An Interactive Qualifying Project submitted to the faculty of the Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science

Sponsoring Agency: Turn Back Time

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Date: May 7, 2019

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Abstract

At Turn Back Time Farm (TBT) children have the opportunity to learn about nature through unstructured play and outdoor activities. Although the instructors at TBT have an extensive background in teaching children, they are missing the knowledge of environmental education to create varying educational modules. Our team had the goal of creating modules about vernal pools for children aged 3-8. At the completion of this project we presented TBT with nine new modules to effectively teach children about vernal pools.

Executive Summary

*Problem / Sponsor Need:*

At Turn Back Time Farm their mission is to give children an alternative learning experience different from the typical classroom setting. The fifty-eight-acre homestead located in Paxton, Massachusetts, instead utilizes nature to educate children. Research shows that nature has benefits for all kids, including enhancing social relationships, motivation for learning to take place and promotion of creativity and imagination (Broda, 2011). While there are a number of programs that support child learning and play outside, including boy scouts, girl scouts, and Tinkergarten, there are very few programs that are accessible to children with behavioral issues. For example, our sponsor, Lisa Burris, explained that she could never drop off her autistic son at boy scouts as the program could not support his needs. Therefore, Burris left her corporate job at Costco to start her own program, Turn Back Time Farms, that supports children with and without behavioral challenges and others in certain at risk groups, including those with a documented diagnosis, in foster care, and those who have experienced trauma.

Nature is critical for any child’s development. In this day and age children are more than “six times more likely to play a video game than ride a bike outside” (Strife & Downey, 2009). Studies prove that children who spend time outside are happier, more attentive, smarter, and less anxious. Nature walks have been tested on a group of children with behavioral problems such as ADHD. After just 20 minutes of walking and exploring outside they showed increased listening
and concentration skills (Taylor and Kuo, 2009). The need for outdoor educational programs such as Turn Back Time Farm, is greater now more than ever. Nature education plays an important role in a child’s overall development, especially those with behavioral problems, therefore Turn Back Time Farms must keep creating new educational modules to teach children all of the natural phenomenons there are.

Small spring pools known as vernal pool serve as a perfect outlet to teach children about nature. In 2017, a Falmouth school constructed their own man made vernal pool to have their own “living laboratory” for children to learn from (Carter, 2017). The pool taught children about biology through the invertebrates and amphibians that inhabit them. Lisa Burris believed that she had at least one vernal pool on her property, but lacked the background knowledge to confirm. With the right curriculum vernal pools would be a perfect addition to Turn Back Time Farm’s nature education program. This project assisted with the lack of environmental education knowledge that Turn Back Time Farms has by researching applicable subject for the children to learn from vernal pools. Research of the vernal pools allowed us to be able to identify possible locations they could be on the farm and create several new educational modules for children aged 3-8 years old. As there are three vernal pools in the surrounding area of Turn Back Time Farms this will assist them make the most of the environmental educational pools that they have to offer.

Background:

Children are spending less time outdoors and it is negatively affecting their lives. More and more children are diagnosed with learning disabilities, anxiety and depression each year, directly corresponding with the increase of children staying inside all day long watching TV or playing video games. Research has proven that children who spend less time indoors and more time in nature have improved cognitive, motor and social skills as well as reduced stress levels (Strife & Downey, 2009).

Vernal pools are small seasonal wetlands that are critical to amphibious species such as frogs and turtles. In their hydroperiod in the springtime, they are filled with sources of water such as a snowmelt and rain. Since the pools are so shallow and normally filled with only up to a couple meters of water, in the summer they tend to dry up (Burne, 2004). In the Northeast alone
it has been reported that up to 550 species rely on these pools to reproduce each spring. The small scale and diversity that vernal pools have to offer make them the ideal environmental teaching model for the children ages 3-8 years old at Turn Back Time Farm.

The vernal pools have to be presented to the children at Turn Back Time in a way that meets Lisa’s philosophy of learning through play and developmental and cognitively appropriate. It is vital for our group to match up the correct activity with the right age group, based on the learning and developmental outcomes that we determine for each activity. Numerous different outdoor educational programs have done used vernal pools as an educational tool for children before, so these will serve as great examples when we are creating our own activities.

*Project Goals and Objectives:*

The goal of this project was to develop activities, games, and resources to enable children ages 3-8 to learn about vernal pools through play at Turn Back Time. In order to achieve our goal the team had a four step plan consisting of the following objectives: 1) Learn the location, characteristics, and ecology of the vernal pools at Turn Back Time Farm; 2) Learn the teaching philosophy, methodologies and practices at Turn Back Time Farm; 3) Compile effective nature educational practices for neurotypical children, children with exceptional needs, specifically children with autism spectrum disorder and attention deficit disorder; and 4) Design and build vernal pool nature education activities tailored to Turn Back Time Farm.

*Methods:*

In order to properly achieve our goal of developing activities, games, and resources to enable children ages 3-8 to learn about vernal pools through play at Turn Back Time, we took each objective we outlined step by step. To learn the location and find out more about the characteristics of the vernal pools, we visited potential sites at Turn Back Time five times between November 2018 and April 2019. At the sites we observed and noted the vernal pools on the farm, their locations, and characteristics. We also interviewed local experts to learn what characteristics to look for, methods for locating and identifying vernal pools, as well as games and activities they use to teach children about vernal pools. Experts included people from the Audubon Society in Worcester, MA, people from Worcester Polytechnic Institute’s (WPI)
STEM Education Center, and Siamak Najafi from the Information Technology department at WPI.

We then dove deeper into learning about Turn Back Time by collecting as much information about “learning through play” as possible through interviews with the experts noted above, our sponsor, as well as journal articles, books, and websites. We then used all this information to design and build finalized educational activities tailored to Turn Back Time vernal pools and students. Finally, we went back to Turn Back Time in order to observe two of our activities: 1) The Salamander Crossing Game and 2) Sense Hunt. We assessed whether or not the learning outcomes were met through our assessment tools, observation, and final interview with our sponsor. Design methods included creating illustrations and designs in adobe Photoshop, Illustrator and InDesign. We also dealt with woodburning to make custom wood signs leading to the vernal pool.

Results:

After collecting data on different educational practices, characteristics of the vernal pool and different educational topics, we used this information to design and build nine educational modules, activities, and tools including:

![Vernal Pool Field Guide](image)

Vernal Pool Field Guide
Vernal Pool Exploration Kit

11 wood burned posts to make a path to the pool

“Salamander Crossing” a fun outdoor game that simulates how salamanders migrate, and the various threats to vernal pool species.
“Spotted Salamander, What Do You See” a children's book with associated coloring pages

“What’s for Dinner Tonight” an activity to teach children how all species are connected to one another in a vernal pool

“Food Web Fun” a fun outdoor game that simulates how food chains work
“Sense Hunt” a scavenger hunt using your five senses

Yellow Spotted Salamander
Average Lifespan: 7 Years
Size: 7 to 9 inches long in total length
Predators: skunks, raccoons, turtles, chipmunks, squirrels, opossums, snakes
Growing Diet: Zooplankton, isopods, and amphipods
Adult Diet: crickets, worms, insects, spiders, centipedes
Fun Fact: The Yellow Spotted Salamander is nocturnal

“Vernal Pool Guess Who” a species guessing game

Activities at Turn Back Time work to develop both content learning and physical, emotional, and social development. Therefore, we developed learning and developmental outcomes for each of the games, activities, and tools, including topics like the food web, vernal pool characteristics, as well as improved motor and social skills. We tried our best to make most activities occur outside since learning through nature is crucial for brain development (Exploring the Benefits of Sensory Play, 2016). But we also wanted to make sure some of the games could be taken inside for days with bad weather.
Through our research we found multiple topics that we can educate the students about in conjunction with the Vernal Pools. We were able to design these games and activities to help children learn about other topics, like pollution, the food chain, the five senses, and species identification. We also went about learning the techniques to make these lessons most effective to children with exceptional needs, in particular, children who have trouble engaging and learning in typical classroom settings, like children with autism, anxiety, and ADHD. We learned that by making these activities take place in nature and focusing on communication and collaboration, the students at Turn Back Time will have the opportunity to socialize and think outside the box in order to solve problems. Learning through nature, play, and collaboration allows students with special needs to have less anxiety, more self-confidence, and an increased ability to work within groups (Dumais, 2016).

Assessment at Turn Back Time Farm
Conclusions:

The purpose of our project was to develop a vernal pool educational program for Turn Back Time Farm. With the help of our sponsor and advisor, and additional expert information about vernal pools and nature-based education, our team created eight vernal pool educational learning modules with an assessment program. Additionally, we created a field guide of the species that can be found in the vernal pool in the surrounding areas. When we presented our activity ideas to Burris, she thoroughly enjoyed them and felt that they fit in well with the programs that Turn Back Time does already (Burris, personal communication, February 27, 2019). The team was also able to create an assessment program to ensure that our activities were meeting our developmental and content learning outcomes while also making sure the children enjoyed doing them. The team was able to go to Turn Back Time Farm and observe and assess two of our educational modules. The assessment taught us how much the children learned from our activities, but also showed us what needed to change in order to make them better. After watching the activities Burris said “The activities were amazing! The kids were so engaged!” (Burris, 2019). The team would have wanted to observe and assess all of the activities, however due to time limitations this was not possible. The team suggests that Turn Back Time Farm registers their vernal pools so they will be protected by the state for years to come.
This team successfully completed its goal in creating a new educational program about vernal pools for Turn Back Time Farm. The team learned a lot from the project and hopefully the integration of vernal pools into Turn Back Time Farm’s nature education programs will introduce students to a new and exciting ecosystem that is easily visible to them. The pools will teach children about various science topics including, species, food webs, water cycle, and defense mechanisms while also teaching them to have a greater appreciation and respect for nature. Through our modules the children will also be able to experience all of the benefits of learning outdoors. Hopefully our nine modules will be able to be used for many years to come.
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Appendix A

Appendix B
1.0 Introduction

Turn Back Time Farm, a fifty-eight-acre homestead located in Paxton, Massachusetts, utilizes nature to educate children. The Farm’s efforts are directed at children who struggle in typical classrooms due to learning disabilities and special needs. The staff knows that nature’s cognitive benefits help children, especially those with special needs. This mission is time consuming due to the constant evolution necessary to maintain a relevant and well-rounded program suitable for all students. Due to the strenuous nature of this educational strategy, Turn Back Time Farm is always in need of new programs. The staff at Turn Back Time Farm all have an expertise in early childhood education, however have no background in environmental education. Our project was aimed towards helping Turn Back Time to fill the gap in the area of vernal pool nature education.

Nature education plays an important role for children in their overall development. Multiple positive nature experiences at a young age have been shown to increase a child’s personal connection with nature, even after they become adults. This connection can help create a positive view of the environment and lead to a willingness to be a part of environmental conservation in later years. Natural environments stimulate different neural pathways in the brain and help to increase the cognitive networks in these areas. Aside from assisting in cognitive development, nature education can improve children’s physical well-being. Active, outdoor play helps reduce the likelihood of childhood health problems such as obesity (Strife & Downey, 2009). Overall, there are a multitude of advantages in engaging children with the outdoors and helping them understand their environment through education.

The project will help Turn Back Time Farm better fulfill their goal of teaching children about nature through play. This project will study a special feature of Massachusetts’ ecology, vernal pools. Then the pools will be used as an educational phenomenon. The goal of this project is to create a vernal pool educational program for the children who attend Turn Back Time Farm. Incorporating the diverse learning styles of students into educational programs will be the most difficult aspect of the project. Interviews with our sponsors and children attending the Farm’s educational programs will give more insight about how these students learn best. This
information will be used to create a program tailored to the children’s needs. Research and professional literature will guide the model to reap all the benefits of learning in a natural environment so that the children are able to fully engage with the material and each other. Our project is designed to help the children better utilize the natural classrooms the farm already possesses. This will give Turn Back Time Farm yet another way to continue uncovering the wonders of nature to children.

The goal of our project was to develop activities, games, and resources to enable children ages 3-8 to learn about vernal pools through play at Turn Back Time. To help Turn Back Time Farm achieve this goal, our team created eight activities and a field guide focused on various biology topics. We accomplished this goals through the following four objectives: 1). Learn the location, characteristics, and ecology of the vernal pools at Turn Back Time Farm. 2). Learn the teaching philosophy, methodologies and practices at Turn Back Time Farm. 3). Compile effective nature educational practices for neurotypical children, children with exceptional needs, specifically children with autism spectrum disorder and attention deficit disorder. 4). Design and build vernal pool nature education activities tailored to Turn Back Time Farm.

2.0 Literature Review

Overview

In the years from 2000 to 2003, spending on ADHD medication for preschoolers increased by 396% (Strife & Downey, 2009). Children of all ages are twice as likely to experience depression than they were 20 years ago (Strife & Downey, 2009). What is causing these issues in children now more than ever? One possible reason is that children are spending a lot less time outdoors and more of their time indoors playing video games, watching TV or surfing the web. In our urbanized world, children are more than “six times more likely to play a video game than ride a bike outside” (Strife & Downey, 2009). Research has shown that children who spend more time in nature have improved cognitive, motor and social skills as well as reduced stress levels (Strife & Downey, 2009). In order to raise children to be as happy and
healthy as they can be, Turn Back Time Farm wants to give more children the opportunity to be outside and learn about the environment around them. Vernal pools are a great avenue to educate children that have yet to be utilized by Turn Back Time Farm.

**Characteristics of Vernal Pools**

Vernal pools are seasonal wetlands that are critical environments to many species, especially amphibians. These pools sustain vital ecological life and can be found in both temperate and mild Mediterranean climates. Northeastern vernal pools are typically found within forested regions. However, some vernal pools are located in floodplains or other regions with suitable depressions and sufficient nutrients. The most exciting time for a vernal pool is the hydroperiod, when the pool holds water (Collins, 2013). Snowmelt, rain, and floods are major sources of water for vernal pools within the Northeastern United States. The average depth of these pools is three to four feet, but they have been known to reach depths up to ten feet and generally cover areas ranging from hundreds to thousands of square feet. During the summer, vernal pools begin to slowly dry out. By the fall the pools are completely dry and will remain dormant until the spring when the snowpack melts. Northeastern vernal pools are typically small, semi-permanent, and geographically isolated from other wetlands (Burne, 2004).

These characteristics are crucial to properly protected. Massachusetts was among the first states in the nation to specifically protect vernal pool habitats beginning with amendments to its Wetlands Protection Act regulations in 1987. Here, vernal pools are protected for their wildlife habitat value and, as a result, are defined primarily by the species that inhabit them. As of 2002, approximately 3500 vernal pools have been certified, but a recent aerial photographic survey of Massachusetts identified nearly 30,000 potential vernal pools (Burne, 2004). That leaves upwards of 20,000 unregistered, unprotected vernal pools in Massachusetts. Along with a host of geographical characteristics, vernal pools consist of specific ecological features (Egnoto, 2016).
Ecology of Vernal Pools in Massachusetts

Vernal pools are unique environmental phenomena that play an important role in maintaining Massachusetts’ ecological diversity. Reports of more than 500 species have been found from vernal pools in the just the North East alone. Obligate vernal pool species such as fairy shrimp, wood frogs, and spotted salamanders will only breed within these distinct environments (Twining, 2013). One of the more well-known species in our region is the spotted salamander. These salamanders, along with wood frogs and spring peepers, participate in amphibious migrations on the first few nights of spring when temperatures are high enough and there has been ample rain (Egnoto, 2016). When such conditions occur, the amphibians emerge from their underground burrows and make their way to find vernal pools. These pools will serve as their home and breeding ground for the next few months. Wood frogs and spring peepers have a distinct mating call that can be heard throughout the spring around vernal pools. When male and female frogs choose their mates they then go through and amplexus process to externally fertilize eggs (Twining, 2013). Wood frogs often deposit large numbers of eggs together creating a mass. Male salamanders drop their spermatophores into the water to externally fertilize the female’s eggs. Another species that breeds in vernal pools are fairy shrimp. These crustaceans have short lifespans but lay eggs that can remain dormant for years regardless of whether or not water is present (Twining, 2013). Vernal pools are unable to support fish populations because they seasonally dry out. The lack of fish is important since amphibian eggs would be consumed in their presence (Twining, 2013).

Along with the classic amphibious vernal pool species, there are many other small organisms and insects inhabiting vernal pools which are vital to the region’s ecosystem. These smaller creatures produce detritus from organic plant waste that helps feed many different species (Sacramento Splash, 2000). Without these microorganisms, forest waste would not be recycled into the food web as easily. Additionally, there are larger animals that frequent vernal pools. These predatory species, such as great egrets, turtles, and snakes, depend on vernal pools to find food. These are just some of the ways that vernal pools not only serve their obligate species but the ecosystem as a whole (Fact Sheet Vernal Pools, 2009).
In order to protect these natural habitats, it is important to be able to identify them even out of their hydro state. There are a variety of methods that can be used to identify vernal pools but common practices rely on landscape characteristics, soil composition and the presence of obligatory species (Vernal Pools, 2018). We plan to use these and similar methods in the identification of vernal pools at Turn Back Time Farm in preparation for the creation of educational materials for the Farm’s afterschool and summer programs.

Vernal Pool Educational Activities

Vernal pools provide a great educational tool for children. Their relatively small size and easily observable ecology make them great examples of active micro-ecosystems. These pools are biological hotspots with small ecosystems that are easily accessed, visualized and understood by younger children (Vernal Pools, 2018). On top of this, since vernal pools are so crucial for New England’s woodland ecosystems, they are well suited to presenting children with the importance of habitat management. Using vernal pools in this way is not new. Numerous existing outdoor programs incorporate vernal pools in their educational activities. Some groups use the vernal pools to teach ecology and biology to children in a hands-on manner (Vernal Pools, 2018). Others allow their students to take on the role of citizen scientists by recording data about local vernal pools, such as size, depth, and species range throughout the year (Vernal Pools, 2018). Our project will focus on elementary school-aged children in the design of an inclusive program for Turn Back Time to incorporate into their existing curriculum.

Ecology is one of the most interesting vernal pool areas and is a great topic to start with for children. Choosing the correct activity for groups is important for its success. Specifically, with ecology, a smaller group could be well suited for a vernal pool visit and observation of the species. The following activity would entail construction of their own field notebooks containing organisms they were able to find (Splash, 2000). With a larger group keeping all students involved is important and getting each direct hands-on time at a vernal pool may be difficult. Games that use vernal pool vocabulary can be well suited for involving children before an in-person visit to a vernal pool can be achieved (Mass Audubon, 2018). Not only is it important
to consider the number of participants when designing and choosing activities, but also the ratio of students to faculty that will be involved in these activities.

Vernal pools have been used as a model to promote nature education many times before. A variety of sources offer valuable information about this topic. An example of this can be seen in the Harvard Forest Schoolyard LTER Program. The program first took students to nearby vernal pools to allow the children to see firsthand what they were going to learn. Students were given the chance to immerse themselves in nature through sight, touch, and sound, adding to the value of their educational program. While at the pools, students were required to identify species in the pools, take water samples, and record detailed measurements of the pools. When they got back to the classroom, the fifth graders had to make stop-motion animation videos about the importance of vernal pools. The teacher chose to have them do stop motion animation because “students are motivated to teach others and while they are deconstructing and constructing their content knowledge they are able to clearly demonstrate what they’ve learned,” (Kablik, 2012). Having students make videos allowed them to gain mastery of a topic relating to vernal pools. It also allowed the students to teach each other about their topic in a way that was accessible to other students.

The timeline of the activities is important to understand what methods of education will be most impactful on the children involved. “Big Night Event” can be effective by inspiring excitement and involvement from children in a single event. A Big Night Event can be held during late March or early April during one of the first warm rains when amphibious migration will begin (Stephenson, 2014). Different strategies can be employed for students enrolled in longer-term programs such as weekly observation of vernal pools. This allows for the opportunity to teach subjects such as the water cycle and changing seasons. Activities like these are only a small sample of hundreds of different educational programs that are available. The impact of an activity relies heavily on quality selection for its intended audience as well as those staff members implementing it (Stephenson, 2014).
Benefits of Nature Education

Involvement with nature and outdoor activities promotes healthy childhood development in a variety of ways. Outdoor-based learning experiences can take an array of forms, including outdoor education and wilderness programs. Outdoor education grew out of camping and survival programs, but now includes a wider range of activities that focus on first-hand experiences. By allowing students to participate at their individual learning pace, these programs foster a greater growth and a better understanding of the topics they are learning about. Due to this independence, these programs have been shown to also help develop critical thinking and problem-solving skills.

Nature education has also shown to help children’s development. Andrea Dumais’ thesis report of Best Practices for Including Students with Autism, Disabilities, and Special Needs in Environmental Education discusses a study by Mary Farnham and Nanette Mutrie. The study looked at the advantages of this type of education for special needs children. They found that “students with special needs had less anxiety, more self-confidence, and an increase in cohesion within this group,” (Dumais, 2016).

Correlation studies have also linked wilderness programs with an increased sense of self and improved self-esteem. (Faber Taylor, 2006) The amount of greenery in a child’s play area is tied to both the creativity of their activities and how well their social skills develop. Studies such as these have been conducted with a variety of children from many different age groups and social backgrounds around the world showing that the benefits of nature access are enjoyed by all children (Faber Taylor, 2006).

Unfortunately, not all populations of children have the same access to safe green spaces. (Strife & Downey, 2009) Urbanization has distanced many children in developed countries from the natural world. This is especially true in economically disadvantaged areas where there tends not to be much in the way of local green spaces, and transportation to green spaces is often an obstacle (Strife & Downey, 2009). Children from black, Asian and minority ethnic (BAME) households were particularly affected. If they were any of these ethnicities and in the low-income bracket, children received even less time outdoors. Just 56% of under-16s from
BAME families visited the natural environment at least one time a week, compared to 74% from white families (Leach, 2018).

Academically, outdoor programs are linked with greater material retention and better overall scores than curricula taught indoors (Faber Taylor, 2006). It is not yet clear if this is because of the effects of nature on the student’s learning or if it is a result of other factors like the hands-on approach of many outdoor-based programs. Schools are becoming more and more interested with improving how available nature is to all children. Forest Schools programs are built on the foundation of outdoor play and can help children learn better overall. Membership for the Forest School Association has grown ten times larger in the last five years from 200 forest school practitioners to 2,000 this year (Leach, 2018). One of the chairman of a forest school named Jon Steele concludes that being outdoors while learning can help children from all backgrounds whether they have learning disabilities or behavioral issues. Steele explains that the lack of walls help the children not “feel penned in.” The teachers explain that just a little bit of outdoor time makes children calmer (Leach, 2018).

Our project will create activities for the farm’s students that engage them with vernal pools. Many of Turn Back Time Farm’s programs are targeted toward children with special needs. Therefore, we must acknowledge the different learning abilities of the students who will ultimately be utilizing the produced material.

Educating Special Needs Students

Students with special needs can also be diagnosed with severe learning difficulties. This can be caused by many different physical or developmental disabilities, such as dyslexia, autism, and cerebral palsy. Special needs can make it harder to excel in a typical classroom setting, therefore it is imperative that all children are given the possibility to learn outside of the typically four wall classroom. According to *Educating K-12 Professionals and Parents: Finding Health Information for Special Needs Children*, there is a large increase in the rates of children who are diagnosed with developmental or physical conditions (Irish, 2015). While a child with dyslexia was playing in the woods on a class field trip, her mother witnessed what she thought to believe
was the first time her daughter was “on the same level as the other students,” (Dumais, 2016). In the classroom, the child always felt one step behind her schoolmates. Outside activities, however, leveled the playing field and allowed the child to excel. It is important that these children are given equal opportunities to succeed.

Special needs students may have a variety of different learning needs and limitations. In order to ensure these children are all included and learning effectively, lessons must be as accessible as possible. Some students may not be able to speak or read well and others may not be able to control parts of their body. In order to properly educate special needs children, it is important to understand their learning strengths and weaknesses. Some common ways to engage children with autism and similar disabilities is to focus on team-oriented projects and communication (Dumais, 2016). Techniques like these give the child an opportunity to socialize and think outside the box. Another great technique to help these students become more independent is to concentrate on giving the students open-ended questions rather than giving them choices. This allows them to open their mind and think freely, rather than having answers given to them. Students with special needs also often benefit from having personal aides or a separate program with as close to a one-to-one teacher-to-student ratio as possible (Irish, 2015).

Children with special needs also benefit from nature education. Turn Back Time Farm in Paxton, MA recognizes this and believes that children with disabilities are not always given the same opportunities to engage with nature as other students. Their programs focus on hands-on, self-directed learning within several structured activities, such as Animal Care and Cook What You Grow. These types of educational programs have been shown to be extremely effective in engaging a special needs student. This project’s goal is to give children of all learning styles the opportunity to learn through vernal pool education.
3.0 Methodology

Project Goal: develop activities, games, and resources to enable children ages 3-8 to learn about vernal pools through play at Turn Back Time

3.1 Objective 1: Learn the location, characteristics, and ecology of the vernal pools at Turn Back Time Farm.
To meet this objective we are going to collect data in the following categories:
3.11). Interview experts in vernal pool location and study, specifically based on location during the non-hydro period

For interviews we conducted semi structured interviews with experts in the vernal pool field. We used convenience and snowball sampling. For convenience sampling, we identified potential participants who have experience or expertise on vernal pools in similar climates and ecosystems. For snowball sampling, we asked participants selected through convenience sampling to recommend other potential participants. In these interviews we learned about characteristics of vernal pools and the best practices for measuring potential pools to see if they meet the specifications of a vernal pool.

The team also made use of secondary research to support the ideas learned from the experts. Peer reviewed articles on vernal pool ecology and articles on finding signs of vernal pool ecology and identification were used. The team also made use of the vernal pool guides already in existence in Massachusetts to identify the ecology most prevalent in the area, species most likely to be within existing pools, and identification of species within the existing vernal pools at Turn Back Time Farm.

3.12). Conduct field observations at Turn Back Time Farm for signs of vernal pool activity.

To learn the basic characteristics of the vernal pool out of season we researched on similar pools elsewhere that have been studied in season. We used this information to create a field guide for TBT in season. In order to learn the characteristics of vernal pool
sites at TBT, we collected data through primary and secondary sources. For primary sources, we used the following techniques:

- Measured vernal pool areas at the farm, including the area and both average and maximum depth through water markings;
- Photo documented our findings at the farm;
- Measured light range exposure of pool at different times of day, including level of sunlight exposure the pools experience.
- Examined the relative amount of decomposition at pool bed
- Looked for evidence of obligate species: species characteristic of vernal pools;
- Interviewed experts on the field to determine best practices for measurements
- Interviewed Lisa Burris about suspected vernal pool sites and characteristics

Table 1: Example of a data chart for use in vernal pool identification.

<table>
<thead>
<tr>
<th>Data</th>
<th>Pool Location 1:</th>
<th>Pool Location 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Pool Area:</td>
<td>150 Square Feet</td>
<td>425</td>
</tr>
<tr>
<td>Average Pool Depth:</td>
<td>3 Feet</td>
<td>4.5 Feet</td>
</tr>
<tr>
<td>Pool Light Exposure:</td>
<td>moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Underbed Decomposition:</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Water Line Height:</td>
<td>N/A</td>
<td>6 Feet</td>
</tr>
</tbody>
</table>

3.2 Objective 2: Learn the teaching philosophy, methodologies and practices at Turn Back Time Farm.

To meet this objective we collected data in the following categories:

3.2.1). Turn Back Time Farm’s use of the philosophy “learning through play”
Turn Back Time Farm relies on its philosophy of learning through play. Our team learned more about this through primary data collection. Field visits were used in order to observe examples of Turn Back Time Farm’s nature education programs and their use of “learning through play”. Semi-structured interviews were conducted with our sponsor Lisa Burris in order to get a better understanding who Turn Back Time Farm’s students were such as their ages and interests. Through talking with Mrs. Burris our team learned more about the programs currently taught at Turn Back Time Farms. We wished to understand what topics the kids were learning about and how the information was being taught to them. These interviews also ensured that we would not be duplicating content already in use at the farm.

3.22). Other nature education programs use of the philosophy “learning through play”

Secondary research was conducted as a support to the information that we had already learned at Turn Back Time Farm. Use of peer reviewed articles on the teaching style of “learning through play” assisted in our groups deeper knowledge of the subject. This also helped us in identifying gaps at TBT and how our group could address them.

Primary data collection was also used through semi-structured interviews of the workers at the STEM education center here at WPI and through other nature education programs with similar teaching styles. This also allowed our group in identifying gaps at TBT and how we could address them. In addition, it gave us additional information about what science topics from vernal pools could be taught in each of the age groups we were targeting.

3.3 Objective 3: Compile effective nature educational practices for neurotypical children, children with exceptional needs, specifically children with autism spectrum disorder and attention deficit disorder.

To meet this objective, we are going to collect data in the following categories:

3.31). Ways to teach children 3-8 environmental STEM topics, including learning through play.
To meet this objective we collected data about strategies to teach children aged 3-8 environmental STEM topics, including learning through play. In order to do this we first engaged in primary data collection by conducting a semi-structured interview with Mia Dubosarsky. Dubosarsky works in WPI’s STEM education office where she works with schools implementing new STEM programs. From this interview we learned she approaches incorporating different learning styles while creating her own STEM programs, the best way for implementing new programs, and challenges we will face while creating these activities for Turn Back Time Farm.

The team conducted another semi-conducted interview with two other specialists in STEM education who teach programs at Mass Audubon. At Mass Audubon we met with Elizabeth Broughton, the Education Program Director, and Martha Gach, the Conservation Coordinator. From these interviews, we gathered valuable information about the best ways to teach children about vernal pool, interesting topics to teach the children about from vernal pools, and challenges that come along with creating activities for children of all ages. They also stressed the importance of not only teaching children about nature at an early age, but also how to respect it.

We also interviewed our sponsor, Lisa Burris, Executive Director of Turn Back Time Farms, to get a better idea how environmental education topics are taught at the Farm through their other programs. From interviewing Burris we learned more about the teaching style done at the farm, learning through play.

In addition, numerous amounts of secondary research was carried out. This including doing a deep investigation of what had been taught in other programs. This research also included looking the correct developmental ages for each vernal pool topic.

3.32). Research special considerations for teaching 3-8 year olds with exceptional needs environmental STEM topics, based on their assets and limitations.

To meet this objective we have conducted extensive research to create a list of expected learning outcomes for children ages 3-8 broken down by age groups. First we
conducted a semi-structured with Mia Dubosarsky, who is the director of the STEM center. In this interview we learned how she incorporated different learning styles into her educational modules, and gave us advice on developing our own, meaningful, programs.

We also conducted an interview with two specialists from the Mass Audubon. From this interview we learned a lot of what to expect from children with special needs around vernal pools and how to keep them interested through exploration and curiosity.

We also conducted an interview with Lisa Burris, who is the executive director of Turn Back Time Farms, to better understand the children we were creating the activities for, as well as her preferences and typical techniques used with similar programs.

Lastly, we have conducted a large amount of secondary research about learning outcomes for children of this age group, learning models, and similar activities. In order to get a better understanding we separated the children's learning outcomes and activities into tighter age groups, this way, if one child is seeming to have trouble, they can be moved to a lower age group.

3.4 Objective 4: Design and build vernal pool nature education activities tailored to Turn Back Time Farm.

To meet this objective we are going to collect data in the following categories:

3.41). Turn Back Time Farm’s programs

Secondary research was conducted on nature activities that implement the same type of teaching style that Turn Back Time farms uses, Learning Through Play. Semi-structured interviews were also conducted with Lisa Burris to get a better understanding of how this teaching style is implemented in their other programs. Taking information from these activities and building to them, five activities were made by each full-time group member. A field guide of all of the local species of vernal pools was designed by the team. Three different layouts were created based on past secondary feedback given to group who made a similar field guide in the past from Turn Back Time Farm.
In order to be completely sure that each activity was tailored to Turn Back Time Farm’s nature education program, a presentation was given to Burris of all the team’s ideas for Vernal Pool activities and the layout of our field guide. From there, feedback was given to the team and Burris was able to pick the activities that best met TBTs learning philosophy and needs to be built and implemented by the team. A final design for the field guide was also determined based on TBT’s educational approach and needs.

3.42) Other nature education programs that include either vernal pools or whose participants fall within the age range of 3-8 years old

Secondary data collection involved looking at other nature education programs lesson plans for vernal pool education. Based on this our team designed ideas for our own activities. Each full-time team member was to come up with five different activities based upon the research that was found. We also conducted interviews with other professionals the STEM Education Center and other known nature education programs. In addition to interviewing Burris after the activities were completed, the team also interviewed the STEM Education Center to get additional feedback on the activities and how we might improve them to meet the learning outcomes in the context of TBT.

In each of our designs we tried to break down every consideration of the plan for the activity such as how much it would cost for all of the materials, what the activity would teach and how safe it was. Each activity’s learning outcomes were broken down into developmental and content. These were also categorized by age (3-4, 5-6, 7-8). Secondary research was also conducted about the each category of ages developmental learning outcomes to ensure that each activity was matched correctly to each age group that Burris asked us to focus on. This was used in addition to the information that Mia Dubosarsky gave us about the developmental outcomes of the children in each age group.
4.0 Results

4.1 Objective 1: Learn the location, characteristics, and ecology of the vernal pools at Turn Back Time Farm.

To find the best vernal pools to conduct the educational activities, we must first find the pools and observe their characteristics. We want to find the pool on Turn Back Time’s property that best exemplifies our description of a vernal pool and will be safe to take the children to. Getting to know the pools will also allow us to properly tailor the activities to what the children will be experiencing.

4.1.1 Characteristics of Vernal Pools

Vernal pools, sometimes referred to as ephemeral pools, autumnal pools, and temporary woodland ponds, are seasonal depressional wetlands that occur all over Massachusetts (Commonwealth of Massachusetts, 2018). These pools are seasonal in the sense that they will be covered by water from winter through spring, but will dry up during the summer. The amazing thing about vernal pools is that they are an amazing habitat and breeding location for multiple animals and plants due to the lack of fish (Environmental Protection Agency, 2018).

4.1.2 Location of the Pools

Since we are conducting our research out of the typical wet season, the pools are most likely dry so they will be harder to locate. We will start by marking the areas on the farm that have a high probability of containing a pool. These areas will be found by using various topographical maps and elevation type maps. We will try to use a GIS mapping system to do further analysis, if necessary. We have found a good topographical map of the area (Bennett, 2018) as well as a website that will find the elevation of any geographical point entered (Maplogs, 2018). We conducted a meeting with Professor Najafi Simak in order to see if this was feasible and to be given access to GIS software, and it seems like this will be a last resort method, since it may bring along extra and unnecessary complication, but if we are having issues...
since the pools have such a small change in elevation, we may need to utilize the GIS software (Kissel, 2008). We then took a day to visit the farm and walk around the land, trying to find evidence of vernal pools based on Lisa Burris’s suggestions and found a few potential areas that pools may be. They are pictured below.
There are signs of vernal pools that you can see while they are outside of the hydro period. This will be very helpful for us in order to confirm that specific areas we have located on the farm are not just puddles but vernal pools. Some of these techniques include looking at physical characteristics such as; (Natural Heritage & Endangered Species Program, 2009)

- Stained leaves in a depression
- Water stains or siltation marks on surrounding tree trunks or vegetation
- Trees with buttressed trunks or stilt trunks
- Wetland plants or sphagnum moss growing in a dry depression
- Wetland or hydric soils

4.1.3 Ecology of the Pools

In order to fully understand the pools at Turn Back Time, we must know what is inside them. Again, since we are not able to observe these vernal pools during their hydro state, we must conduct outside research to try and figure out what is most likely in these pools. According to the Mass Audubon and Lisa Burris we will most likely be dealing with spotted salamanders, wood frogs, and fairy shrimp (Mass Audubon, 2018). But there are many species that require vernal pools at a certain point in their lives, these are called obligate species. The obligate species of vernal pools will also be useful for our activities.
4.2 Objective 2: Learn the teaching philosophy, methodologies and practices at Turn Back Time Farm.

Turn Back Time Farm, a fifty-eight-acre homestead located in Paxton, Massachusetts, utilizes nature to educate children. The farm was started by Lisa Burris and was inspired and informed by Burris’s education, research and personal experience with her own two children. The farm’s efforts are directed towards children who struggle in typical classrooms due to learning disabilities and special needs. The staff knows that nature’s cognitive benefits help children, especially those with special needs. This mission is time consuming due to the constant evolution necessary to maintain a relevant and well-rounded program suitable for all students.

Due to the strenuous nature of this educational strategy, Turn Back Time Farm is always in need of new programs. Turn Back Time focuses on learning through play and exploration of nature. During our research we found a lot of benefits of learning through play. With the evolution of technology in recent years, kids have become less social and have lost their sense of meaningful play. This gives children more opportunities to learn than a typical classroom with a scripted curriculum. By utilizing a learn through play philosophy the child is more intrinsically motivated to learn since they are having fun (Mead 2018).

All of these children are developing useful skills that they will need throughout their life. They will develop their mental and social skills through exploration and creativity. The children will also fine-tune their motor skills through all the hands-on work they will be doing. Children are able to expand social and mental abilities through play because play gives children the opportunity for children to communicate and solve problems collaboratively in a pressure-free environment. According to the Center for Parenting Education this is why “children who often engage in pretend play tend to have more sophisticated levels of interaction,” (Center for Parenting Education, 2018).
4.3 Objective 3: Compile effective nature educational practices for neurotypical children, children with exceptional needs, specifically children with autism spectrum disorder and attention deficit disorder.

While working towards this objective, research was conducted on other nature based education programs with similar teaching objectives to Turn Back Time Farm. This combined with research on teaching children with exceptional need and semistructured interviews with experts in elementary nature education, the team was able to compile a list of appropriate topics to teach through vernal pools such as food webs, pollution, and the predator prey relationship.

4.3.1 Teaching these Topics to Children with Exceptional Needs

After determining the appropriate subject matter, we then looked into the best way to present this material to the children. Special needs students may have a variety of different learning needs and limitations. In order to ensure these children are all included and learning effectively, lessons must be as accessible as possible. Some students may not be able to speak or read well and others may not be able to control parts of their body. In order to properly educate special needs children, it is important to understand their learning strengths and weaknesses. Some common ways to engage children with autism and similar disabilities is to focus on team-oriented projects and communication (Dumais, 2016). Techniques like these give the child an opportunity to socialize and think outside the box. Another great technique to help these students become more independent is to concentrate on giving the students open-ended questions rather than giving them choices. This allows them to open their mind and think freely, rather than having answers given to them. Students with special needs also often benefit from having personal aides or a separate program with as close to a one-to-one teacher-to-student ratio as possible (Irish, 2015).

4.3.2 The Planning Pyramid

Taking these into mind we will implement a planning pyramid while creating our activities. Planning pyramid are a technique used by teachers when creating lesson plans to ensure that all students learning levels are included (Gould & Vaughn, 2000). As seen in the figure below there are 3 levels to a planning pyramid: material every student will be able to learn, material most students will learn, and material some students will learn. While all of these
aspects will be entertaining, this method makes sure there is no limiting what a child can and cannot learn in our activities. The planning pyramid takes into consideration what is needed from each student in order to to able to learn each level of the pyramid. It ensures that all the children’s needs will be met and promotes the best learning experience possible (Gould & Vaughn, 2000). The planning pyramid helps with the planning process and assists the organizer in getting a better understanding of the concepts that they want to teach, the best way to teach the content, and then also how to assess that it was learned. Using this will creating our learning modules ensured that we were making the best program to serve the children’s and TBT needs.

4.4 Objective 4: Design and build vernal pool nature education activities tailored to Turn Back Time Farm.

To achieve objective four, our team brainstormed an initial eleven ideas for different games, resources, and tools to use to teach about vernal pools at Turn Back Time Farm. Initial designs were created based off of other nature education games used in other programs and at Turn Back Time Farm. Through research on learning outcomes for children 3-8 years old, the
team determined the learning outcomes for both development and content for each of the activities. Next, the activities were evaluated by the team based on how well they worked into the planning pyramid to ensure that every child would be able to get something out of them. Designs for the modules were drafted into a powerpoint and presented to Burris, Stoddard, and Dubosarsky and final drafts of the modules were completed based on their feedback. The nine most applicable modules were chosen and built by the team for use in a future Turn Back Time Farm program. The final descriptions and designs of the activities are outlined below.

4.4.1 Module 1: Salamander Crossing Game

Objective: A game to teach the children about how Salamanders survive in vernal pool.

Ages: 3-8 yr olds

Outcomes: Promotes problem solving while teaching children about migration and the life cycle

Description:
A game to teach the children how Salamanders live in vernal pools and migrate into the forest for their food source.

The rules:
1. The children will line up on one side of a field in the “vernal pool” where they are spawning. It is their mission to make it to the forest on the opposite side, grab a food source (worm or slug) and come back to the vernal pool to continue mating. They should run away from obstacles while making the journey between the two spots. Kids acting as predators (Eastern Garter Snakes) can tag them as they are trying to cross back and forth.
2. After the first round, teachers should ask for volunteers to be “predators” of the salamanders (Eastern Garter Snake) to tag them.
3. Play as many rounds as you want. Additionally different factors (for the older kids) like different pollutants such as Pesticides (Atrazine) and Light Pollution that can now also tag out the salamanders. Each round it will become harder and harder for the salamander to get back and forth from the vernal pool and the forest. It will also teach the children humans impact on the environment around them through the use of pesticides and cutting down too many trees to cause light pollution.

Build: Design of the game and all of the rules.
4.4.2 Module 2: Children’s Book and Coloring Pages

**Objective:** For children to learn about the key species in Massachusetts’ vernal pools, and to learn the color and letters associated with these species.

**Ages:** 3-6

**Outcomes:** Through engaging with our book, children will learn species, as well as their associated colors and letters. We will also create a coloring book version where kids can fill in colors and connect dots to form letters.

**Description:** The children will first read through the completed book and will then receive coloring pages for them to color in as well as trace the letters of the name of the species. Studies show that writing down something helps you better remember something, so hopefully this will help the children better remember the species in a fun way!

**Build:** Designed final layout of book on *Adobe Illustrator and InDesign*. Designed the coloring pages in Adobe Illustrator and Photoshop.
4.4.3 Module 3: Food Web Fun!

**Objective:** A simulation activity to teach kids about how different parts of the vernal pool food web interact with each other

**Ages:** 5-8 yr olds

**Outcomes:** Teaches children critical thinking skills while teaching them how each part of the food chain depends on the rest

**Description:**

1. Introduce the activity. Explain that they will learn their animals role in the vernal pool food web.

2. Assign roles.

   Hand each student one of the following food web fun animal cards that has an animal from the Vernal Pool food web: Snakes (Northern Water Snake), Birds (Northern Cardinal), Salamanders (Eastern Redback Salamander), Frogs (Spring Peeper), Turtles (Eastern Box Turtle) and Insects (Diving Beetle and Giant Water Bug). For example, if you have a class of 30 students, there should be 2 snakes, 2 birds, 5 salamanders, 5 frogs, 6 turtles, and 10 insects.

3. Start the simulation of the food web

   - Have one area of the playing field be the vernal pool and be sure to explain that this area is vital to each of the animals playing the game.
   - Make sure the insects to stay in the vernal pool area and they may not leave the area. Explain that the vegetation (algae) in the area is their favorite type of food.
   - In the next area closest to the vernal pool the salamanders, turtles, and frogs should be standing. Explain that they are looking for insects to eat.
   - The birds and the snakes should be in the final area farthest from the vernal pool as they do not directly rely on it. As they are hungry, have the birds and snakes pick one of the salamanders, turtles, and frog by tapping them on the shoulder. When the salamanders, turtles, and frogs are tagged they turn into insects/
   - The salamanders, frogs, and turtles are also very hungry and allow them to only “eat” the insects.
   - Defense Mechanisms may be used by each species up to 3 times!
○ Turtles- go into their shells, in a ball
○ Frogs- Camouflage, lay down on ground
○ Salamanders- Ribs stick out and poke predator, Muscle arms
○ Diving Beetles- Swim Away, Swimming Motion
○ Giant Water Beetles- Fight Back, Chomp Chomp

- If a snake or bird strikes out 3 times they become a turtle, frog, or salamander and an insect becomes a bird or snake. If a turtle, frog or salamander strikes out 3 times they become an insect.

4. Have students reflect on their experiences and new understandings.

**Build:** Design of the game and all of the rules. Created species cards for the children to wear during the game. This included laminating all cards and hot glue gunning string to them so the children could wear them around their necks.

4.4.4 Module 4: What’s for Dinner Tonight?

**Objective:** An activity to teach children how all species are connected to one another in a vernal pool

**Ages:** 7-8 yr olds

**Outcomes:** This gives students the chance to use the information on their life card and make connections with any other organism in the group. In this activity the kids will learn concepts the food web!

**Description:**

1. Students should make a large circle all facing towards each other
2. Pass out the vernal pool life cards to all of the students.
3. Pick one student to explain how their card is related to another card in the circle. For example, a wood frog tadpole is connected to algae because algae is consumed by the wood frog tadpole. Kids could take this a step further and make connections such as a wood frog tadpole is connected to the sun because it eats algae, which uses the sun to produce energy for itself.
4. After explaining how they are connected, the student will throw the yarn ball to that student in the circle (while holding on to the end of yarn)
5. The game will continue the student now with the yarn ball and they must make a connection to someone different in the circle.
6. The ball of yarn must go to everyone in the circle. When this is complete, the yarn will form a physical web that they students can see, and physically show students that all living things in the vernal pool are connected to one another.

**Build:** Design of the game and all of the rules. Created “life cards” for the children to use during the game. This included laminating all the cards.

4.4.5 Module 5: Vernal Pool Guess Who

**Objective:** Learn detailed species characteristics of vernal pool plants + animals through a vernal pool guess who game.

**Ages:** 7-8

**Outcomes:** Through our guess who game we intend to build children's social skills through conversation and communication. Also this game is intended to teach children about vernal pool species and their characteristics.

**Description:**

1. Children will set up the game by piling up and shuffling the cards, as well as setting up the mat or personal game boards.
2. Each child will pick a species card
3. Children will take turns asking yes or no questions to try to figure out the species
4. The first child to figure out the other player's species wins.

**Build:**
We started by buying a Guess Who set from amazon and measuring all the pieces. We then duplicated all the pieces in photoshop and replaced them with vernal pool species, printed it, then laminated it.

4.4.6 Module 6: Nature Walking Path

Objective: A path on the way to the vernal pools set up with 12 posts. All posts will have a word pertaining to vernal pools on it and will come with a guide to explain it in more detail.

Ages: 3-8 yr olds

Outcomes: Create a clear path to the vernal pools while also giving a broad overview of what vernal pools are and what they are made up of.

Description: 11 posts will be set up along the pathways to the vernal pools so that the pools may always easily found. The path will start with a word pertaining to Vernal Pools that starts with the A letter and have posts continue through 10 more posts of words beginning with various different letters. Each post will be made out of wood and have the letter, word, and simple image etched into the wood. Each post will be approximately 60 steps apart. This comes from the
knowledge that the average human step is about 2 feet (60 steps/ 2 feet= 30 feet * 11 posts = 330 feet total of the trail) and I would approximate from site visits that there are about 330 ft from the edge of the forest to the location of the vernal pools. The posts will spell out “VERNAL POOL”

The idea would be to have a clear path to the vernal pools that are clearly marked. The letters and pictures will also make it easier for the children to remember the various species and characteristics in a vernal pool. Lastly, an added element could be added to the path where students are asked to count the number of steps they take in between each post to work on their counting skills.

**List of Posts Made:**
- Vernal
- Ecosystem
- Rain
- Newt
- American Bullfrog
- Leaves
- Producers
- Obligate Species
- Omnivore
- Larva

**Build:** Each wooden post was hand wood burned by a wood burning pen. First each design was hand drawn in pencil on the post so it could be easily erased. After the design was perfected it was wood burned into the stumps. In order to make sure that they were weatherproof, each post was completely covered with four coats of polyurethane.

4.4.7 Module 7: Sense Hunt
**Objective:** Children will choose or be given several adjectives that relate to their senses (smooth, shiny, fragrant, slimey, etc.) and a bag, then must go to the area of a vernal pool and collect items that are described by those adjectives. Finally, the student will then describe the item and its connection to the class.

**Ages:** 5-8

**Outcomes:** This activity gives children the understanding of counting, adjectives and the 5 senses. It is also good for the students exploration and critical thinking skills.

**Description:**
1. Children will be given a list of different adjectives and a brown paper bag
2. Children will explore the vernal pools and surrounding areas
3. Children will try to find objects in and around the pools that are described by an adjective on the list
4. The children will then all group up and describe what's in their bag to each other

**Build:** List was made of different adjectives that could describe different species and objects surrounding a vernal pool.

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**4.4.8 Module 8: Vernal Pool Inspection Set**

**Objective:** Students will be provided the tools that they need in order to properly inspect the creatures living in the vernal pools

**Ages:** 4-8

**Outcomes:** This activity helps children develop their motor skills both fine and gross. It requires the children to use the tools to carefully look through the vernal pool and will allow them the opportunity to see more of the species that they are learning about in the field guide more up close.

**Description:** In this activity, the children will be given the opportunity to take a closer look at the species in the vernal pools for themselves. Using the tools that our team will provide Turn Back Time Farm with, the students will learn more about vernal pools while also learning how to properly handle these species.

1). Students will either take the net or the scooper and begin searching through the vernal pool for any species.
2). The student will then move their findings into one of the observation containers depending on the size of the species pulled from the pool
3). Time must be given for the dirt in the water to settle so a song could be sung to keep the children busy! For example: https://youtu.be/sAjC0VHTHQc?t=16
4). Once the song is complete and the water has settled it is time to observe what was scooped out of the pool!
5). The species (or water samples) may be moved into a smaller observation container with the spoons so that they may be more clearly seen. If necessary use a magnifying glass.
6). Students will use the provided field guide to try and determine what is in their observation container.
7). Students will walk around and observe all of the found species!
8). Carefully each species will be returned to their homes, the vernal pool

**Build:** Each part was purchased online. Pot was attached to the end of a long wooden stick using string and hot glue to be able to pull out larger items from the vernal pool.

**Tools in the kit (8 items total):**
- Net
  - To pull species from the pool
- Scooper
  - To pull species from the pool
- Small red observation bowls
  - To observe the species that were pulled from the pool
- Large white observation bowls
  - To observe the species that were pulled from the pool
- Ice cartons
  - To take a closer look at the species pulled from the pool
- Spoons
  - To transfer species from one observation place to another (ex: bowls to ice cartons)
- Magnifying glass
  - To take a closer look at the species pulled from the pool
- Skimmer
  - To skim the top of the vernal pool for species
4.4.9 Module 9: Vernal Pool Field Guide

**Objective:** A central place for teachers and children to use to look up species of the vernal pool.

**Ages:** 5 & up

**Outcomes:** Teach children about the species of vernal pools so that they will have a better understanding of them

**Build:** Designed each of the pages in a word document with all of the basic information about the species. Then the pages were printed out double sided and laminated. Using binder rings and a carbeaner the book was bond.

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### Spotted Salamander

**Habitat:** hardwood and mixed forests, swamps, ponds, and vernal pools

**Predators:** skunks, raccoons, turtles, chipmunks, squirrels, opossums, snakes

**Lifetime:** average life time of 20 years

**Diet:** (omnivore)
- Larva consume zooplankton, isopods and amphipods.
- Adult consume crickets, worms, insects, spiders, slugs, centipedes, and millipedes.

**Fun Facts:** Eggs sometimes contain green algae. The algae will consume the carbon dioxide that salamander embryos produce and turn it into oxygen that the embryos can use.

**Size:** 7 to 9 in. long in total length, Egg mass between 1/6 in. diameter

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4.4.10 Assessment
The team was able to observe two of our activities at Turn Back Time Farm. The modules were assessed on a group of 20, 4 to 10 year old children in Turn Back Time Farm’s homeschool program. The salamander crossing game was the first activity presented to the students. Before playing the game we discussed and explained to the children about salamanders, why they live in vernal pools, what they eat, and what eats them. The children excitedly participated in the conversation and volunteered to add their own anecdotes about vernal pools. After the fundamental knowledge needed to play the game was established, the rules of the game were explained. Six rounds of the game were played until there were only a few salamanders still remaining and they were declared the winners. At the completion of the game, a list of assessment questions were asked the children to make sure they had a full understanding of the topics we had hoped to teach them. The assessment was considered a success as they were able to answer all of the questions completely without assistance. After we interviewed Lisa Burris and she said that she was very impressed by how engaged the students were in the game.

We also had the chance to also observe the Sense Hunt game with the same group of children. The children were presented with a list of senses and a list of different “items” to find around a farm. This game would ideally be played around a vernal pool in the future, however the safe trailway that is going to be created by the boy scouts was not complete yet. The game was still effective as the children had the chance to be free and discover new things around the farm. At the end of the activity we were unable to ask the assessment questions pertaining to vernal pools, as we did not play around them. However, the children were able to answer all questions not pertaining to vernal pools and did so without assistance. Asking the children if they enjoyed the activity at the end, they all agreed excitedly.

5.0 Conclusion and Recommendations

The goal of the project was to develop activities, games, and resources to enable children ages 3-8 to learn about vernal pools through play at Turn Back Time. Eight activities, games, and resources were created for the farm to use, as well as a field guide for species identification in the vernal pools. After research and gathering expert advice, the team was able to create learning modules about vernal pools that were tailored to Turn Back Time Farm’s needs.
Due to a lack of time we were unable to assess each of our programs at Turn Back Time Farm. Our team did however create an assessment program for each of the modules where it was applicable. Through more interviews with Mia Dubosarsky, our team was able to create and present additional recommendations to the assessment of our modules. With Dubosarsky, we learned about the five keys to quality assessment which are outlined below. We took the four types of assessment methods (selected response, written response, performance assessment and personal communication) and used one to two of them to assess the quality of our modules. Our example assessment programs can be seen below:

Assessment Program:

Module 1: Salamander Crossing Assessment-

Keys to Quality Classroom Assessment:
All of the pieces contributing to sound classroom assessment instruments and practices are built on a foundation of the following five keys to quality:
1. They are designed to serve the specific information needs of intended user(s).
2. They are based on clearly articulated and appropriate achievement targets.
3. They accurately measure student achievement.
4. They yield results that are effectively communicated to their intended users.
5. They involve students in self-assessment, goal setting, tracking, reflecting on, and sharing their learning.

Key 1- Clear Purpose:
a. Identify the key users of classroom assessment information and know what their information needs are.
   -Teachers at Turn Back Time Farm
b. Understand formative and summative assessment uses and know when to use each.
   -Formative- Assessment for Learning
     -Formal and Informal processes teachers and students use to gather evidence for the purpose of improving learning
   -Summative- Assessment of Learning
     -Assessment information used to provide evidence of student achievement for the purpose of making a judgement about student competence or program effectiveness

Key 2- Clear Targets:
What kinds of achievement are to be assessed?
Human’s Impact on the Environment
- Understanding that pollutants such as fertilizers and light pollution are harmful to vernal pool
  Salamanders need vernal pools to breed
- Obligate Species have to be in vernal pools to reproduce
  Salamander’s predators and prey
- Be able to name one of Salamander’s predators (Eastern Garter Snake)
- Be able to name one of Salamander’s prey (Slugs or Worms)

**Developmental & Content Learning Outcomes:**

<table>
<thead>
<tr>
<th>Age</th>
<th>Development</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-4</td>
<td>● Problem solving</td>
<td>● Salamander’s role in the vernal pool food web</td>
</tr>
<tr>
<td></td>
<td>● Playing with other children to develop social skills</td>
<td>● Salamander’s predators and prey</td>
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<td></td>
<td>● Following simple rules</td>
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<td>● Avoiding obstacles</td>
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<td></td>
<td>● Walking and running with ease</td>
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<td>● Cooperation</td>
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<tr>
<td>5-6</td>
<td>● Problem solving</td>
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</tr>
<tr>
<td></td>
<td>● Vary the direction, speed and quality of their movements</td>
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<td></td>
<td>● Playing fairly</td>
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</tr>
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<td>● Problem solving</td>
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<td>● Salamander’s role in the vernal pool food web</td>
</tr>
<tr>
<td></td>
<td>● Cooperation</td>
<td>● Human’s impact on the environment</td>
</tr>
<tr>
<td></td>
<td>● Critical thinking</td>
<td></td>
</tr>
</tbody>
</table>

_Planning Pyramid:_
Incidental Concepts- Human’s Impact on the Environment, Fertilizers and Light Pollution
Next Most Important Info- Salamander’s need vernal pools to breed
Most Important Concepts- Salamander’s role in the vernal pool food web, Salamander’s predators and prey
Foundational Concepts- Vernal Pools are vital to species in the environment

**Key 3- Sound Design:**
- Personal communication- This assessment activity requires a student to produce evidence of learning by speaking or writing. The teacher may directly interact with the student either in writing or verbally in the communication process which may extend over a period of time.

**Assessment Example**
Have students reflect on their experiences and new understandings. Ask students to describe what they learned from the simulation.
Ask: Why is it so important that Salamanders are able to cross back and forth from vernal pools to the forest? Students should be able to identify that this is because salamanders have to breed in the vernal pools and eat their food source in the forest.
Ask: What do Salamanders eat?
Ask: What eats Salamanders?
Ask: What would happen if there were no Garter Snakes?
Ask: How do humans impact salamanders?

**Key 4- Effective Communication**
- Through observation, we will
-record formative and summative assessment information accurately
-combine and summarize information appropriately to accurately reflect current level of student learning.

**Key 5- Student Involvement**

-Through interviews with the TBT staff we will get a better understanding of how the children enjoy the games and if they believe that they are getting the most that they can out of the games.

**Module 2: Children’s Book Assessment**

**Keys to Quality Classroom Assessment:**

All of the pieces contributing to sound classroom assessment instruments and practices are built on a foundation of the following five keys to quality:

1. They are designed to serve the specific information needs of intended user(s).
2. They are based on clearly articulated and appropriate achievement targets.
3. They accurately measure student achievement.
4. They yield results that are effectively communicated to their intended users.
5. They involve students in self-assessment, goal setting, tracking, reflecting on, and sharing their learning.

**Key 1- Clear Purpose:**

a. Identify the key users of classroom assessment information and know what their information needs are.
   -Teachers at Turn Back Time Farm
b. Understand formative and summative assessment uses and know when to use each.
   -Formative- Assessment for Learning
     -Formal and Informal processes teachers and students use to gather evidence for the purpose of improving learning
   -Summative- Assessment of Learning
     -Assessment information used to provide evidence of student achievement for the purpose of making a judgement about student competence or program effectiveness

**Key 2- Clear Targets:**

What kinds of achievement are to be assessed?

Species of a vernal pool

- Name 3 species?
  - Can you spell them?
  - What color are they?
- What species look alike
<table>
<thead>
<tr>
<th>3+4</th>
<th>Fine Motor Skills</th>
<th>Specific species in MA vernal pools and their characteristics</th>
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<td>● Coloring inside lines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Tracing Letters (coloring book)</td>
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</table>

<table>
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<tr>
<th>Language Art Skills</th>
<th></th>
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<tbody>
<tr>
<td>● Writing Letters</td>
<td></td>
</tr>
<tr>
<td>● Reading Skills</td>
<td></td>
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</tbody>
</table>

Planning Pyramid:

Incidental Concepts- knowing how to spell the different species
Next Most Important Info- Learn the colors of different species
Most Important Concepts- what the basic animal types look like (Salamanders, frogs, beetles, etc)
Foundational Concepts- animals to expect in a vernal pool

**Key 3- Sound Design:**
- Personal communication- This assessment activity requires a student to produce evidence of learning by speaking or writing. The teacher may directly interact with the student either in writing or verbally in the communication process which may extend over a period of time.
Assessment Example
Have students reflect on their experiences and new understandings.
Ask: What types of animals are typically at a vernal pool?
Ask: What species are popular at a vernal pool?
Ask: What are the colors of these species.

Key 4- Effective Communication
-Through observation, we will
  -record formative and summative assessment information accurately
  -combine and summarize information appropriately to accurately reflect current level of student learning.

Key 5- Student Involvement
-Through interviews with the TBT staff we will get a better understanding of how the children enjoy the games and if they believe that they are getting the most that they can out of the games.

Module 3: Food Web Fun! Assessment-

Keys to Quality Classroom Assessment:
All of the pieces contributing to sound classroom assessment instruments and practices are built on a foundation of the following five keys to quality:
1. They are designed to serve the specific information needs of intended user(s).
2. They are based on clearly articulated and appropriate achievement targets.
3. They accurately measure student achievement.
4. They yield results that are effectively communicated to their intended users.
5. They involve students in self-assessment, goal setting, tracking, reflecting on, and sharing their learning.

Key 1- Clear Purpose:
a. Identify the key users of classroom assessment information and know what their information needs are.
   -Teachers at Turn Back Time Farm
b. Understand formative and summative assessment uses and know when to use each.
   -Formative- Assessment for Learning
     -Formal and Informal processes teachers and students use to gather evidence for the purpose of improving learning
     Ex: midterms, see how to improve the teaching for the rest of the course
   -Summative- Assessment of Learning
     -Assessment information used to provide evidence of student achievement for the
purpose of making a judgement about student competence or program effectiveness
Ex: finals, see what a student has learned in the course

**Key 2- Clear Targets:**
What kinds of achievement are to be assessed?

**Food Web**
- Name two species in a vernal pool that are predators, and two species that are prey

**Defense Mechanisms**
- Understand what a defense mechanism is
- Name two species from the game and how they protect themselves in the nature

What happens if one species does not exist?
- Be able to explain how species rely on each other as food sources. For example, if one prey species in the food web didn’t exist, that would threaten the predator species’ ability to exist.

**Developmental & Content Learning Outcomes:**

<table>
<thead>
<tr>
<th>Age</th>
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</tr>
</thead>
<tbody>
<tr>
<td>5-6</td>
<td>● Problem solving</td>
<td>● Food web</td>
</tr>
<tr>
<td></td>
<td>● Playing with other children to develop social skills</td>
<td>● Species type</td>
</tr>
<tr>
<td></td>
<td>● Vary the direction, speed and quality of their movements</td>
<td>● Defense mechanisms of prey</td>
</tr>
<tr>
<td></td>
<td>● Cooperation</td>
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<td></td>
<td>● Playing fairly</td>
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<tr>
<td>7-8</td>
<td>● Problem solving</td>
<td>● Food web</td>
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<tr>
<td></td>
<td>● Playing fairly</td>
<td>● What happens if one species does not exist?</td>
</tr>
<tr>
<td></td>
<td>● Critical thinking skills</td>
<td></td>
</tr>
</tbody>
</table>
Incidental Concepts- All Species, Their Defense Mechanisms, Prey and Predators etc
Next Most Important Info- Defense Mechanisms
Most Important Concepts- Predators and Prey
Foundational Concepts- Species in a vernal pool

**Key 3- Sound Design:** creating an assessment that will deliver the results you want from your clear purpose and targets

- Performance assessment: also known as alternative or authentic assessment, is a form of testing that requires students to perform a task rather than select an answer from a ready-made list.
- Personal communication assessment: This assessment activity requires a student to produce evidence of learning by speaking or writing. The teacher may directly interact with the student either in writing or verbally in the communication process which may extend over a period of time.

**Example Assessment:**
Performance Assessment:
After playing the game multiple times with the colored information cards, try playing the game with the new cards without colors. The only information given will be the animals name and picture. Students will be tested to see if they can remember, who that species eats, who eats that species, and the defense mechanism that species uses.

Personal Communication Assessment:
Have students reflect on their experiences and new understandings. Ask students to describe what they learned from the simulation.
Ask: What would be different if there were no birds and snakes? Students should recognize that the birds and snakes changed the behavior of the turtles, salamander, and frogs. They should also realize that the birds and snakes, by turtles, salamander, and frogs, help keep those animals from eating too many insects.

Ask: What might happen if the animals eat too much of the insects? Students should understand that if the insects disappear, so will many of the animals that eat them, including the turtles, salamander, and frogs. Make sure students understand that the insects are important in the ecosystem, and the birds and snakes help keep the insects at just the right level by eating the animals that eat the insects.

Ask: Students to list the different defense mechanisms and act them out

**Key 4- Effective Communication:** assessment results function to increase student achievement, results are managed well, combined appropriately, and communicated effectively

-Through observation, we will
  -record formative and summative assessment information accurately
  -combine and summarize information appropriately to accurately reflect current level of student learning.

**Key 5- Student Involvement**
-Through interviews with the TBT staff we will get a better understanding of how the children enjoy the games and if they believe that they are getting the most that they can out of the games.
-what tbt should do

**Module 4: What’s for Dinner Tonight Assessment**

**Keys to Quality Classroom Assessment:**
All of the pieces contributing to sound classroom assessment instruments and practices are built on a foundation of the following five keys to quality:
1. They are designed to serve the specific information needs of intended user(s).
2. They are based on clearly articulated and appropriate achievement targets.
3. They accurately measure student achievement.
4. They yield results that are effectively communicated to their intended users.
5. They involve students in self-assessment, goal setting, tracking, reflecting on, and sharing their learning.

**Key 1- Clear Purpose:**
a. Identify the key users of classroom assessment information and know what their information needs are.
-Teachers at Turn Back Time Farm
b. Understand formative and summative assessment uses and know when to use each.
- Formative- Assessment for Learning
  - Formal and Informal processes teachers and students use to gather evidence
    for the purpose of improving learning
    Ex: midterms, see how to improve the teaching for the rest of the course
- Summative- Assessment of Learning
  - Assessment information used to provide evidence of student achievement for the
    purpose of making a judgement about student competence or program effectiveness
    Ex: finals, see what a student has learned in the course

**Key 2- Clear Targets:**
What kinds of achievement are to be assessed?
Food Web
  - Name two species in a vernal pool that are predators, and two species that are prey
What happens if one species does not exist?
  - Be able to explain how species rely on each other as food sources. For example, if one
    prey species in the food web didn’t exist, that would threaten the predator species’ ability
    to exist.

**Developmental & Content Learning Outcomes:**

<table>
<thead>
<tr>
<th>Age</th>
<th>Development</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-8</td>
<td>● Teamwork</td>
<td>● Food web</td>
</tr>
<tr>
<td></td>
<td>● Creativity</td>
<td>● Show how all living species of the ecosystem are dependent of each other to live</td>
</tr>
<tr>
<td></td>
<td>● Social skill of including everyone in the group</td>
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<td></td>
<td>● Critical thinking</td>
<td></td>
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<td></td>
<td>● Public speaking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Ability to focus on activity for long spans of time</td>
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</tr>
</tbody>
</table>

**Planning Pyramid:**
Incidental Concepts- How they depend on each other indirectly
Next Most Important Info- How they depend on each other directly
Most Important Concepts- How they depend on each other
Foundational Concepts- Species in a vernal pool

**Key 3- Sound Design:**
- Performance assessment: also known as alternative or authentic assessment, is a form of testing that requires students to perform a task rather than select an answer from a ready-made list

**Example Assessment:**
Performance Assessment:
This game is the final game that we want the children aged 7-8 to play. In order to complete this game, the students must have a working knowledge of vernal pools, the species in them, and how all the species depend on each other. Therefore they should play salamander crossing, what’s for dinner tonight first If each student is able to complete this game more than once (i.e. with different cards) then our program was a success.

**Key 4- Effective Communication:** assessment results function to increase student achievement, results are managed well, combined appropriately, and communicated effectively
- Through observation, we will
  - record formative and summative assessment information accurately
  - combine and summarize information appropriately to accurately reflect current level of student learning.
**Key 5- Student Involvement**
- Through interviews with the TBT staff we will get a better understanding of how the children enjoy the games and if they believe that they are getting the most that they can out of the games.

**Module 5: Vernal Pool Guess Who Assessment**

**Module 7: Sense Hunt Assessment**

**Keys to Quality Classroom Assessment:**
All of the pieces contributing to sound classroom assessment instruments and practices are built on a foundation of the following five keys to quality:
1. They are designed to serve the specific information needs of the intended user(s).
2. They are based on clearly articulated and appropriate achievement targets.
3. They accurately measure student achievement.
4. They yield results that are effectively communicated to their intended users.
5. They involve students in self-assessment, goal setting, tracking, reflecting on, and sharing their learning.

**Key 1- Clear Purpose:**
a. Identify the key users of classroom assessment information and know what their information needs are.
- Teachers at Turn Back Time Farm
b. Understand formative and summative assessment uses and know when to use each.
- Formative- Assessment for Learning
  - Formal and Informal processes teachers and students use to gather evidence for the purpose of improving learning
- Summative- Assessment of Learning
  - Assessment information used to provide evidence of student achievement for the purpose of making a judgment about student competence or program effectiveness

**Key 2- Clear Targets:**
What kinds of achievement are to be assessed?

The 5 Senses
- What senses did you use?
- What did it smell like?
- Could you hear any animals?

Vernal Pool Ecology
- What was the vernal pool like?
- What did you find?
- Did you see any animals?
- What makes a vernal pool special?
<table>
<thead>
<tr>
<th>Age</th>
<th>Development</th>
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</tr>
</thead>
<tbody>
<tr>
<td>5-6</td>
<td>Language Arts</td>
<td>Environment of a vernal pool</td>
</tr>
<tr>
<td></td>
<td>● Understanding of adjectives</td>
<td></td>
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<tr>
<td></td>
<td>● Teamwork and communicating with others</td>
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<td></td>
<td>Social Skills</td>
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<tr>
<td></td>
<td>● Exploration</td>
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<td></td>
<td>● Critical thinking</td>
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<td>● Exploration</td>
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<td></td>
<td>● Critical thinking</td>
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<td>Mathematics</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>Science</td>
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</tr>
<tr>
<td></td>
<td>● The 5 senses</td>
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<tr>
<td>7-8</td>
<td>Language Arts</td>
<td>Environment of a vernal pool</td>
</tr>
<tr>
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<td>● Understanding of adjectives</td>
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</tr>
<tr>
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<td>● Understanding how to use words to describe things in more detail</td>
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<td></td>
<td>● The 5 senses</td>
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</tbody>
</table>

Planning Pyramid:
Incidental Concepts- understanding of adjectives.
Next Most Important Info- 5 senses
Most Important Concepts- what can be found inside and around a vernal pool
Foundational Concepts- the qualities of a vernal pool

Key 3- Sound Design:
- Personal communication- This assessment activity requires a student to produce evidence of learning by speaking or writing. The teacher may directly interact with the student either in writing or verbally in the communication process which may extend over a period of time.

Assessment Example
Have students reflect on their experiences and new understandings.
Ask: What did you find while exploring the vernal pool?
Ask: What adjectives describe these items?
Ask: What is a vernal pool?
Ask: Describe a vernal pool in relation to your different senses. (excluding taste)

Key 4- Effective Communication
- Through observation, we will
  - record formative and summative assessment information accurately
  - combine and summarize information appropriately to accurately reflect current level of student learning.

Key 5- Student Involvement
- Through interviews with the TBT staff, we will get a better understanding of how the children enjoy the games and if they believe that they are getting the most that they can out of the games.
Recommendations:

In the future we recommend that Turn Back Time Farms assesses all of the modules at the completion of every program using the assessment program we outlined above. This will ensure that every child going through every program will have the chance to experience all that they can from the activities. The goal of our project was to create educational modules about vernal pools that could be taught to children of all learning styles, so to make sure that the modules are truly teaching each child Turn Back Time Farms must assess the children constantly. We also recommend that Turn Back Time Farms continuously edits the modules. To ensure that our activities will be played at TBT for a long time in the future, changes will need to be made so that the games can evolve and become better for the next generation TBT kids. Through observing each game the teachers will have a better sense of how the games could be better, and how to fix them. In each of the games, different species could be switched out so that the game is teaching about new and exciting species. Also, as the children have the chance to observe and find out more about vernal pools they may want to add more species to the field guide.

Finally we recommend to Turn Back Time Farm that they certify through the state the vernal pools that they have on their property. Vernal pools support a rich and diverse amount of endangered massachusetts wildlife, so it is vital that they are protected by the state. We recommend that Turn Back Time makes the certification of the vernal pools an activity for some of their older students. The steps are pretty simple to do so, and are all outlined online on mass.gov. Allowing the students to assist in certifying the vernal pools will give them a greater appreciation and respect for nature. It may also make them more likely to protect the nature around them in the future.

Conclusion:

In conclusion, our team was tasked with creating an educational program to teach children 3-8 years old about the vernal pools at Turn Back Time Farms. Through expert interviews and extensive research our team learned about vernal pools and the species that inhabit them. We also learned about the benefits of nature education, teaching children with learning disabilities, and how to properly assess a program. At the completion of the project we
will be giving Turn Back Time Farms eight new educational models to teach, as well as a vernal pool field guide. The team has truly enjoyed this experience and hopes that Turn Back Time Farms will be able to use their activities about vernal pools for many years to come.
References


Burris, L. (2019, April 23). Great job today! [E-mail to the author].


Leach, A. (2018, March 01). “Improving children's access to nature starts with addressing inequality”. Retrieved 1, 2018 from


