that is developed (NRC, 2012). Place-based writers and advocates often point to issues such as equity
and social justice in their writings as a major goal. They point out that PBE not only has a focus on diversity, multiculturalism, and teaching in a fashion that is culturally responsive but is far more genuine and effective in addressing these issues in the context of the immediate community and environment (Guenewald & Smith, 2008). Smith (2002) goes beyond saying that PBE methods have the ability to meet the educational needs of diversity in the classroom. He states that it empowers students to become a part of solving equity and justice issues in their community (Smith, 2002).

**Implications**

There are many opportunities for educators to use place-based methods that are in line with the principles laid out in the *Framework* (NRC, 2012). In looking at the six principles from which the *Framework* was built, the correlations were apparent in each one. To see these correlations between *A Framework for K-12 Science Education* (NRC, 2012) and place-based methods and theory causes one to conjecture that the use of place-based methods to teach science is a valid and even preferable pedagogical choice. This is especially true when understanding that the recommendations made by the six principles in the *Framework* (NRC, 2012) were informed by the large body of research and knowledge laid out in *Taking Science to School* (NRC, 2007) which explains how children learn science best, as well as *Ready, set, SCIENCE!* (NRC, 2008) which uses the information from the *Framework* for how to teach science.

With regards to the NGSS (Achieve, 2013), Demarest’s recommendation of using the understanding by design model (UBD) for curriculum design is promising for educators hoping
to incorporate PBE into their classroom in meaningful ways. Similarly, Lieberman’s (2014) Environment as the Integrating Context (EIC) model not is a model that allows for combining the local community and environment and pre-determined learning objectives (i.e. standards). This is not only a model that helps to combine the two, but has been shown to be effective in boosting student achievement allowing for classroom teachers to not feel as though they have to choose between PBE and teaching to standards (Lieberman & Hoody, 1998).

Recommendations for Further Research

Using PBE Methods for Meeting Standards in the NGSS

In her Plan B project, Next Generation Science Standards and Place-Based Education, Sarah Jane Hackworth looked at teachers using place-based education principles to meet NGSS standards (Hackworth, 2015). She found that teachers held a strong belief that their teaching of the NGSS standards was strengthened by the use of PBE principles (Hackworth, 2015). This conclusion allows for one to conjecture that, due to a strong correlation between the Framework (NRC, 2012) and PBE methods, students’ development of science concepts in the NGSS is strengthened when learning using PBE methods.

Currently, there are very few standardized assessments linked to the Next Generation Science Standards (CCSSO, 2015). Those few tests that have been developed by states for this purpose, at the time of writing this, have been in existence for only months and have had little, if any, time for evaluation through field testing (CCSSO, 2015). In late 2014, the National Research Council (2014) released recommendations for the development of assessments aligned to the NGSS. These recommendations are a new direction for assessments as the
Framework was a new direction for science standards (NRC, 2014). I recommend that research be done on the efficacy of PBE methods as shown from these newly developed assessments. As Lieberman and Hoody (1998) showed with standardized assessments that growth could be made that was significant using PBE methods, it would be powerful to show growth and achievement on these new assessments.

Design thinking is a process of solving problems in a community or organization. It has recently gained some note in education as a way to approach instruction; specifically allowing students to be a part of designing solutions to problems they encounter in their own schools or communities. Seemingly, using a process to design solutions to perceived or experienced problems in a community would be a natural fit to use as a pedagogical method alongside place-based education. I recommend that research be done on the correlations of PBE literature and design thinking. Another possibility would be to look at the efficacy of the use of design thinking combined with place-based education methods.

**Personal Reflections**

As an educator, a primary goal for my own instruction has always been to engage students in the content being presented. At the most basic level of instruction, all teachers know that engagement in content enhances learning and develops retention of concepts. I have found this difficult at times with students who have shown to feel little connection to what is being taught. Place-based education has shown in my own practice to be a compelling method for deepening students’ connection to content taught in the classroom. However, it has often felt difficult to justify taking the extra time working on developing concepts strengthened by
the local environment and community. The hours spent outside of the classroom can seem like wasted time to an observer. The strength in correlation that I have found between the Framework and the use of PBE methods creates a compelling argument to take the time to use these methods often in all subjects but specifically in science.

The use of Understanding by Design (Wiggins & McTighe, 2005) was taught to me in my studies as an important instructional tool for teaching science content. Demarest (2015) suggests its use when incorporating PBE into the classroom. This strengthens what Smith (2002) calls for when he says that for students to be fully engaged in their local community and environment, teachers need to be curriculum creators rather than consumers. As an instructor, this gives me the charge to be critical of the standards selected to instruct so that they are carefully aligned to develop local places. Beyond being selective of standards to teach, it gives me the freedom and ability to feel confident in searching for ways to use PBE in learning standards that are mandated for me to teach.
References


