Gamiing Nature Centre – Wetlands Traveling Exhibit

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Final Report

By

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Wetlands Traveling Exhibit

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Abstract

The purpose of this project was to develop and create a design manual that will be used to construct an interactive traveling exhibit for Gamiing Nature Centre. Approaches used to gather information on components of effective exhibits and content for the exhibit included textual analysis, oral interviews, and critical analysis of existing exhibits. The data collected was analyzed to determine what components of an educational traveling exhibit are most effective, inclusive and interactive. All existing exhibit observations were placed in charts and rated according to criteria which define the characteristics of an effective exhibit. This data analysis method allowed us to categorize and rate exhibits and quantify results. The findings produced led to the development of an interactive and curriculum-linked traveling exhibit manual, designed to promote "Environmental Education and Natural History" of local wetlands (Carrothers, Gamiing, 2010). The "Design Manual - Wetland Traveling Exhibit" presents Gamiing Nature Centre with the design for a traveling exhibit focused on delivering environmental education to schools and community groups aligned with Gamiing Nature Center's mission and mandate. The wetland traveling exhibit is designed in such a way that it can be integrated with Gamiing's "Discovery Box Program" (Gamiing, 2011a).

Acknowledgements

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This project would not have been possible without the enthusiasm and participation of the individuals we interviewed. Mark Rupke, a naturalist at the Kawartha Pine Ridge District School Board Laurie Lawson Outdoor Education Center, provided us with great insights on how to design a traveling exhibit specifically focused on wetlands. Mark also provided us with valuable advice regarding components of exhibits that are most effective, interactive, and able to maintain audience attention. The staff at the Ontario Science Center in Toronto, Ontario were especially helpful and willing to provide us with tips on designing an effective, interactive and inclusive exhibit. The Canadian Canoe Museum staff in Peterborough, particularly Carolyn Hyslop, were extremely resourceful. Carolyn invited us to join an elementary class for an afternoon educational program to observe students and how they interacted with existing exhibits. Further thanks to Gayle McIntyre, Co-coordinator of Museum Management and Curatorship Programing at Fleming College, for her eagerness, advice and guidance. We would also like to thank the staff from the Ontario Federation of Anglers and Hunters and the Peterborough Museum and Archives.

Finally, we would like to thank all of our colleagues and everyone else who made this project possible. We hope that the Gamiing Nature Centre will benefit from this project as they continue to grow and expand. With access to funding, this project will be especially useful in helping Gamiing branch its educational resources to all community members and schools in the local area.

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1.0 INTRODUCTION

Gamiing Nature Centre has recently developed an "Education Outreach Plan" consisting of several tools and resources of varying complexity (Gamiing, 2011a). One important aspect of the "Education Outreach Plan" is the inclusion of traveling exhibits which will be aimed at promoting "Environmental Education and Natural History" (Carrothers, Gamiing, 2010). The primary goal for including traveling exhibits in the "Environmental Outreach Plan" is to deliver environmental education that is consistent with Gamiing's "mission, mandate and central interpretive themes" to local school and community groups (Carrothers, Gamiing, 2010). Although the overall project consists of four exhibits in total, this project focuses solely on one, the wetlands exhibit.

The purpose of this project is to develop and create a design manual for an interactive curriculum-linked traveling exhibit, promoting environmental education specific to Gamiing's local wetlands. The design manual will provide a layout and design plan for a portable, interactive exhibit of approximately 100-200 square feet (to fit within a school gymnasium). The exhibit is specifically designed to be integrated with Gamiing's "Discovery Box Program," and aligned with Ontario's curriculum targets. This project will be developed in two phases:

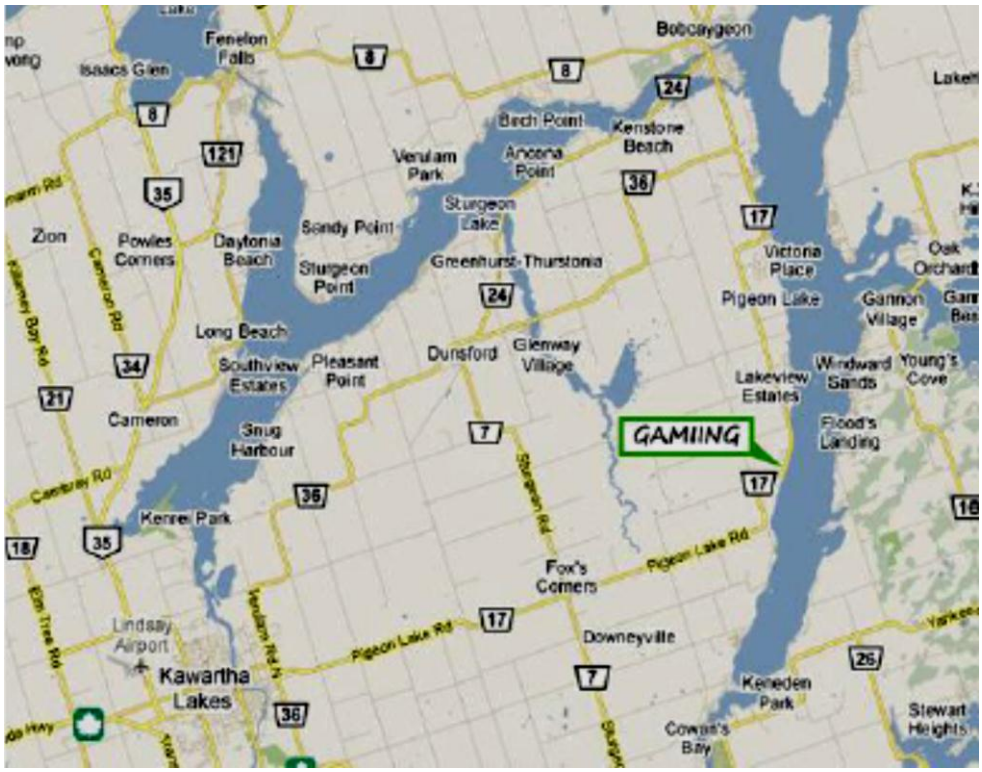
- Phase 1: the research, development and design of the exhibit
- Phase 2: the identification of curriculum links, relevant educational activities and effective exhibit presentation

The first phase will focus on researching the components of effective traveling exhibits, and the collection of information that is site specific to the wetlands at Gamiing Nature Centre. Findings will be compiled to develop and design an effective traveling wetland exhibit, including wetland information that is specific to Gamiing. The initial phase will also include design plans, a hypothetical materials list, and a rough estimate of the cost that are required to create this type of exhibit.

The second phase of this project consists of the development of educational activities and effective presentation methods and lessons which will emphasize the exhibits storyline. This aspect of the project is further intended to identify current threats to local wetlands, and the importance of environmental stewardship. This section will also focus on identifying and describing the Ontario Science and Technology Curriculum (2007) connections to the wetland travelling exhibit (Ontario Ministry of Education and Training, 2007, 1-167).

1.1 Study Area

Gamiing Nature Centre is "located on the west shore of Pigeon Lake, between Bobcaygeon and Lindsey, Ontario" (Gamiing, 2011d). Gamiing "operates from a 100-acre property with a natural shoreline, surrounded by wetlands, forests and meadows" (Gamiing, 2011c). The Nature Centre is a non-profit charitable organization, created to "practice a philosophy of land and water stewardship" (Gamiing, 2011d). To preserve this land as a "dynamic natural venue" available for public enjoyment, and to continue to educate the public through "demonstrations of low-impact and zero-impact lake shore living," it has been placed in a Conservation Easement and put in Trust with the Kawartha Heritage Conservancy (Gamiing, 2011c). As outlined on their website, www.gamiing.org, Gamiing promotes the enjoyment and importance of "living in harmony with nature", by engaging the community in educational experiences (Gamiing, 2011c). Gamiing's mission and mandate include educating the community about the importance of "balancing human needs with the needs of nature in our everyday lives", "becoming stewards of our land, water and air", and "working towards a sustainable ecosystem for future generations" (Gamiing, 2011c).



(Available Online. Accessed on April 2, 2011 at: http://sohoadmin.gamiing.org/Contact_Us.php).

FIGURE 1: LOCATION OF GAMIING NATURE CENTRE

As seen below in Figure 1.1 Gamiing Trail and Wetland Map, this site has 35 hectares of property. Gamiing has over 3.6 kilometers of trails, and over 5 hectares of wetland along Pigeon Lake (Gamiing, 2011). In the future, Gamiing plans to include a 600m boardwalk path into the marsh wetland. The dotted green line on the site map indicates the proposed location of the wetland boardwalk path.

(Designed and produced by Katherine Burgess, May 2008, Scanned document provided by Gamiing Nature Centre).

FIGURE 2: SITE MAP OF GAMIING NATURE CENTRE

1.2 Research Questions

Based on existing nature exhibits, how can we design an effective traveling exhibit and relevant programming, which will reflect the importance of local wetlands and bring revenue to Gamiing Nature Centre?

1.3 Research Objectives

The objective of this project was to design and develop a manual that outlines how to create an "interactive curriculum-linked" wetlands traveling exhibit which will promote "Environmental Education and Natural History" (Carrothers, Gamiing, 2010). This manual will provide Gamiing with the design, layout, and relevant program planning information that will be used to create an interactive traveling exhibit of approximately 100-200 square feet. The exhibit is designed to be integrated with Gamiing's "Discovery Box Program", and is both "thematic and aligned with Ontario curriculum targets" (Carrothers, Gamiing, 2010). Furthermore, this design manual will be helpful for Gamiing when applying for funding, specifically funding which would be used towards creating the exhibit.

In order to design an effective traveling exhibit, research objectives included determining the most effective components of traveling exhibits; materials and approximate costs; the form, function and structure of the natural history and environmental issues related to local wetlands; and collecting information about site specific issues such as conservation, native plants and wildlife species. The following research methods were used: interviews, observations and extensive reviews of existing academic literature. The findings discovered through the research were used to create an interpretive design manual, encompassing the scope of this exhibit based on the topic of wetlands.

1.4 Key Research Terms

Conservation:

Conservation implies that something is being kept close to its original form for future use and human benefit. This term is usually applied to the natural environment and natural resources including various wildlife species and habitats. Conservation also includes social actions or thoughts to conserve these environmental issues. This term can be broken down into two aspects: the rate in which resources are consumed, with specific reference to renewable

resources, and the desire to ensure the survival of species and habitats for the future (Adams, 2004, 107-108).

Environmental Education:

Environmental Education (EE) is defined as "education for sustainable living, the type which enables people to make informed choices that will lead to more sustainable living practices and lifestyles" (Uhuo and Závodská, 2010, 1). Environmental Education is a "process of developing the skills and behavior necessary to understand and accept the relationship between people, culture and the natural environment" (Uhuo and Závodská, 2010, 1). The primary goal of EE is to educate society about the importance of "practical decision-making and environmentally-friendly behaviour" (Uhuo and Závodská, 2010, 1). Furthermore, EE focuses on increasing public awareness and "providing every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment" (Potter, 2010, 23).

Environmental Stewardship:

Environmental stewardship is defined as "the responsibility for environmental quality shared by all those whose actions affect the environment" (United States Environmental Protection Agency, 2011).

Preservation:

Preservation is the "protection, maintenance and care" of both built and natural environments (Johnson and Gregory, 2004, 297). This term encompasses the preservation of "historic buildings, human artifacts, and archaeological sites" as well as specific natural landscapes or the biophysical environment (Johnson and Gregory, 2004, 297). Preservationist ideas are similar to the work of conservationists, as they both work toward maintaining various aspects of historical significance through the use of statutory powers entrusted from agencies (Johnson and Gregory, 2004, 297).

Storyline:

For the purpose of this project, the "storyline" refers to a detailed description of important information which will be used to construct the wetlands traveling exhibit. The storyline will include a compilation of relevant research which will be displayed in the exhibit, including site specific information about Gamiing's wetlands, wetland microorganisms, plants, animals, threats to local wetlands and environmental stewardship.

Traveling Exhibit:

For the purpose of this project, a traveling exhibit, also referred to as a traveling exhibition, is: "an interactive, informative display with mobility built into the design" (Minten, 2011). A traveling exhibit is designed in such a way that it can be set up at a venue (such as a school gymnasium or community center) for a period of time, then easily disassembled and re-assembled at the next venue.

Wetlands:

Wetlands have been identified as one of the most important natural ecosystems on the planet and are essential in providing habitats for a wide range of plant and animal species (Environment Canada, 2009a). Wetlands benefit both people and the environment through their ability to stabilize shorelines, purify water, store water, help control floods and stabilize climate by acting as carbon holders (MNR, 2011c). These landscapes provide a valuable service to human populations, acting as natural water filters which help purify water by trapping sediments and toxins (MNR 2011e, 1; Botkin et al., 2006, 362). As described by Botkin et al., (2006, 362), "wetlands are one of the primary nursery grounds for fish, shellfish, aquatic birds and other animals". It is has been estimated that "as many as 45% of endangered animals live in wetlands or depend on them for their continued existence" (Botkin et al., 2006, 362). In Canada, there are many "species at risk" identified by Canadian Wildlife Services living in wetland ecosystems (Ducks Unlimited, 2006). In addition to being "aesthetically pleasing to people", wetlands are highly productive ecosystems "where many nutrients and chemicals are naturally cycled" (Botkin et al., 2006, 362).

2.0 LITERATURE REVIEW

2.1 Wetlands

While wetlands "represent one of the world's most productive ecosystems," they have been identified as one of the most threatened natural landscapes on our planet (MNR, 2011b, 1). Wetlands perform several vital functions, including: "improving water quality, storing greenhouse gasses, helping to prevent flooding, providing habitat for numerous species," and to filter or "neutralize" several contaminants (Ducks Unlimited, 2006). Wetlands are considered, "transitional habitats," meaning they form the connection between aquatic and terrestrial or land ecosystems (MNR, 2011d, 1). They are identified as being landscapes that are either permanently covered in water, or where the water table is very close to the surface (Environment Canada and Ducks Unlimited, 2010). Due to constant water cover, wetlands consist of "waterlogged (hydric) soils," allowing for the growth of "water-tolerant plants" (MNR, 2011d, 1). Wetlands are often flooded year round, while other classifications may experience flooding only throughout the spring and fall months (MNR, 2011d, 1). As identified by the Ministry of Natural Resources (2011b), Ontario has twenty five per cent of Canada's wetlands, with an "estimate of 23 million to 29 million hectares of wetlands" (MNR, 2011b, 1).

In 2010, Environment Canada, in collaboration with Ducks Unlimited published an article discussing the importance of wetlands as being essential components of the natural environment. The publication explains how wetlands function as fresh water filters, with their ability to remove sediments and toxins that otherwise have the potential to negatively impact wetland ecosystems (Environment Canada and Ducks Unlimited, 2010). Wetlands have the unique ability to trap harmful contaminants, functioning as "natural water filters that help purify water" (Botkin et al., 2006, 362). Wetlands improve water quality by "remov[ing] sediments, absorb[ing] nutrients and biologically chang[ing] many chemicals into less harmful forms" (MNR 2011c, 1). Surface runoff from "towns, cities, roads, forestry and mining operations" containing "sediments, excess nutrients, viruses and pathogens" and several additional chemicals, flow into nearby wetlands (MNR, 2011c, 1). Wetlands have the ability to remove these unwanted sediments and toxins, including "phosphorus and nitrogen," reducing the amount of harmful material that flows into "lakes, streams, rivers and groundwater" (Ducks Unlimited, 2006). These wetland systems are also able to "recharge our groundwater," working as a sponge;

storing and releasing water as it is needed (Ducks Unlimited, 2006; Botkin and Keller, 2006). Through this process, wetlands are able to help control floods through the storing large amounts of water (DucksUnlimited, 2006).

Unfortunately, as a direct result of human impacts, up to 70% of wetlands in areas across Canada have been lost (Environment Canada and Ducks Unlimited, 2010, 2). There is a threshold to how many pollutants, destructive human activities, sewage and agricultural runoff that wetlands can handle (Environment Canada 2009a, 2). Initially, pollutants produce "algae blooms," which indicate an increase in wetland productivity. However, when the algae covers the surface of the water, this prevents sunlight from entering the wetland. As a result, microorganism and plants in the wetland are not receiving energy necessary for survival, causing them to slowly die. Eventually, animals within the wetland ecosystem also begin to die as they do not have access to food and essential nutrients. Through the decomposition stage oxygen in the wetland is significantly reduced, further decreasing wetland productivity. This process can reduce the water quality as well as limit the amount of livable habitats for plants and animals (Environment Canada, 2009a). Considering wetlands provide such an important tool as a natural fresh water filter, environmental education seeks to educate people about their significance and stress the importance of preserving these environments.

As a consequence of environmental and economic values of wetlands not being well understood, wetland landscapes in Canada continue to be lost and destroyed at alarming rates. It is increasingly important for people to recognize the importance of preserving wetland environments and keeping them intact rather than draining or destroying them (Ducks Unlimited, 2006). If these precious landscapes are destroyed, the chances for serious flooding and floodwater damage in Canada will increased dramatically (MNR, 2011c, 1). The debates surrounding wetland preservation is relevant to both social and human geographies, because they surround the issues of human effects of the natural environment. As supported in existing literature, the issue of human impacts on wetlands is one that concerns human populations worldwide (Huppes and Midden, 1994; Janssen et.al., 2005; Haines, 1978; Bean, 1978). Wetland restoration and protection involves "consideration of the ecological, social and economic conditions" (Hopfensperger et al., 2006, 578). Wetlands are especially critical to maintaining biodiversity, which is essential for healthy ecosystems and human survival (Environment Canada, 2009a; Ducks Unlimited, 2006). These natural ecosystems also provide habitat for over

600 species of wildlife, including "over one third of Canada's at risk species" (Ducks Unlimited, 2006). Evidently, continued loss of wetland habitats would be detrimental to bird and aquatic species that require many hectares of this precious ecosystem for their survival (Environment Canada, 2009a; Ducks Unlimited, 2006).

Community collaboration has been identified as important in order to gain support for protection of these ecosystems (Hopfensperger et al., 2006). Many wetland owners across Ontario also do not understand the importance of the land in which they occupy. Through interviews of 120 rural wetland owners in southern Ontario, one study exposed that landowners often have little awareness of wetland values (Kretzwiser and Pietaszko, 1986, 13). Gamiing Nature Center recognizes the importance of public involvement and stewardship for wetland preservation. Increased interest in these fragile ecosystems is gaining strength; however, there is still much to do to help wetland rehabilitation and stewardship programs (such as Gamiing) (Environment Canada and Ducks Unlimited, 2010). Gamiing Nature Center hopes to educate people of all ages on the importance of local wetlands for all of the reasons discussed above. Their goal is to ensure that people are aware of the vast benefits and services that wetlands provide for Canadians. Furthermore, and aside from human importance, these wetlands are essential habitats which provide a home to hundreds of species and endangered populations (MNR, 2011b, 1-2).

There are various features that are evident in wetlands and used as elements in classifying wetlands by type. The different classifications of wetlands include: swamps, marshes, bogs and fens (Zoltai and Vitt, 1995, 131). Each have individual "hydrological functions and habitat types" that have distinguishing features classified by type (Zoltai and Vitt, 1995, 131). Gamiing Nature Centre represents a marsh wetland, as it is permanently flooded and includes "non-woody plants such as cattails, rushes, reeds, grasses and sedges" (MNR, 2011d, 1). According to The Ontario Wetland Classification System (2011, 1), wetland types are based on scientific and social characteristics such as, "wetland productivity, ecological and biological aspects, water filtration and social aspects" which make them valuable to human populations. The majority of Ontario's wetlands exists in northern Ontario and is often classified as bog and fen wetlands (MNR, 2011b, 1). Gamiing Nature Centre is located in southern Ontario, and consists of a marsh wetland which and is classified in the following definition.

Marsh:

Marshes are "non peat-forming wetlands" and typical vegetation consists of, "non-woody plants such as cattails, rushes, reeds, grasses, and sedges" (MNR, 2011d, 1). Evident changes in weather patterns as well as seasonal changes are what mediate marshes and allow them to be either "periodically or permanently flooded" (Zoltai and Vitt, 1995, 131). Marshes commonly have pools and openings of water that are referred to in many of the following ways: "ponds, shallow lakes, oxbows, reaches or impoundments" (MNR, 1993, 29). Wetlands with the characteristics of pools and openings of water are known as treeless wetlands because of their large water flow; however, they are still considered to be rich in nutrients (Zoltai and Vitt, 1995, 131). As a result, open water marshes contain different vegetation compared to other varieties of wetlands, such as "submerged water plants and pond weeds" (Zoltai and Vitt, 1995, 131; MNR, 2011d, 1). Gamiing's wetland represents a marsh wetland, as it has the characteristics of trees surrounding the wetland area (MNR, 1993, 29). The Gamiing wetland area is covered in submerged and floating plants and also includes plants common to marsh wetlands such as cattails, reeds and grasses. Marshes are common throughout Ontario, and similar to Gamiing's location, they are commonly found along the shorelines of lakes (MNR, 2011d, 1).

(Accessed Online April, 2011. Available at: < http://www.pc.gc.ca/~/media/pn-np/on/Pelee/s-w/swamp.ashx>.)

FIGURE 3: PHOTOGRAPH OF A MARSH. "POINT PELEE NATIONAL PARK OF CANADA NATURAL HERITAGE"

Swamp:

Swamps are characterized as areas flooded for the majority of the year and have many more trees and low lying shrubs than other wetlands (OMNR, 1993). Considering they are saturated with water, swamps have very similar characteristics as marshes (Zoltai and Vitt 1995, 133). Swamps are considered both "nutrient rich and productive" (Environment Canada, 2009). The fluctuation in water levels and sometimes fast moving currants account for the fact that swamps contain very little peat matter (Zoltai and Vitt 1995, 133). Some of the trees found in swamps include: "coniferous and deciduous species, tall shrubs such as willows, dogwood and alder" (MNR, 2011d, 2). Swamps can be categorized in two ways: (1) "forest swamps" with thick tree cover; and (2) "thicket swaps," containing "tall shrubs such as willow, dogwood and alder" (OMNR, 1993, 29). Below is an image of a swamp showing high water levels and tree cover.

(Accessed Online April, 2011. Available at: <http://www.pc.gc.ca/~/media/pn-np/on/Pelee/s-w/swamp.ashx>.)

FIGURE 4: PHOTOGRAPH OF A SWAMP. "POINT PELEE NATIONAL PARK OF CANADA NATURAL HERITAGE"

Bog:

Bogs are identified as a type of wetland containing large amounts of peat material, which is where the majority of nutrients are stored (Keddy, et.al. 2009, 45). Bogs are considered the most common form of peatland; however, they are more common in northern Ontario and considered rare in southern Ontario (MNR, 2011d, 2). Bogs are generally wide open spaces with no trees in the center, large wet areas separated by dry areas with low lying peat areas (Keddy,

et.al. 2009, 45). Bogs are highly acidic which is mainly attributed to anthropogenic contributions of materials that decompose in bogs (Zoltai and Vitt 1995, 135). Peat filled bogs are created by decomposing plant matter which increases their acidity and minimizes the amount of mineral nutrients present (Zoltai and Vitt 1995; MNR, 2011d). Some living vegetation types that thrive in bogs include: "stunted black spruce trees, health plants such as laurels and blueberries, and carnivorous plants such as sundews and pitcher plants" (MNR, 2011d, 2). Bogs are extremely slow forming and take thousands of years to develop, making the protection of them even more important (MNR, 2011d, 2). Bogs are considered to have low productivity but because of their mass amount of peat content, they are extremely efficient at storing carbon. This is especially important in helping reduce harmful amounts of carbon emissions in the atmosphere as these peatlands are able to store large amounts greenhouse gasses (Keddy, et.al. 2009, 42). Below is an image of the low lying peatland that is supportive of trees in the center and has both pond and dry areas.

(Available Online. Accessed on April 2, 2011 at: http://www.nipissinghistory.com/nipissing-gallery/bog-northern-ontario-canada.jpg)

FIGURE 5: PHOTOGRAPH OF A BOG: NIPISSING HISTORY

Fen:

Fens are similar to bogs in that they also accumulate peat; however, they differ in that they are much richer in minerals such as calcium, which come from mineral deposits in surrounding soils (Zoltai and Vitt, 1995, 133). Fens are more productive than bogs considering they contain a more significant amount of nutrients (Environment Canada, 2009).They also receive minerals through "groundwater discharge from adjacent uplands" and due to the

characteristics of low lying areas, they generally have poor drainage (MNR, 1993, 29). Fens are more nutrient rich than bogs and are also less acidic and promote the growth of sedges, grasses, reeds and various moss species (MNR, 1993, 28-29). Unlike marshes and bogs, fens do have shrub cover and contain some trees including, "tamarack and white cedar, sundews, pitcher plants and orchids" (MNR, 2010; MNR, 1993). Fens are located in similar areas as bogs, often in northern Ontario, and are also uncommon in southern Ontario (MNR, 2010).

(Accessed Online April 2, 2011. Available at: <http://www.eoearth.org/article/Fens>)

FIGURE 6: PHOTOGRAPH OF A FEN WETLAND AREA: ENCYCLOPEDIA OF EARTH. "FENS"

2.2 Environmental Stewardship

Environmental stewardship is defined as "the responsibility for environmental quality shared by all those whose actions affect the environment" (United States Environmental Protection Agency, 2011). In this sense, everyone is responsible for environmental stewardship. Environmental Stewardship encompasses "both a value and a practice by individuals, companies, communities, and government organizations" (EPA Environmental Stewardship Staff Committee, 2005, 8). Stewardship behavior is accomplished through the "continuous improvement of environmental performance to achieve measurable results and sustainable outcomes" (EPA Environmental Stewardship Staff Committee, 2005, 8). These values and practices are expressed through everyday choices made by individuals, businesses, communities and government organizations.

The EPA Environmental Stewardship Staff Committee (2005) considers that sound environmental stewardship practices have a number of distinct characteristics. Such practices of environmental stewardship include: "protect[ing] natural systems and us[ing] natural resources effectively and efficiently, making the environment a key part of internal priorities, values and ethics, lead[ing] by example, hold[ing] themselves accountable, believ[ing] in shared responsibility, invest[ing] in the future, and exceed[ing] required compliance" (EPA Environmental Stewardship Staff Committee, 2005, 13–14).

There are a number of motivations and barriers for individuals practicing environmental stewardship. Some motivations include: "consideration for future generations, individual belief systems, quality of life, and increased awareness and access to information and scientific evidence" (EPA Environmental Stewardship Staff Committee, 2005, 14). Some of the barriers to stewardship behaviour include: "lack of accountability, feeling that small, individual actions don't make a difference," perception that "green products are more costly and a lack of measuring and valuing tools" (EPA Environmental Stewardship Staff Committee, 2005, 14).

The well-being of wetlands coincides with environmental stewardship (Ducks Unlimited Canada, 2011, 1). Ducks Unlimited Canada has created the Environmental Farm Plan (EFP) to make wetland stewardship practices easier for land owners (Ducks Unlimited Canada, 2011, 1). The EFP encourages environmental stewardship in restoring wetlands by providing individuals with "biological diversity and enhancement planning and expertise, assistance with engineering design, regulatory approvals and construction supervision, a site visit if you require planning or restoration advice, and a free wetland restoration guide outlining techniques and approval requirements" (Ducks Unlimited Canada, 2011, 2). Ultimately, wetland restoration stewardship practices benefit land owners and the environment. Through this restoration process, "impacts of droughts and floods are reduced," the "quantity and quality of ground and surface water resources improves," and "reduction of soil erosion and watershed sedimentation, improve air quality as wetlands help to remove and store greenhouse gasses" (Ducks Unlimited Canada, 2011, 1).

2.3 Environmental Education

During the 21st century, there has been concern about "how to preserve and protect the environment for future generations" (Buza, 2010, 8). In the early 1970s, the emerging environmental education movement was amplified by the 1972 "United Nations Conference on the Human Environment", which recommended that environmental education be recognized and promoted in all countries (EEON, 2003, 20). The goal of environmental education (EE) is to "seek solutions to environmental problems, and to develop attitudes and the motivations to work towards solutions, as well as prevent future problems" (EEON, 2003, 20). As defined by Uhuo and Závodská (2010, 1), EE is "education for sustainable living, the type which enables people to make informed choices that will lead to more sustainable living practices and lifestyles." Environmental education aims to draw public attention to knowledge about, and solutions to environmental concerns (EEON, 2003, 20). Furthermore, EE focuses on providing each individual with the opportunity to acquire knowledge of "human-environment interactions", and the environmental problems that such interactions have caused (EEON, 2003, 20). Overall, environmental education aims to provide society with the knowledge, "values, attitudes, commitment" and resources to make environmentally friendly and sustainable decisions (Potter, 2010, 23).

As outlined by Environmental Education Ontario (EEON, 2003, x), there is a desire within formal education to "become both more knowledgeable and more skilled at making decisions that will allow for continued prosperity within a framework of ecological sustainability." The goal of EEON (2003, 13) is to make "ecological literacy mainstream". Unfortunately, in the 1990s, changes to the Ontario education system decreased the opportunities and effectiveness of EE in public schools (EEON, 2003, 21). While updated elementary and secondary curriculum documents include topics such as ecology and the environment, "there is a lack of content on values, attitudes and stewardship" (EEON, 2003, 21).

Considering humans have great impacts on the environment and its resources, educations seems to be the best tool for providing people with an understanding of the effects of their actions (Buza, 2010, 10). According to UNESCO, "Educating for a Sustainable Future" (1997), moving towards the goal of sustainability requires fundamental changes in human attitudes and behaviour. Considering such, progress in this direction is especially dependent on education and public awareness. UNESCO (1997) states, "It is widely agreed that education is the most

effective means that society possesses for confronting changes of the future". This document outlines the need to reform curricula and educational policies and structures in the developing world, giving high priority to basic environmental education. Furthermore, UNESCO (1997) reviews the valuable experience and role of environmental education.

As outlined by Stapp et al., (1969, 14) environmental education is aimed at producing a "citizenry that is knowledgeable concerning the biophysical environment and its associated problems," and a society motive to work towards finding and implementing solutions. Evidence found in a study conducted by Liu and Kaplan (2006, 17) indicated that children who participated in environmental education programming were "more appreciative of natural resources, expressed more determination to care for the environment, and gained more information on topics such as plants, animals and historical events".

For environmental education to achieve its greatest impact, its primary goal is to influence attitude. In the context of environmental education, "attitude" implies a "combination of factual knowledge and motivating emotional concern, which result in a tendency to act" (Stapp et al., 1969, 15). As concluded by Stapp et al., (1969) for environmental education to be most beneficial, it has to (1) "provide factual information which will lead to understanding of the total biophysical environment;" (2) "develop a concern for environmental quality which will motivate citizens to work toward [solutions to such problems];" and (3) "inform citizens as to how they can play an effective role in achieving goals derived from their attitudes" (Stapp et al., 1969, 15). Overall, the literature on environmental education indicates the urgency and importance of educational programs emphasizing environmental stewardship, sustainability, and working "both individually and collectively toward the solution of problems that affect [the environment and] our well-being" (Stapp et al., 1969, 14).

2.4 Interpretive Design

Howe (1998) describes a shift in social and educational research that has been occurring over the past several decades, ranging from a "positivist-behavioural" (quantitative) approach to an "interpretivist" (qualitative) perspective (Howe, 1998, 13). He describes this "interpretive turn" (Howe, 1998, 13) as representing the notion that humans are no longer easily conditioned, passive subjects of stimuli, but rather active participants in the construction of their own behaviours and knowledge (Howe, 1998). In response to the new shift in social and educational

research, interpretation is a useful tool to support the understanding of statistical information, facts, and other information by adding an entirely new, and effective dimension of communication (Tilden, 1957). The addition of interpretation in an educational experience is generally presented through the use of observable objects, first hand experiences, and various types of media (Tilden, 1957). To be an effective educational tool and sustain involvement, interpretive design must be fundamentally motivating throughout the entire experience. The interpretive experience is made possible through focusing on "immediate apprehendability, physical interactivity, conceptual coherence and diversity of learners" (Allen, 2004, 17).

Despite the constant need for motivation, Allen (2004, 20) acknowledges that the focus of participants is limited by cognitive overload, or "museum fatigue." Allen (2004, 20) further suggests that visitors focus time is restricted to approximately thirty minutes. In order to reduce cognitive overload, interpretive exhibits should incorporate components that are simple and imply obvious uses (Allen, 2004, 21). Is it therefore important to note a balance between interactivity and education, as too much interactivity (resulting in cognitive overload) can ultimately obstruct visitors learning outcomes (Allen, 2004). Allen (2004, 21) also suggests "standardizing for consistency" as a technique in exhibit design to reduce cognitive overload. For example, labels, text and electronic devices should be consistently placed in the same location at each display (Allen, 2004, 21).

It is important to ensure that interpretive designs supportive a large diversity of learners. In order to cater to diverse audiences, it is important to understand that exhibit visitors will all have different cognitive learning styles (Allen, 2004, 21). When considering interactivity and a diverse audience with diverse learning styles, it is necessary to consider catering to all five senses: visual, auditory, tactile, smell and taste (Allen, 2004, 28). By attempting to more readily cater to a diverse number of learning styles, you are increasing the chance of your learners or participants understanding and making more effective connections to the interpretive material being displayed (Allen, 2004, 28).

3.0 METHODS

3.1 Literature Review

A literature review is "an account of what has been published on a topic by accredited scholars and researchers" (Taylor, 2011,1). The purpose of a literature review is to deliver to the reader an overview of what "knowledge and ideas have been established on a topic," and furthermore, what the "strengths and weaknesses" of existing literature are (Taylor, 2011, 1). A thorough study of key journals and articles relevant to a specific discipline is necessary "to situate the research in an appropriate theoretical framework" (Hay, 2005, 58). The literature review was used to identify and define several key constructs, or research terms, most relevant to this project (Reuber, 2010, 106). This literature review includes several topics which are directly related to the research question, including: information about site specific wetlands at Gamiing, effective components of traveling exhibits, interpretive design, environmental education and environmental stewardship.

The literature review was intended to be both "constructive, and critical in tone," while identifying both the strengths and weaknesses of existing literature selected for the review (Hay, 2005, 58). The literature review demonstrates how existing research complements or supports our work. Rather than simply providing an annotated bibliography of relevant articles, the literature review is a supportive element that relates the analyzed articles to our research question (Reuber, 2010, 106). Throughout the research process, the literature review was ongoing and wide ranging, allowing us to gain and maintain a broad scope and understanding of our subject area (Reuber, 2010, 106). Findings from the literature review will help justify our approach to the topic, and determine why our work is a significant and contemporary issue (Hay, 2005, 58).

3.2 Textual Analysis

Textual analysis is a research method used to conduct a detailed exploration of the text selected for review of a certain subject of interest. According to this method, "an interpretation is produced which results from the interaction between the text being studied and the intellectual framework of the interpreter" (Duncan, 2000, 825). Through a textual analysis of several journals, articles and publications, this method provides an overview and analysis of information most relevant to the research question. This methodological approach was used to determine

what past case studies and research projects have been determined to be the most essential and effective components of an effective traveling exhibit. The textual analysis was beneficial in determining the most efficient and effective approach to collect and analyze our data, based on an evaluation of how past researchers have conducted similar studies.

The textual analysis provided us with insights on the various aspects of good exhibits which have been identified in existing literature. While observing and critically analyzing existing exhibits, we carefully considered our findings from the textual analysis. It enabled us to focus on certain aspects of exhibits such as the use of audio and video to gain visitor attention. For example, when we visited the Ontario Science Center we observed how visitors responded to this type of display. We approached all museum exhibits in this way, using our knowledge from the textual analysis to structure our observations and analysis of exhibit components.

Academic publications related to the design and development of effective museum exhibits (Smithsonian Institute, 2002; Canadian Museums Association, 2011; Bitgood and Patterson, 1987; and Russel and Ansbacher, 2009) were used to determine what steps need to be taken in the design and creation of a traveling exhibit, and what aspects of educational exhibits are most effective. As students with no background in exhibit design, an extensive analysis of these resources was especially beneficial. It allowed us to gain a better understanding of this complex, detailed process of exhibit design, and helped us to determine what steps are needed in creating the most effective exhibit possible. The Canadian Museums Association (2011) provided us with a wealth of valuable information to consider in determining what materials should be used in designing an effective exhibit. In particular, this resource led us to understand the importance of developing an exhibit based on principles of sustainability, using recycled materials, and producing as little waste as possible. Although our project did not place a great amount of emphasis on design materials and costs associated with exhibit design, it is an important component to the design process, and will be beneficial in the future for Gamiing. An article by Bitgood and Patterson (1987) provided a list of architectural facts to consider when designing an exhibit, as well as important principles of exhibit design. An analysis of Russel and Ansbacher's (2009) top ten points to assist with the designing process of creating engaging exhibits was also highly significant in developing our understanding of effective exhibit components. Overall, an analysis of these texts was significant in helping us to understand the

design process in exhibit creation and the important aspects to consider in the development of our wetland traveling exhibit content and display.

Textual analyses for the natural history of Gamiing Nature Centre and the property on which it is located was quite challenging. The only document that was proven to be effective in understanding the history behind the property boundaries was the Gamiing website, www.gamiing.org. On this website, Mieke Schipper documented the history of the land. Textual data on this subject was compromised due to limited resources. However, this document was effective in providing us with a succinct description of natural history and the environmental and physical processes that occurred on Gamiing's land prior to Schipper family ownership. Due to lack of resources about site specific plants and animals, we consulted extensive literature on southern Ontario wetlands.

In terms of the text available on environmental issues local to Gamiing Nature Centre, we were provided with a letter written by Mieke Schipper to Chris Darling. The letter regarded a proposed subdivision development; accompanied by other infrastructure developments. This document was extremely helpful in positioning some of the environmental threats that are site specific to Gamiing. Natural Resources Canada (2011) was further used to collect maps and additional information pertaining to wetlands, along with the Ontario Ministry of Natural Resources (2011), the Atlas of Canada (2009) and Environment Canada (2010).

The analyses of these primary texts specific to wetland functions (Novitzki et al., 1997; Carter, 1997; Botkin et al., 2006) were used to outline the how wetlands function as habitats for plants and animals and natural water filters. This aspect of the textual analysis will be used in creating the wetland traveling exhibit storyline. In addition, a textual analysis on native and invasive plant and animal species was conducted with reference to (Houlahan and Findlay, 2004; Ducks Unlimited Canada 2011; MNR, 2011) as the main sources of information. Plant and animal species textual analysis will help in the creation of exhibit programing and ideas.

3.3 Oral Interviews

Oral interviews are a method used to gain information through verbal communication with other people who are knowledgeable about a specific subject or topic. As a means of collecting information about effective wetland traveling exhibits, we conducted several semi-structured interviews throughout the research process. These interviews had some degree of

"predetermined order", but "ensur[ed] flexibility in talking to the informant" (Hay, 2005, 79). We selected oral interviews as a method for this project because they could provide us with insights and current knowledge from individuals with expertise in the fields of environmental education and exhibit design. These interviews provided us with the opportunity to collect information from professionals who had sufficient background knowledge relating to our research question. While conducting the interviews, we record responses and quotes using a notepad and paper; however, we were able to voice record one interview which was conducted in a quiet, more formal setting. Since the interviews were semi-structured, the locations in which they took place varied. For example, some were conducted where interviewees worked or volunteered, and others were informally conducted with museum staff while walking through existing exhibits and displays. With this type of interview structure, we were able to create a casual atmosphere where we could ask questions such as:

- Which exhibit / display / activity is most popular?
- Why do you think it the most popular?
- What is it about the exhibit/display/activity that draws and maintains visitor attention?
- How would you recommend developing an exhibit/display/activity?
- How do you make your exhibits/displays/activities inclusive to all ages?
- If you were to design the most "effective exhibit", what components would it include and why?

Each of these questions provided us with valuable insights as to what professionals in the field of environmental education and exhibit design consider being most effective. We included open-ended questions which ensured that we were allowing the interviewee to share as much information and insight as possible. It was beneficial to have semi-structured interviews to ensure that during each interview we were able to manipulate our questions accordingly in order to gain as much relevant information as possible.

The interviews provided valuable information about specific components that help make exhibits interactive and inclusive to all ages. This is an essential part of our project, as it is important to ensure that each exhibit/display/activity has elements that cater to all audiences. Furthermore, we were able to gather some great insights and ideas relating to both the design and content of our traveling exhibit. Many of our interviewees were able to provide

us with substantial information on design elements that work well for them, and those that do not. They also provided us with suggestions of what to include in the design of a wetland traveling exhibit, from content to display components, and overall layout. While visiting museums and nature centers, we interviewed museum staff and personnel, program coordinators, and educational directors. In the interviewing process, we made sure to use a broad scope by communicating with a several individuals from various museums and nature centers. This broad scope allowed us to gain several perspectives regarding exhibit design and elements that make exhibits inclusive. Furthermore, we also gathered advice and guidance regarding content specific to a wetlands traveling exhibit from experts in that field.

3.4 Critical Analysis of Existing Exhibits

While visiting local museums, nature centers and environmental education centers connected with Kawartha Pine Ridge District School Board, we observed and critically analyzed existing exhibits. For each location (Ontario Science Centre, Ontario Federation of Anglers and Hunters, Canadian Canoe Museum, Peterborough Archives Museum, and Laurie Lawson Outdoor Education Centre), we created a chart to record information about various exhibits at each site. The charts included a column including several "Components of a Good Exhibit," which were derived from our literature review, textual analysis and oral interviews. The components of a good exhibit include: "interactive," "inclusive," "visually stimulating/use of video," "diversity of learners reached," "captivating," "visually appealing/colourful," "involve role playing/dress up," "clear information/vocabulary - understood by intended audiences," "use of audio," and "use of textiles/movable props" (see section 4.3 Critical Analysis of Existing Exhibits). At each individual exhibit, each group member added a * in the chart, indicating that they thought the exhibit included a specific component. If the exhibit did not include a certain component, such as "visually stimulating," the group members would not give it a *. If an exhibit received four stars, it indicated that all group members felt that a particular aspect of an effective exhibit was achieved.

The goal of this aspect of our research was to gain a broader understanding of the content of existing effective interpretive exhibits. By organizing our data into chart form, it allowed us to better analyze our information and draw conclusions about our findings. This method allowed us to easily identify which exhibits we thought were more effective. This is important to our

research question because it allows us to determine effective components of exhibits that we would include in the design manual for the wetland traveling exhibit. In addition, we took several photographs of particular exhibits that we found to be the most effective. Ideas drawn from the data analysis, as well as graphic images have been compiled and used in the design manual. Through our analyses, we intended to determine: what components of an exhibit are most effective and which are not; the importance of inter-activeness and interpretation; strategies to engage audiences of all ages; possible materials that can be used when constructing the exhibit; and cost approximations.

4.0 RESULTS

4.1 Textual Analysis

4.1.2 Design Evaluation Results

4.1.2.1 Exhibit Design

In the creation of an exhibit, the Smithsonian Institution (2002, 13) identifies three primary roles of expertise and responsibility: (1) the "curator"; (2) the "designer"; and (3) the "educator". Based on scholarly knowledge and expertise of the collection, the *curator* is responsible for focusing his or her attention on the "public presentation" of an exhibit (Smithsonian Institution, 2005, 4, 13). The *curator* is responsible for developing and creating the overall exhibit concept, and is generally seen as the "subject matter specialist" (Smithsonian Institution, 2002, 13). The role of the *designer* is to ensure that the exhibit is coherent and visually appealing (Smithsonian Institution, 2002, 13). Essentially this person is responsible for ensuring that the material is displayed in an "appealing, understandable and attractive manner" (Smithsonian Institution, 2002, 13). Finally, the role of the *educator* is to establish the connection between "exhibit content" and museum audiences (Smithsonian Institution, 2002, 13). This person is identified as a "communication specialist", who has a strong understanding of the different ways people learn, the needs of museum audiences, as well as the "relationship between the museum's program" and educational objectives relevant to schools through curriculum connections (Smithsonian Institution, 2002, 13). The educator also communicates with the visitors, and plans evaluation activities which are used to examine the success of an exhibit and determine whether it met its intended objectives (Smithsonian Institution, 2002, 13-

14). This method of exhibit design is called the "team approach", in which this exhibit design team establishes "shared goals and objectives for the exhibition, share and balance authority and responsibility for a project's vision and outcome, and reach agreement by consensus" (Smithsonian Institution, 2002, 14).

According to Smithsonian Institution (2002, 25), the primary step in designing an exhibit is the "concept development" stage, in which the team works together "on the parameters for content, ideas, design, size and cost". In this stage, brainstorming ideas, and research on visitor assessment is necessary. When feasible, it is beneficial for museums to "assess potential audiences' levels of interest in the understanding of basic concepts" (Smithsonian Institution, 2002, 25). The next stage, referred to as the "design development" stage, involves important decisions concerning issues such as "how many objects, how much text, whose words, whose 'voice'" (Smithsonian Institution, 2002, 26). Throughout this stage, the designer is constantly aware of, and considering how these design features will influence the visitors' experience. The final stage in the design is referred to by Smithsonian Institution (2002, 26) as the "fabrication and installation stage". It is at this time that building and construction of the exhibit begins. Although some museums have the skills and resources to build the exhibit "in-house", it is most common for the fabrication stage to be contracted out due to time constraints, lack of resources and skills (Smithsonian Institution, 2002, 26).

Based on information gathered from Canadian Museums Association (2011), we recommend that the design of the wetland traveling exhibit be eco-friendly, green, and aligned with the "principles of sustainable development". According to the Canadian Museums Association (2011), sustainable design is intended to "eliminate negative environmental impact completely through skillful, sensitive design". Some important aspects to consider when designing any exhibition include: "promoting the use of low-impacts materials", use products that are sturdy and flexible to extend their period of use, chose "eco-certified products", use recycled materials, ensure "easy disassembly and reassembly" for traveling exhibits, "design modular systems which can be reused", and reduce size whenever possible to reduce waste (Canadian Museums Association, 2011). When designing a traveling exhibit, "size, weight and modularity need to be considered" (Canadian Museums Association, 2011). The Canadian Museums Association (2011) recommends designing traveling exhibits that "fit in standard size crates" to help reduce the amount of waste produced.

An article published by Bitgood and Patterson (1987) called "Principles of Exhibit Design" concluded that size is a very important consideration when designing any type of exhibit. In an exhibit, "larger objects produce longer viewing times than smaller ones" (Bitgood and Patterson, 1987, 4). Motion, referring to moving objects rather than stationary ones, also reported greater visitor attention, and longer viewing attention (Bitgood and Patterson, 1987, 4). Sensory qualities were also identified as an effective exhibit component (Bitgood and Patterson, 1987, 4). For example, adding sound and touch to an exhibit increased its attracting and holding power. Interactive elements were also identified as essential in increasing visitor attention (Bitgood and Patterson, 1987, 4). Bitgood and Patterson (1987) suggest including a "push button device" that can enact a light or sound to increase the length of viewing time. Furthermore, it was suggested that "more exciting exhibits appear to act as a catalyst for social interactions between visitors" (Bitgood and Patterson, 1987, 4). In the design of our own traveling exhibit, all of these points discovered in previous studies will be carefully considered, and wherever possible included in the design manual.

In terms of architectural factors, visibility, position of the exhibit, and realism were all recognized as significant components (Bitgood and Patterson, 1987, 4-5). More specifically, "the greater the ease of visibility" with which objects of an exhibit can be viewed, the more attention they will receive (Bitgood and Patterson, 1987, 4). Level of lighting is important to consider, and avoidance of visual obstacles such as barriers that block the line of sight between the visitor and the display are important aspects to consider (Bitgood and Patterson, 1987, 4). Past research has found that a central position of objects and text on an exhibit resulted in greater visitor attention. When the images or text are too high or too low, people are less likely to stop (Bitgood and Patterson, 1987, 4). Also, the more "real" an exhibit is perceived, the more positive the attitudes and responses will be to the exhibit, and viewing time of the exhibit will be increased (Bitgood and Patterson, 1987, 5). Considering this in the design of our wetland exhibit, we will aim to make the exhibit as realistic as possible, including an aquarium with live plants and animals, as well as skulls and bones, stuffed beavers and birds and other wetland creatures that the visitors can touch, pick up, and explore.

Several workshop presentations and conferences have been conducted by Russel and Ansbacher (2009) in order to help people understand the importance of creating "the perfect exhibit experience". As described by Russel and Ansbacher (2009), when designing an exhibit,

it is important to differentiate between "experience-based exhibits" and "information-based exhibits". In designing our wetland traveling exhibit, the focus will be on creating experiences in which visitors are able to engage in their learning through hands on interactions with the display. Ensuring that visitors actively experience and observe aspects of the exhibit, such as live animals, real furs, and various wetland components, and incorporating all five senses (taste, touch, smell, sight, sound) are essential aspects of design. The goal of an information-based exhibit is to transmit information to visitors through informative displays, text, and audio / video components. Objects including, artifacts and interpretive texts for the sole purpose of displaying information are important to ensure that the exhibit addresses all ages and levels of knowledge (Russel and Ansbacher, 2009, 1). The following table includes the top ten points emphasized by Russel and Ansbacher (2009) in helping with the designing process of creating engaging exhibits based on experiences and interactions between visitors and the exhibits:

DESIGN GUIDELINES	KEY POINTS
Provide Advance Organizers	- Obvious starting point in exhibit - Titles, introductions, themed areas to connect exhibit
Design Appropriate Environments	- Inviting, attractive design - Comfortable, safe, and secure - Non-intimidating, and non-distracting - Physically/intellectually accessible activities and content - Create experiences that fully immerse visitors
Accessible and Easy-to-Use	- Good mapping (easy to follow) - Appropriate technology, media - Simplicity - Standardized graphics (ex. Directional cues from one exhibit to the next, all look the same)
Present Real Objects/Phenomenon	- Show genuine, real objects - Emotional intellectual experiences - Aim for the "WOW" factor
Meet Visitor Expectations	- Visitors should have fun, but still engage in a learning, educational experience - Encourage social interaction, include all five senses, pique curiosity, surprise and intrigue, and evoke sense of confidence
Provide Entry Points to Meet Individual Needs	- Meet needs of target audiences - Entry points accessible to everyone, including those with disabilities - Front-end evaluation: identify target audience knowledge, interests, and reactions to exhibit elements - Mixed-media to meet different ages, interests and cultural backgrounds

	- Appropriate tools to use exhibit effectively - Pose questions, or make visitors pose their own to create a sense of curiosity
Offer Choices, Control, Feedback and Success	- Open-ended options - Multiple inquiry paths and clear procedures - Layer experiences and labels - Offer sequences of action at different levels of complexity
Support Experiences with Labels, Staff, and Cooperative Engagement	- Staff or volunteers to: point out things, provide instructions and suggestions, raise questions, answer questions, connect to other experiences, and place in context - Cooperative engagement: collaborative activities for various groups, opportunities for conversation - Educational programming: films, demonstrations, discovery carts, facilitated activities, experiments, take home materials
Support for Follow-Up	- Related books in resource area, libraries - Web page resources - Follow-up classes, field trips, outreach - Leads to other community resources
Evaluate	- Front-end evaluation: identify visitor knowledge, interests, preferences - Formative evaluation: identify mechanical and conceptual elements that need revision - Summary evaluation: overall effectiveness/outcomes

(Adapted from Russel and Ansbacher, 2009. Available Online. Accessed at: http://exs.exploratorium.edu/wp-content/uploads/2009/08/design_points.pdf)

FIGURE 7: TOP 10 TIPS FOR DESIGNING ENGAGING EXHIBITS

4.1.2.2 Exhibit Components

In order to measure the effectiveness of existing exhibits, several academic publications have similarly studied what types of existing exhibits "attract and sustain interest" of visitors (Knutson, 1949, 28). A study by Knutson (1949) specifically measured exhibit effectiveness from both the exhibitor's and the observer's points of view. This study found that exhibits with simple and clear objectives were best understood, and that complex statistics and difficult vocabulary lead to poor understanding of the information presented (Knutson, 1949, 34). This study also concluded that exhibits can be improved in physical ways, including: the use of more gadgets, visual aids, colour, movement, and simple easily understood graphs (Knutson, 1949, 34). Other suggestions were made that indicated a "desire for more opportunity for interactions between the observer and the exhibit" (Knutson, 1949, 34). It was further concluded that more "opportunity for audience participation" and "demonstrations accompanying literature" are important in creating effective exhibits (Knutson, 1949, 34).

Literature describing the creation of effective exhibits explains that exhibits should facilitate learning while also supporting diversity in the context of visitors' interests (Allen, 2004; Patience, 2010; Van Schijindel, 2010). In order for exhibits to be effective teaching tools while additionally sustaining the involvement of diverse audiences, they must be highly engaging. Some visitors intend to explore the exhibit for leisure purposes, and therefore the exhibit must be successful not only in keeping their attention and involvement, but also maintaining their interest in continuing to interact with the exhibit. Allen (2004) notes there are four vital areas to exhibit design and include "immediate apprehension, physical interactivity, conceptual coherence and diversity of learners" (Allen, 2004, 17). She explains that these are fundamental areas of consideration when designing museum exhibits.

In an article by Rubenstein et al. (1993) a descriptive visitor study "systematically evaluated visitor response to a traveling exhibit at four settings across Canada" (801). This study provides information on environmental design and exhibit effectiveness. The results found that the most successful exhibits were those that incorporated "motion and interaction" as a design feature (Rubenstein et al., 1993, 817). Visitors reacted positively to the use of sound, as telephone displays were identified as a highly popular exhibit feature (Rubenstein et al., 1993, 816). An additional study by Hamer (2001) reviewed a broad range of exhibits to discuss issues concerning historical exposition, presentation and understanding. In particular, Hamer's (2001) review assessed scholarly content of the exhibits; the extent, variety and appropriateness of the objects displayed; the function of design in the exhibit; and issues of funding and institutional support (Hammer, 2001, 123). In the critical analysis of existing exhibits portion of this project, we took into close consideration each of these components regarding effective exhibit design.

4.1.2.3 Materials List

The following provides a list of sustainability, evaluation and assessment methods that should be used to quantify environmental impacts when designing a traveling exhibit. On an on-going basis, this assessment will ensure environmental protection is a top priority through the use of the following guidelines: "Life Cycle Assessment" (LCA), "Environmental Accounting Method" (EAM), as well as the "Environmental Preference Method" (EPM) and the "Ecoscarcity Method" (EM) (Abeyasekera, 2006, 28).

The Canadian Museums Association (2011) has developed a plan that works towards utilizing materials and finishes that have a limited impact on the environment when building a traveling exhibit. The following chart is a brief synopsis of the types of materials that can be used when building an exhibit as well as the environmental advantages and disadvantages, and has been adapted from the Canadian Museums Association (2011, Chapter 2). This model is a good approach as many of the descriptions take into consideration the entire life cycle of the material and not simply how it will be used for the purposes of the exhibit, but also once the material is no longer a useful product (Canadian Museums Association, 2011, Chapter 2).

Material	Advantages and Disadvantages
Wood	Environmental advantages: low environmental footprint, good insulation value, recyclable, biodegradable and structurally sound
Engineered Wood	Include: glulam (glued-laminated timber), parallel strand lumber (PSL), laminated veneer lumber (LVL), plywood, and oriented strand board (OSB), wafer board, prefabricated wood trusses and wood joists. Considered sustainable as entire trees, regardless of species, shape, and age can be used in their entirety.
Rapid Regrowth Wood	Include: laminated strand lumber (LSL), manufactured from indigenous Canadian wood with fast rejuvenation. Also tropic wood products, such Durapalm and Plyboo.
Perdure	A high temperature wood treatment that is an ecological substitute for chemically treated wood. It extends the service life of wood and can apply to all species.
Lauan	Lauan is a veneer wood.
Medium Density Fiberboard (MDF)	Almost isotropic, fine wood texture, cheaper, available in various thicknesses, can be flame resistant, waterproof to a certain extent
Cardboard	Made from recycled materials, malleable, can be protected with "green coating" such as silk paper, and recycled water based paint, Vitrification treatment helps make them water and stain repellent
Green fabrics	Raw materials come from plants of animals
Formaldehyde-free materials	This is important as formaldehyde, are highly flammable reactive compounds. At room temperature formaldehyde is a reactive gas.

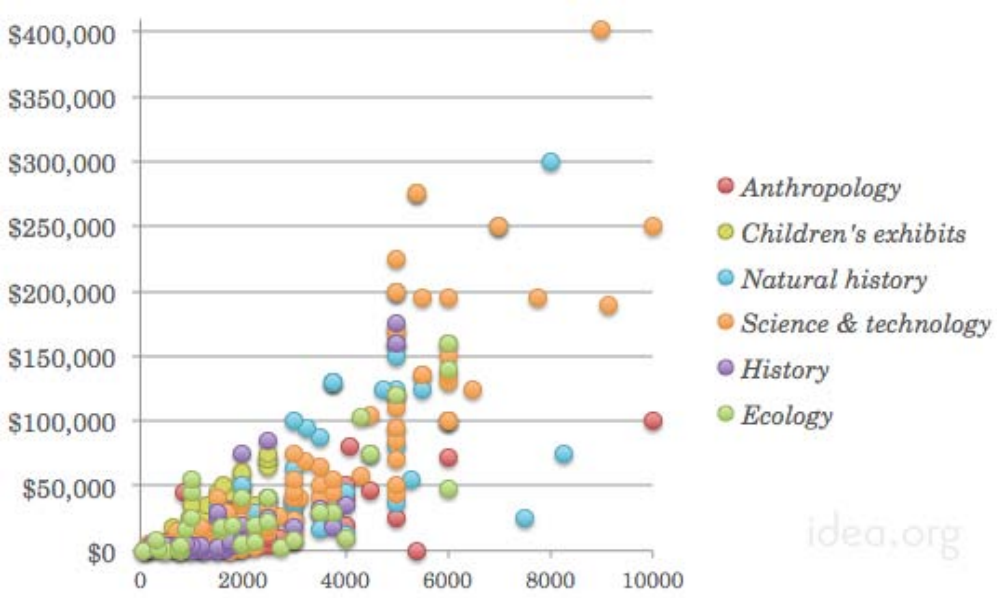
Low or no-VOC adhesives (Volatile Organic Compound)	Use low-toxic or water-based adhesives, conventional glues are very high in VOCs and off-gas for long periods of time, also choose water-based glues or natural, plant-based glues.
Low or no-VOC paints, stains and sealants	Instead of traditional paints, look for no-VOC paints, made with talc powder, clay or chalk, they have a lesser environmental impact.
Recycled plastics and glass	Recycling reduces volume on the planet, and need to extract new raw materials
Lexan	Good alternative to Plexiglas as it is highly durable, malleable and resistant to sunlight.
Plastics with a natural compound base	Plastics made from vegetable oils, wood fibers and starches and also contain no petroleum with minimal environmental impacts
Carpets and floor coverings	Use alternatives such as: flooring made of bamboo or cork, modular carpeting, concrete, linoleum and other coverings made from recycled and recyclable materials.

(Adapted from the Canadian Museums Association, 2011, Accessed Online. Available at: <http://www.museums.ca/Sustainable_Development/Chapter_4_Exhibition_Materials/2._Materials_and_finishes/?n=30-37-79>).

TABLE 1: MATERIALS LIST

4.1.2.4 Expenses

Costs for traveling exhibits vary depending on size, complexity, subject matter, and objectives of the loaning organization (Intense Debate, 2011). Although this is an American resource, the Traveling Exhibition Database (TED) would be useful for determining various pricing of traveling exhibit design and creation (Intense Debate, 2011). Currently, there are 768 traveling exhibits in the TED in the United States (Intense Debate, 2011). The following diagram illustrates the distribution of size versus the costs, in U.S. dollars, based on various types of traveling museum exhibits (Intense Debate, 2011).



(Intense Debate, 2011. Available Online. Accessed at: <http://www.idea.org/blog/2011/02/10/what-does-it-cost-to-rent-a-traveling-exhibition/>).

TABLE 2: DIAGRAM DEMONSTRATING THE DISTRIBUTION OF SIZE VERSUS THE COST IN USD

Another aspect for costs of traveling exhibits can be the utilization of classroom memberships where teachers will pay a fee based on each school year where they can sign out exhibits throughout the entire year for a set rate. Based on this information, it is difficult to determine exactly how much it would cost for Gamiing to create a traveling exhibit, although Intense Debate (2011) provides some valuable insights and a starting point for looking into pricing.

4.1.3 Content and Habitat Research Results

4.1.3.1 Wetland Functions

According Botkin et al., (2006, 361), "wetland ecosystems serve a variety of natural service functions for other ecosystems and for people." Wetlands are recognized and known worldwide for their function as productive habitats, providing a physical environment suited for many species of plants and animals (Novitzki et al., 1997). While their functions as habitats are highly significant, scientific principles are based primarily on maintenance of water quality and hydrology and are important and applicable to our exhibit. Hydrologic functions in wetlands are associated with the quality of water that enters the wetland, and exists within the wetland

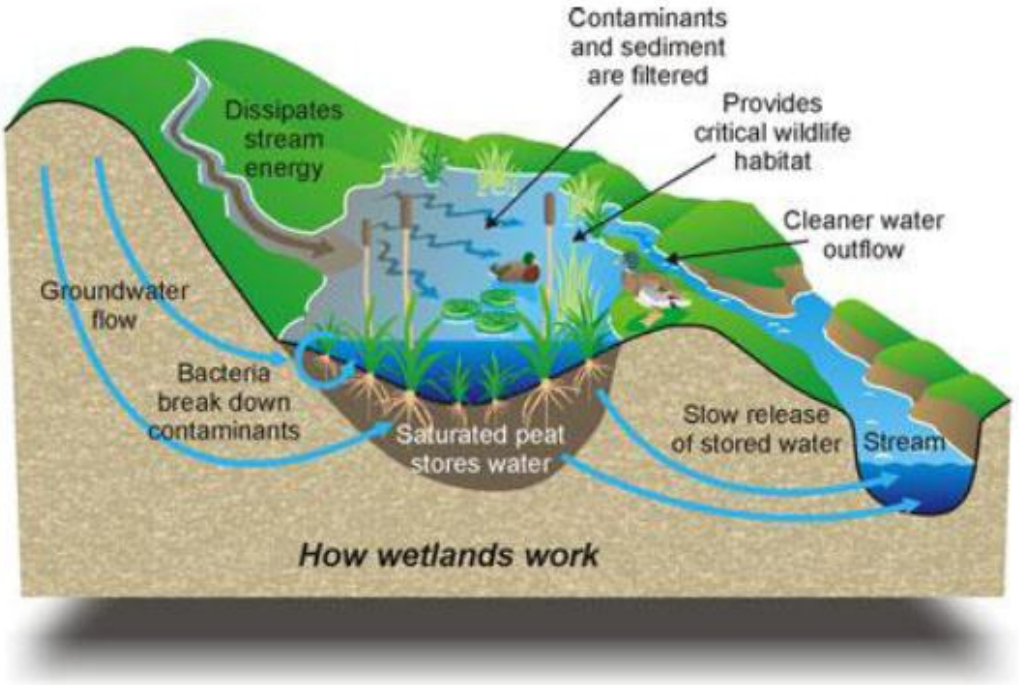
(Novitzki et al., 1997). As outlined by Carter (1997), there are four components of wetlands which water purification depends upon: microbial populations, substrate, water and vegetation.

First, microbes such as fungi, algae, and protozoa, are accountable for the majority of chemical transformations occurring in wetlands (Carter, 1997). These microbes use oxygen; transform nutrients, such as phosphorous and nitrogen, iron and manganese; and produce carbon dioxide, methane and hydrogen sulphide gas (Carter, 1997; Keddy et.al., 2009). The second component, substrate, provides a habitat for microbes and a "surface for biochemical reactions" (Carter, 1997). Wetland soils supply the condition in which chemical transformations occur, and provide an area in which chemicals required by wetland plants are stored (Carter, 1997). In wetlands, the ground and surface water transfer gases and solid materials to the plant and microbe populations, extract by-products of biological and chemical reactions, and further maintain the environment in which these processes occur (Carter, 1997). Wetland vegetation is extremely significant, as it decreases the flow and velocities of water, allowing for deposits of minerals, organic particles and phosphorous or metals (Carter, 1997). Through roots, plants provide oxygen to the soil in wetlands, and create a zone in which bacterial transformation can occur (Carter, 1997). Wetland plants also absorb small amounts of nutrients, trace metals and other compounds which are then incorporated into the plant tissue (Carter, 1997; Keddy et.al., 2009). These nutrients can enter the fresh water system from developments of agricultural and industrial industries, which retaliate with the natural environment by polluting the water and harming the wildlife within the wetland (Ducks Unlimited, 2006).

Internally, these wetland functions listed above sustain wetlands and are essential for the continued existence of plant and animal species. At national, regional and local scales, wetlands act as natural filters that help purify fresh water systems (Botkin, et al. 2006, 362). Wetlands trap and absorb up to 90 percent of harmful bacteria because invertebrates such as insects living in the wetlands feed on them (Ducks Unlimited, 2006). According to research, wetlands trap up to 70 percent of sediments found in runoff, which is helpful in purifying the water (Ducks Unlimited, 2006).

Wetlands are also incredible natural water filters and are able to neutralize harmful substances that enter the environment. Like a sponge, wetlands also store water and are able to reduce flooding during high river flow (Botkin et al., 2006, 361). In addition, they are important areas of groundwater recharge, or discharge (Botkin et al., 2006, 361-362). Considering wetlands

naturally filter the water that passes through them, wetland and water conservation is crucial to keeping our water clean and healthy. As seen in Figure 2.0: How Wetlands Work, wetlands act as giant water filters, breaking down contaminants, filtering the contaminants and sediments, and releasing cleaner water.



(Natural Resources Canada, 2011c). Available Online. Accessed April 3, 2011 at: http://geoscape.nrcan.gc.ca/h2o/bowen/factory_e.php)

FIGURE 8: HOW WETLANDS WORK

4.1.3.2 Plant and Animal Species

Native Species:

Some of the locally populated native species to Gamiing's property include: "foxes, porcupines, and deer" (Gamiing Nature Center, 2011b). Due to its waterfront location and the nature of the wetlands, "frogs and toads are abundant, and signs of beaver, mink, otters and other semi-aquatic mammals" are common characteristics (Gamiing Nature Center, 2011b). Additionally, the wetlands are the only spawning area suitable for remaining pickerel in Pigeon Lake (Schipper, 2009).

Gamiing's wetlands are also known to be the nesting areas of many species at risk, and a resting place for the black tern bird (Schipper, 2009). The black tern is "a small, boldly marked

tern with a black head and underparts during the breeding season" (The Royal Ontario Museum, 2006). Their nests are built to float in loose colonies in “shallow marshes, especially in cattails," (The Royal Ontario Museum, 2006) and have been classified under "special concern provincially" (The Royal Ontario Museum, 2006). Black tern birds are currently protected under the "Migratory Birds Conservation Act," (The Royal Ontario Museum, 2006) because their population has been declining since the 1980’s due to "wetland drainage and alteration, water pollution and human disturbance at nesting colonies" (The Royal Ontario Museum, 2006).

Invasive Species:

Exotic and invasive species have been identified as a major cause of “ecosystem homogenization” (Houlahan and Findlay, 2004b,1132). Some of the contributors to invasive species in Ontario wetlands include: “extensive commercial and recreational boat traffic in the Great Lakes, combined with widespread urban and suburban development in surrounding watersheds” (Trebitzand and Taylor, 2007, 705). Exotic and invasive plants are, “disproportionately common in wetlands compared to other terrestrial ecosystems” (Trebitzand and Taylor, 2007, 607). Invasive species thrive in weakened ecosystems and since wetlands are experiencing stress from development, sedimentation and alteration they are “easily infiltrated” (Trebitzand and Taylor, 2007, 607). Some of the invasive species that have established themselves in Ontario wetlands include: purple loostrife, european frog-bit and invasive carp (O.F.A.H, 2011).

Purple Loostrife is one of the most “aggressive” invasive species to Ontario wetlands (O.F.A.H., 2011). Ducks Unlimited Canada has noted that Purple Loostrife demands the most efforts to control all other invasive species (Ducks Unlimited, 2011b). The species has no natural predators in Canada, allowing it to completely take over in wetland areas. Once established in a wetland area, Purple Loostrife creates what is describe as a “dense monoculture” (O.F.A.H., 2011). It pushes out native species which reduces biodiversity within the area (Ducks Unlimited, 2011b). This is harmful to the many plant and animal species that depend on healthy wetland ecosystems in order to, “feed, support their young, and hide from predators” (O.F.A.H., 2011). The Ontario Federation of Anglers and Hunters suggests digging up and burning these plants in June, July and early August, as this is when they are “in flower and easily identified” (O.F.A.H., 2011).

4.1.3.3 Natural History of Gamiing Wetlands

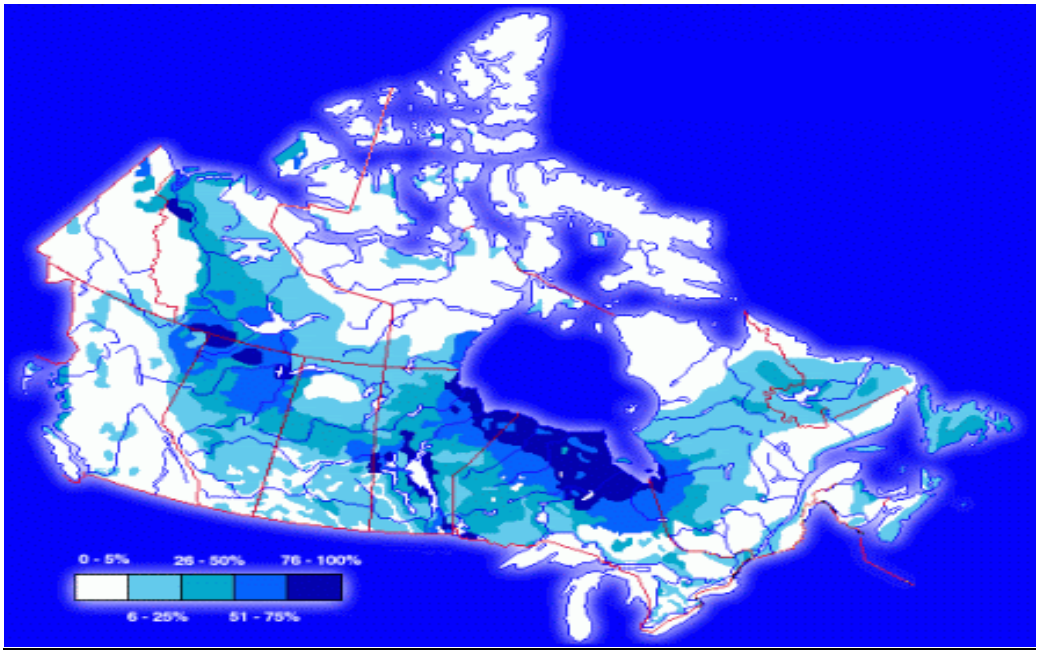
The Gamiing Nature Centre website (Gamiing, 2011b) provides a significant account of the information about the natural history on Gamiing's property, which has been placed under a regional land trust with the Kawartha Heritage Conservancy. The website noted that in 1984, Mieke Schipper purchased 100 acres of land because she and her family were interested in protecting this vulnerable and beautiful landscape from future developments (Gamiing, 2011b). Originally, the land was an abandoned farm on the west shore of Pigeon Lake and had been used for agricultural purposes since the mid-1800s. Unfortunately, farming was not successful on this parcel of land as most of "Kawartha's topography is composed of glacial till" (Gamiing, 2011b) and only "a very thin layer of topsoil" (Gamiing, 2011b), which was insufficient for farming practices. Approximately 50 years after the land had been cleared for farming, the farm became a "refuse farm" (Gamiing, 2011b) as the soil was quite "arable" and was "lost to wind and water erosion".

After their purchase, the Schipper family has allowed the land to "revert back to its natural state," as if it were the same as "when the indigenous peoples had lived" there many years before (Gamiing, 2011b). The Schipper family followed the "guidance of local environmental organizations" and planted "hundreds of native trees" on the property with the help of the Ontario Ministry of Natural Resources (Gamiing, 2011b). After the forestation was firmly rooted onto the property, "10km of trails were cut" in order to accommodate "hiking, skiing, horseback riding" and to provide opportunities for "nature walks" (Gamiing, 2011b).

Since the replanting of the forest, indigenous fauna have begun to repopulate the area and the area has once again become inclusive to animals such as "foxes, porcupines and deer" (Gamiing, 2011b). Other "semi-aquatic mammals" such as frogs, toads, beavers, minks and otters were also found within the property boundaries, indicating that the land has reverted to its natural state and is once again a productive ecosystem supporting many wildlife species (Gamiing, 2011b). The Schipper family promotes that the wetlands on this property are highly significant and important to the area, and 30 acres were considered as an Area of Natural and Scientific Interest and placed under a "Land Trust" to "be protected as a conservation area" (Gamiing, 2011b). Under a regional land trust, Schipper gifted the land to the Kawartha Heritage Conservancy where the Gamiing Nature Centre was established (Gamiing, 2011b).

4.1.3.4 Environmental Issues and Gamiing Wetlands

Before European settlement, southern Ontario was home to nearly 2 million hectares of wetlands (Atlas of Canada, 2009). By the early 1980's, more than half of these wetlands had been destroyed (Atlas of Canada, 2009). In by the year 2009, over 90% of the original wetland acreage in south-western Ontario was gone, and this number has since continued to increase (Atlas of Canada, 2009). Ontario's wetlands are being destroyed at some of the fastest rates in the world (Atlas of Canada, 2009).



(Natural Resources Canada, 2011a, Accessed online, Feb 2011. Available at: <http://atlas.nrcan.gc.ca/site/english/learningresources/theme_modules/wetlands/wetland_distribution.gif/image_view>.)

FIGURE 9: MAP OF CANADIAN WETLAND COVERAGE

North of the Gamiing property (which currently has over 5 hectares of wetlands along Pigeon Lake), there is a proposed development draft plan requesting the area be re-zoned from an "Agricultural Zone and Environmental Protection Zone" to a "Rural Residential Type Three Exception Zone" (Schipper, 2009). The development is proposed to transform the landscape by building a subdivision with 21 lots, a vacant land block, an open public space and a storm water management block (Schipper, 2009). These developments threaten to take place along the lakeshore behind a wetland that is classified as provincially significant. These wetlands are known to be the nesting areas of species at risk. The site is also the only spawning area for

pickerel left in the lake, and has a significant amount of butternut trees (Schipper, 2009). The environmental impacts of these proposed developments will contribute significantly to the destruction of the wetlands on Pigeon Lake. Wetlands near urban areas are under the greatest stress, often because they conflict with the interest of human activity. Ultimately, the majority of the destruction of wetlands occurs due to increasing urban development such as those proposed in the north of Gamiing (Ducks Unlimited, 2011).

Residential developments that contribute to the destruction of wetlands include: "the building of roads, large facility sites such as malls and condominiums, harbours, airports and utility reservoirs" (Environment Canada, 2010). Recreation activities involving the construction of other facilities such as "marinas, docks, cottages and beaches are also considered to be destructive to wetlands" (Atlas of Canada, 2009). All of these activities contribute to air pollution, water pollution and toxic runoff which put the vegetation, wildlife, and water quality of our wetlands at risk (Environment Canada, 2010). Additionally, other activities that one might consider to be beneficial to wetlands are actually detrimental. Cleaning pond bottoms (brush and weeds) and draining and filling wetlands often results in the destruction of wetland plants, wildlife and their nesting places due to the artificial changes in water levels and wetland structure (Environment Canada, 2010). The Gamiing wetlands represent a haven for the black tern, (Schipper, 2009) who's population has been declining since the 1980s due to "wetland drainage and alteration, water pollution and human disturbance at nesting colonies" (Royal Ontario Museum, 2006).

Wetlands provide important ecosystem functions for "wildlife, habitat, water filtration and flood protection" (MNR, 2011d, 2). However, plant and animal communities are increasingly threatened by human modifications to the natural landscape (Houlahan et.al. 2006, 79). Species richness is threatened by human activities such as deforestation and road construction and building density (Environment Canada, 2010; Houlahan et.al., 2006). Wetland size is important for survival of plant and animal species and biodiversity, and therefore the loss of wetland areas can be extremely destructive (Houlahan et.al., 2006, 79). Land uses occuring as far as 250-300m from a wetland have shown to affect, "plant diversity, adjoining habitats and stream dispersal routes" (Houlahan et.al. 2004a, 79). Overall, Houlahan's (2006) study results show that current land management practices are inadequate for the proper protection of wetlands (Houlahan et.al.2004a, 94). Figure 5.0 below illustrates the number of Canadian

wetlands currently at risk. Considering such, it is imperative that individuals, communities and developers become more educated about the effects of their actions have on Canada's wetlands in order to preserve and maintain these natural landscapes.

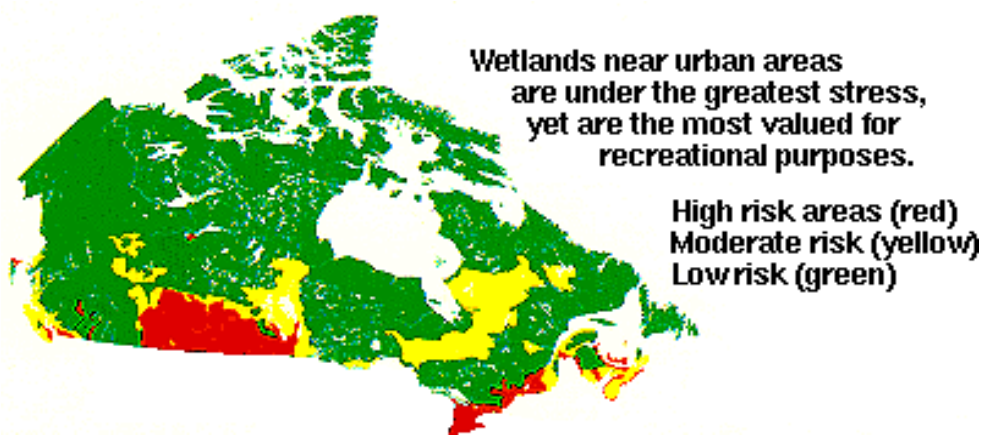


Figure 5.1: Map of Canadian Wetlands at Risk (Natural Resources Canada, 2011b, Accessed Online Feb2011.Available at: <http://atlas.nrcan.gc.ca/site/english/learningresources/theme_modules/wetlands/ewetrisk.gif/image_view>).

FIGURE 10: MAP OF CANADIAN WETLANDS AT RISK

4.1.4 Evaluation Results with Respect to Curriculum

4.1.4.1 Curriculum Connections

The educational objectives of this wetland traveling exhibit are to teach students and community members about what wetlands are, how they provide a habitat for a wide variety of plant and animal species, how they are endangered, and how they function as natural fresh water filters. Specifically, this exhibit emphasizes how and why local wetlands are being destroyed at such alarming rates. Through experimentation, observation, and discussion, individuals interacting with the exhibit will gain a strong understanding of the benefits of wetlands, and take away ideas about how they can help to conserve these natural landscapes in their own communities and surrounding areas.

This traveling exhibit has several links to the Ontario Science and Technology Grade 1-8 Curriculum, particularly in the 'Life Systems' strand. The most relevant curriculum link is to Grade 4 'Habitats and Communities'. Students in Grade 4 will gain an understanding of the ways in which humans can affect the natural world, specifically destruction of wetlands through processes such as urban development. In an exhibition context, visitors will explore a variety of

different ways that they can help conserve and protect local wetlands. Furthermore, they will learn how wetlands function as natural fresh water filters, absorbing pollutants and sediments that can be harmful to fresh water. Visitors will also be able to make connections as to how human impacts can destroy wetlands, cause habitat loss, and impact the cleanliness of our fresh water. The overall objective most relevant to the exhibit is that "By the end of Grade 4, students will: describe ways in which humans can change habitats and the effects of these changes on the plants and animals within the habitats" (Ontario Ministry of Education and Training, 2007, 85). While this exhibit is focused primarily on curriculum links to the Grade 4 'Habitats and Communities' unit, there are many other connections that can be drawn for a variety of grade levels. These links include:

- **Grade 1 (Living Things):** While exploring our exhibit, students in grade one will learn how wetlands provide a habitat for many plants and animals. Students will gain an understanding of how destroying wetlands causes habitat loss for many plants and animals.
- *Overall expectation*: Demonstrate awareness that animals and plants depend on their environment to meet their basic needs (Ontario Ministry of Education and Training, 2007, 46).
- **Grade 2 (Growth and Changes in Animals):** Grade two students will gain an understanding of how humans are responsible for destroying wetlands to build homes, roads, and factories. Students will learn how human destruction of wetlands causes habitat loss for many plants and animals.
- *Overall expectation*: Identify ways in which humans have an impact on other animals (Ontario Ministry of Education and Training, 2007, 58).
- **Grade 3 (Growth and Changes in Plants):** Students in grade 3 will explore ways in which humans can protect natural areas, specifically wetlands, to maintain habitats for a wide variety of animals and native plant species.
- *Overall expectation*: Describe the effects of human activities on plants (Ontario Ministry of Education and Training, 2007, 72).
- **Grade 7 (Interactions in the Environment):** Students in grade seven will learn how human activity can be harmful to wetlands. Specifically students will discuss pollution from human activity, and destruction of wetlands for human benefit.

Students will explore how human activities can negatively impact wetland ecosystems. Furthermore, students will discuss what actions they can take to help conserve wetlands.

- *Overall expectation*: investigate interactions within the environment, and identify factors that affect the balance between different components of an ecosystem (Ontario Ministry of Education and Training, 2007, 126).
- **Grade 8 (Understanding Life Systems: Cells):** Grade eight students are expected to learn how systems are interdependent, which can be applied to the interconnected life systems of plants and animals in wetlands. Students can make connections about how wetlands are some of the most complex ecosystems and that the plants and animals within are interdependent.
- *Overall expectation*: assess the impact of cell biology on individuals, society, and the environment (Ontario Ministry of Education and Training, 2007, 140).
- **Grade 9 Applied & Academic (Sustainable Ecosystems and Human Activity):** Students in grade nine are expected to grasp concepts of sustainability in both the applied and academic courses. Students in grade nine will learn how factors related to human activity can have negative effects on wetlands. They will be able to demonstrate an understanding of the dynamic of ecosystems, the ecological balances and how human activity disrupts these systems. Moreover they will learn about sustainability and the impact of humans on aquatic and terrestrial ecosystems.
- *Overall expectation*: Assess the impact of human activities on the sustainability of terrestrial and/or aquatic ecosystems (Ontario Ministry of Education and Training, 2008, 50).
- **Grade 10 Academic (Earth and Space Science: Climate Change):** In grade ten, students learn about the effects of climate change. Wetlands are amazing carbon sinks and are extremely valuable as they store greenhouse gas which contribute to climate change. Through the wetland exhibit, students can better understand how important wetlands can be as fighters of climate change.

- *Overall Expectation*: Investigate various natural and human factors that influence Earth's climate and climate change (Ontario Ministry of Education and Training, 2008, 78).
- **Grade 10 Applied (Earth's Dynamic Climate):** In grade ten applied science, students will learn about how some areas of Canada have been experiencing hotter and drier summers which attributes to poor harvests, loss of wetland habitat and increased forest fires. Students will gain an understanding of the importance of wetlands and how they can help to reduce the impacts of anthropogenic climate change.
- *Overall Expectation*: demonstrate an understanding of various natural and human factors that contribute to climate change and global warming (Ontario Ministry of Education and Training, 2008, 90).

All curriculum connections are adapted from Ontario Ministry of Education and Training (2007 and 2008).

4.2 Oral Interviews

On Friday January 28th, 2011 we were fortunate to meet with Mark Rupke, a naturalist with the Kawartha Pine Ridge District School Board from Laurie Lawson Outdoor Education Center. Mark provided us with great insights regarding techniques and suggestions of how to design effective exhibits. He strongly expressed the importance of making an exhibit interactive. He recommended using as few words as possible on displays and to include many visually appealing, eye-catching and colourful images. It is important to make sure the exhibits are engaging, which will hold the attention of a wide range of audiences. Mark told us that his displays are designed to be attractive to audiences of all ages and academic grade levels. In order to make the exhibits inclusive, he usually creates a basic display with many images and a few words. He then provides further details, such as relevant books or magazine articles nearby for those who are interested in learning more about the topic. Mark also strongly emphasized the importance of providing audiences with several different types of objects, images and activities to keep their attention. A tool that Mark finds quite effective in his practice as an outdoor education naturalist is the use of the QX5 computer microscope. He would have students collect insects and organisms from the nearby stream which they could put underneath the lens and

observe a large image of the critters a computer screen. He would also have this set up within the main cabin so that people can use the technology and create their own slide show presentations of various stream critters and view it on the projector.

Another informative interview was conducted on Thursday, February 17th with Jacob Rodenburg, head of Camp Kawartha. Jacob has many years' experience in environmental education with youth of all ages. He is an expert in what excites children about environmental education, and provided us with excellent incite as to how we could best design our exhibits. Jacob explained that in order to create an effective traveling exhibit and relevant programming that reflects the importance of wetlands the exhibit must be interactive and have flexible elements to cater to various age levels. He stressed that it would be vital to make our exhibit adjustable, from simple to complicated, so that it could reach a larger age groups. Furthermore, the exhibit must have interactivity as its main focus. For younger ages Jacob suggested using a puppet show to encourage students to become involved in the programming. Another suggestion was to have a Styrofoam model wetland where students could participate in adding the components to a wetland. Jacob explained that our exhibit must also be sophisticated enough and involve enough substantial information to keep students interested. Coupling wetlands with endangered species could be one way of drawing on deeper themes and concepts. In summary, the strongest exhibits always have a central concept that should be easy to understand with a wraparound theme. The weakest exhibits are those with too many words and information. Overall, Jacob found that it is essential to keep things interesting, engaging and interactive. He explained that it is fundamental to find a central theme that excites and motivates people and to find a balance in all aspects of the exhibit to ensure that you are not presenting them with an overwhelming amount of information.

4.3 Critical Analysis of Existing Exhibits

The findings obtained through investigations have provided us with objective data on characteristics of successful exhibits. Some questions we asked while observing existing exhibits included the following:

- Does the exhibit sustain interest long enough to be read in its entirety?
- Is the vocabulary and style of writing such that the intended audience can comfortably follow and understand the exhibit?

- Will all graphs, charts and diagrams be clearly understood by the intended audience?
- Is it inclusive to a diverse audience?
- Is the exhibit interactive?
- Is the exhibit attractive / visually appealing?
- Does it appeal to the five senses?
- Is it accessible to all audiences?
- What creative ways did they achieve these aspects of successful exhibits?

LEGEND: Critical Analysis Rating System for Museum Charts

* Met one of the criterion for a good exhibit, ** Partially met criterion for a good exhibit, *** Met criterion of a good exhibit, **** Exceeded criterion of an excellent exhibit.

Components of a Good Exhibit	Science Center Exhibits	Children's Play and Discovery Zone	Mechanics	Rain Forest	Whales/ Tohora Exhibit
Interactive	***	****	****	*	**
Inclusive	****	*	****	****	***
Visually Stimulating/Use of Video	****	*	**	*	***
Diversity of Learners Reached	****	***	****	*	****
Captivating	****	***	***	***	**
Visually Appealing/Colourful	****	***	***	***	**
Involves Role Playing/Dress Up	*	***	n/a	n/a	n/a
Clear Information/Vocabulary Use	***	***	**	***	**
Use of Audio	****	**	***	**	***
Use of Textiles/Moveable Props	****	***	***	*	**

TABLE 3: ONTARIO SCIENCE CENTER EXHIBITS

Although the children's play and discovery area in the Science Center is specifically geared towards children (with the accompaniment of an adult,) we found it to contain highly effective exhibits for all ages. This exhibit incorporated multiple activities, and displays that encompassed interactive components, inclusivity, and was also considerate in including a

diversity of learners/learning styles. The use of video was limited in this area, with the exception of an exhibit where children could perform music on a stage, and see themselves on a video screen as if they were staring in a real music video. The learning was mainly tactile as opposed to audio. There were few audio stations as hands on learning seemed to be more popular for younger age groups. Everything was very visually appealing with lots of bright colors, signs (with large and clear fonts,) arrows, good directional cues and various uses of textiles and movable objects. This portion of the museum also incorporated role playing, dress up and props through construction and building centers where children would wear work vests, construction belts, and place velcro bricks on a building. Another area was set up where children could pretend to shop in a miniature grocery store (relating to Canada's Nutrition Guide) and illustrated in the appendix in Figure 39, and another where visitors could try on different furs and pelts, to which they could match up to a corresponding wall to try and camouflage themselves. An example of this can be seen in the appendix, Figures 37 & 38.

In the Wetlands and Ontario Ecosystems exhibit at the science center the use of live animals was effective at gaining visitors attention. Museum staff at the Museum of Hunters and Anglers also noted that their large fish tank was extremely captivating for younger children as well as adults. The science center water exhibits also featured were also skulls and plant materials which would be excellent to include in our wetlands travelling exhibit. Photographs from this exhibit can be seen in the appendix, Figures 27 & 28. In the Science Center's Whales/Tahora Exhibit, we found that many visitors enjoyed entering one of the displays that resembled a submarine. This exhibit was easy to enter and once inside, visitors could watch a video of whale hunting and hear the sonar/clicking sounds that whales used to hunt. Adults and children were attracted to this exhibit and we were able to see that this achieved the educational objectives of the exhibit while maintaining visitor attention.

Relevancy to Grade Levels	Science Center Exhibits	Children's Play and Discovery Zone	Mechanics	Rain Forest	Whales/ Tohora Exhibit
Appeals to grades K-6	**	***	**	**	n/a
Appeals to grades 7-8	**	n/a	**	***	*
Appeals to grades 9-12	**	n/a	**	***	***
Appeals to adults	**	** (accompanying	*	***	***

		children)			

TABLE 4: GRADE LEVEL RELEVANCY FOR ONTARIO SCIENCE CENTRE EXHIBITS

All of the Science Center exhibits had some elements that were relevant to the Ontario Curriculum guidelines. For the most part, the museum is most appealing to kindergarten to grade six; however there are definitely exhibits, such as the Mechanics, Rainforest, and Whales/Tohora exhibit that are geared towards grades 7 and up, including adults. In these sections, there were elements of tactile activities, however there were more activities that focused on hearing, seeing, and included exhibits that had detailed information on plaques for enhanced knowledge.

Components of a Good Exhibit	Anglers and Hunters Exhibits	Entrance Room – Fish Tank	Invasive Species / Hunting Section	Animal Exhibits/Stuffed Canadian Creatures
Interactive	**	***	***	*
Inclusive	**	***	**	**
Visually Stimulating/Use of Video	**	***	***	*
Diversity of Learners Reached	**	***	**	**
Captivating	**	***	**	**
Visually Appealing/Colourful	**	****	**	**
Involves Role Playing/Dress Up	*	n/a	n/a	n/a
Clear Information/Vocabulary Use	**	**	**	**
Use of Audio	**	n/a	n/a	n/a
Use of Textiles/Moveable Props	*	n/a	***	n/a

TABLE 5: THE ONTARIO FEDERATION OF ANGLERS AND HUNTERS EXHIBITS

The Anglers and Hunters included many appealing displays, particularly the invasive species exhibit. Here, the viewer's took on the role of a detective in a cops and robbers theme, where the invasive species were portrayed as robbers or the "Unwanted" (Figure 45). This sort of role playing was extremely appealing to visitors, and all of the text/display boards were clear and concise, making them easy to read and comprehend (Figure 47). Another aspect of the Anglers and Hunters exhibits that attracted our attention was the fish tank located in the main entrance. It was large and in direct eyesight as soon visitors entered the museum (Figure 42). The

tank had appropriate signage indicating that guests could view the fish during their feeding time, which occurred twice a day. This effectively retained visitors' attention, because if the feeding time was up and coming, visitors were more inclined to stay for the feeding (while in turn, viewing surrounding displays more in depth).

As far as the rest of the exhibits, there were a number of 'scenes' which displayed life sized, lifelike, stuffed animals found in Canada (Figure 43). These were far less interactive than the invasive species exhibit. Viewers were not allowed to touch anything in the 'scenes,' which prevented the retention of attention. As a result, far less time was spent time viewing these exhibits. The only interactive portion of these 'scenes' was the consistent provision of small computer touch screens which did provide audio descriptions. Additionally, these screens translated from English to other language options which imply an attempt to make the exhibits inclusive.

Relevancy to Grade Levels	Anglers and Hunters Exhibits	Entrance Room – Fish Tank	Invasive Species / Hunting Section	Animal Exhibits/Stuffed Canadian Creatures
Appeals to grades K-6	***	****	****	**
Appeals to grades 7-8	**	**	*	**
Appeals to grades 9-12	*	*	n/a	**
Appeals to adults	**	**	n/a	***

TABLE 6: GRADE LEVEL RELEVANCY FOR THE ONTARIO FEDERATION OF ANGLERS AND HUNTERS

These exhibits related most specifically with grades 2 through 7. Students in grades 1 through 3 learn how wetlands provide a habitat for many plants and animals, whereas those in grades 4 through 7 become more aware of human impacts. In having the children play the role of a detective chasing after unwanted invasive species, they are likely to gain a sense of vested interest in catching the 'bad guys.' They will learn how to help and what to look out for in terms of the most unwanted invaders. Visitors also learn how they themselves can minimize the chances of introducing new invasive species. Furthermore, students should be able to discuss what actions they can take to help conserve wetlands. Based on our observations, we suggest that the stuffed animal displays were targeted to older grades, merely due to the fact that there were a

lot of restrictions, in terms of what they could physically touch. The Ontario Federation of Anglers and Hunters employs certified teachers, which gives confidence in their ability to relate to specific grade levels.

Components of a Good Exhibit	Canoe Museum Exhibits	Entrance Room	Canoe Collection / Displays	Info. Boards / Video Stations	Canoe Construction Area	Role Playing Areas
Interactive	**	*	n/a	***	***	****
Inclusive	**	**	**	***	***	***
Visually Stimulating/Use of Video	***	n/a	***	****	*	n/a
Diversity of Learners Reached	***	n/a	***	***	***	***
Captivating	**	***	***	***	***	****
Visually Appealing/Colourful	***	***	***	***	***	***
Involves Role Playing/Dress Up	***	n/a	*	*	n/a	****
Clear Information/ Vocabulary Use	***	***	***	***	**	***
Use of Audio	***	*	**	***	**	*
Use of Textiles/Moveable Props	**	n/a	n/a	*	***	****

TABLE 7: THE CANADIAN CANOE MUSEUM EXHIBITS

The Canadian Canoe Museum had many exhibits that were interactive, inclusive as well as visually appealing and stimulating. In particular, there was an information board illustrating the spreading of the Hudson's Bay Company's Trading posts. This display included clear, concise and readable text at an appropriate level for reading. This display was electronic, and when visitors pushed the button, lights on the map lit up. This was especially engaging for visitors of all ages. The programming provided for lower grade levels made the museum much more interactive for younger children. Without the programming, the museum may not have been as inviting and exciting for younger visitors. This being said, the canoe museum is highly

effective in interactivity when children are taken on guided tours, however when self-led, the museum was limited to extensive text boards and scattered televisions playing movies.

In terms of additional effective exhibits at the Canoe Museum, was the role playing stations (Figure 12, 13, 15 and 19). Role playing is a great way for children to be creative and engage in their learning. There is also a station where visitors learned how canoes were traditionally built, and where they can follow instructions on weaving snowshoes (Figures 18 and Figure 21).Exhibits at this museum had some interactive components that caught students attention. Particularly the station where visitors can practice climbing into a canoe properly and the life sized tepee that students could sit inside around a fake fire (Figure 17 and Figure 13) or sit inside a life size tepee (Figure 13). Overall, we found that the Canadian Canoe Museum to be very visually appealing with incredibly clear informative and easily understood vocabulary.

Relevancy to Grade Levels	Science Center Exhibit	Children's Play and Discovery Zone	Mechanics	Rain Forest	Whales/ Tohora Exhibit
Appeals to grades K-6	**	n/a	n/a	*	****
Appeals to grades 7-8	****	**	**	***	*
Appeals to grades 9-12	****	***	***	***	n/a
Appeals to adults	***	****	****	***	n/a

TABLE 8: GRADE LEVEL RELEVANCY FOR THE CANADIAN CANOE MUSEUM EXHIBITS

As this chart indicates, exhibits at the Canadian Canoe Museum are targeted primarily to students in grade 7 and up. However, this museum is designed in such a way that it can be inclusive to all ages, including K-6. We were fortunate to observe a kindergarten class at the museum, and the use of a puppet show and interactive hands-on activity programming by the museum staff ensured that the exhibits could appeal to younger audiences as well. With hands-on interactive components, as well as a wealth of informative information and data, this museum was moderate in including exhibit design components that cater to all ages.

Components of a Good Exhibit	Peterborough Archives Museum	Exhibit Routes, Design and Themes	Children's Play Area	Gift Shop
Interactive	***	****	****	**
Inclusive	***	***	**	**
Visually Stimulating/Use of Video	**	*	n/a	n/a
Diversity of Learners Reached	**	**	*	*
Captivating	**	**	***	**
Visually Appealing/Colourful	**	*	***	*
Involves Role Playing/Dress Up	**	**	**	n/a
Clear Information/Vocabulary Use	**	***	**	n/a
Use of Audio	**	*	*	n/a
Use of Textiles/Moveable Props	***	**	****	***

TABLE 9: PETERBOROUGH MUSEUM ARCHIVE EXHIBITS

This museum was lacking in effective exhibit components. Designs and themes in the children's play area did not include the use of visually stimulating video, and the labeling was written in incredibly small font displayed above eye level. A neat idea however, was the way in which participants were encouraged to walk through the museum. The approach used was a type of discovery game, in which there were four different lenses that one could walk through the museum with including themes such as automotive history, etc. Visitors were encouraged to select one of the four theme packages (including a question sheet and writing materials), and walk through the museum, filling out the puzzles and questions. This approach allows visitors to learning about a new topic each time they walk through the museum. This is effective in creating an exhibit where participants can visit more than once, and learn something new each time. It was also interesting how the children's zone was not only a fun and exciting environment for children, but also was an environment where adults could easily supervise their children, while reading the signage posted around the room, and learn about historical children's toys.

Relevancy to Grade Levels	Peterborough Archives Museum	Exhibit Routes, Design and Themes	Children's Play Area	Gift Shop
Appeals to grades K-6	**	***	***	****
Appeals to grades 7-8	**	***	*	***
Appeals to grades 9-12	**	***	*	***
Appeals to adults	***	***	*	***

TABLE 10: GRADE LEVEL RELEVANCY FOR PETERBOROUGH MUSEUM ARCHIVE EXHIBITS

In regards to grade level relevancy, the Peterborough Archives Museum was relevant to a wide age group. There were elements of a good exhibit that were focused on kindergarten to grade 6, as well as grade 7 to adults. The different routes, quizzes and puzzles are geared more to grades 5 and up, while the children's play area, for its intended purpose of playing and guided learning, and are geared to grades 4 and younger. There was also a great amount of historical information, presented in such a way that would appeal to grades 9 and up.

Components of a Good Exhibit	Laurie Lawson Outdoor Education Center	Indoor Activities	Outdoor Activities
Interactive	****	****	****
Inclusive	****	****	****
Visually Stimulating/Use of Video	***	**	n/a
Diversity of Learners Reached	****	***	**
Captivating	****	****	****
Visually Appealing/Colourful	***	****	**
Involves Role Playing/Dress Up	**	n/a	**
Clear Information/Vocabulary Use	***	***	**
Use of Audio	**	**	n/a
Use of Textiles/Moveable Props	***	***	***

TABLE 11: LAURIE LAWSON OUTDOOR EDUCATION CENTRE EXHIBITS

Although this outdoor education center is not wheelchair accessible, thus immediately excluding those in a wheelchair, we were informed that the center is currently working towards creating a more inclusive environment through the use of board walks and ramps. The Laurie

Lawson Outdoor Education Centre includes various indoor activities, exhibits and displays that retain the attention of all ages. For example, many displays have very large and colourful pictures with few words. Below the exhibits a supply of magazines and books was provided to allow visitors with a wider collection of more detailed information. This exhibit design is illustrated in the appendix, Figure 55. Captivating the students' attention through the use of a bird watching exhibit was an especially effective technique. There was a chart beside the window listing the different bird species with images and text. Visitors were encouraged to observe the birds and put a check mark in the box indicating that they observed a certain species, as illustrated in the appendix, Figure 53. This was effective in catering to different learning styles because some visitors would simply check off the list, while others took the opportunity to read the display board and learn more about the species they observed. There were also stuffed birds on display for visitors to observe.

Relevancy to Grade Levels	Laurie Lawson Outdoor Education Center	Indoor Activities	Outdoor Activities
Appeals to grades K-6	****	****	****
Appeals to grades 7-8	****	***	****
Appeals to grades 9-12	**	**	*
Appeals to adults	***	***	***

TABLE 12: GRADE LEVEL RELEVANCY FOR LAURIE LAWSON OUTDOOR EDUCATION CENTRE EXHIBITS

Since, the Laurie Lawson Outdoor Education Centre is run by a naturalist who was hired by the Kawartha Pine Ridge District School Board; grade level relevancy is highly significant and evident throughout all of their planning. The outdoor education center targets kindergarten to grade 8 specifically; however, the center is open to running activities and exhibits that cater to high school students and adults. Since it is the only outdoor education center in the area, many students have already gone there for several years throughout their schooling thus discouraging many high school teachers from planning trips there. Another reason as to why high school students are not as fully involved is the fact that they are registered in classes that are broken into various periods in a day, which is not conducive in being able to take full day trips. The outdoor

education center does however; still allow older students and adults to become involved through cooperative education programming.

5.0 DISCUSSION OF KEY FINDINGS

The findings obtained in our investigations have provided us with significant data on the characteristics of successful exhibits. This data can be applied by testing planned exhibits in order to determine whether or not they will be successful (Knutson, 1949, 36). Understanding the factors that impact visitation behaviours and exhibit effectiveness are an increasingly important aspects which relate to the "talent, creativity, and expertise" of those involved with the difficult job of making these exhibitions (Rubenstein et al., 1993, 818). The key findings that were determined through extensive research regarding effective components of a traveling exhibit include the following:

Interactivity:

Interactive components are important within exhibits to attract and retain the attention of its required audience for enough time that the entire exhibit can be understood. In designing an effective exhibit, it is essential that the interactive components include experiences all of five senses, and providing participants with opportunities to touch, taste, feel, smell and hear. It is important for the interactive components to be simple enough that all users can participate, yet complex enough that more advanced users do not become bored, lose interest, and move on. Interactive components in exhibits should not be overwhelming, and each exhibit display or activity should perhaps only focus on one or two of the five senses so as to not overload the senses.

Inclusivity:

Another important aspect is that the exhibit design incorporates inclusivity. This is important in ensuring that all ages, cultures and genders are able to partake in the exhibit experience without being limited in any way. Ensuring that displays, activities and labels are positioned at appropriate heights for the intended target audience is vital to the effectiveness of displays. Also, ensuring that the exhibits' design encompasses enough space for wheelchair accessibility and has activities that cater to individuals of all abilities is important. Although we

did not focus specifically on gender and cultural inclusivity, we determined how to make an exhibit inclusive to individuals of all ages. For example, ensuring that the content and text on display is simple and concise, and providing additional materials such as books, website links, or a plaque with more detailed descriptions ensures that a display would be appropriate varying ages.

Clear/Concise Text and Labeling:

Ensuring that the text in the exhibits, as well as text or labels instructing participants how to maneuver the exhibit, are clear and concise is important so that participants are allowed to wander freely through the exhibit, while still following the projected agenda. Effective labeling is often accomplished through central positioning. Exhibits should avoid lengthy text and confusing statistics as these often discourage interaction and comprehension. Texts should be written in clear and concise formats, with the use of bullets and numbering whenever possible. Utilizing familiar fonts and sizes is also important so that individuals are not guessing what the text says, and can easily read the information. It is also important to place texts and labeling in consistent locations throughout the exhibit so the audience does not have to search for information and instructions, but rather they are placed in appropriate positions so that they won't be missed.

Encouragement of Social Interaction:

Finally, the encouragement of social interactions is important. Although the exhibit design is meant to cover all areas of expertise and ensure that the participants are receiving as much information as possible, it must be achieved in an effective and creative way. The experiences of others within situations concerning wetlands are valuable, and sharing stories between participants is important in the learning process in order to further contextualize the information. Additionally, the more social interaction, the more likely it is that the exhibit will create hype or buzz within the community. In this sense, social interaction creates awareness. Social interaction is also encouraged through programming and planned activities. This also ensures that the exhibits are utilized to their fullest potential and increases the likelihood that the learning objectives will be achieved. It also helps younger visitors grasp concepts that may otherwise only be outlined in text and not learned.

Overall, these four components: (1) Interactivity; (2) Inclusivity; (3) Clear/Concise Text and Labeling; and (4): Encouragement of Social Interaction was concluded as the most important components to include in the design of an effective traveling exhibit. In section 5.1 Design Manual, we outline information and relevant programming included in the wetland traveling exhibit design manual. In each aspect of the final exhibit design, we have made sure to include all of these components to ensure that the exhibit will be as effective as possible.

5.1 Design Manual

All data collected was analyzed in order to determine what components of an educational traveling exhibit are most effective, inclusive and interactive. The findings produced led to the development of an interactive and curriculum-linked traveling exhibit manual, designed for Gamiing Nature Center. Our hope is that this manual will be used by Gamiing to promote "Environmental Education and Natural History" of local wetlands (Carrothers, Gamiing, 2010). We also hope that these designs and ideas could one day be used to bring revenue to Gamiing Nature Center.

The "Design Manual - Wetland Traveling Exhibit" presents Gamiing Nature Centre with the design for a traveling exhibit focused on delivering environmental education to schools and community groups aligned with Gamiing Nature Center's mission and mandate. The wetland traveling exhibit is designed in such a way that it can be integrated with Gamiing's "Discovery Box Program" (Gamiing, 2011a) and can be found in the Appendix pages 69-87**.**

5.2 Limitations

While this project aimed to achieve all requirements to provide our host organization with a detailed report on designing an effective wetland traveling exhibit, we were faced with some limitations throughout the researching and writing process.

Due to time constraints, we were unable to complete an in-depth analysis of visitor behaviour and visitor experience at each individual museum exhibit. This type of research would have been extremely beneficial to our overall project, but was not manageable in the given time frame. We would have also liked to have spent more than one day at each museum in order to complete in-depth analyses of visitor behaviour and experience at each individual museum exhibit and have a written documentation of such observations. Unfortunately, due to both time

constraints and distance, it was also difficult for us to access museums and other resources further than 1.5 hours away from Peterborough, Ontario. The Ontario Science Centre in Toronto, Ontario was the farthest we were able to travel, although it would have been extremely beneficial to our project if we could visit places such as the Ottawa Nature Museum, The Algonquin Park Visitor Center and The Royal Ontario Museum.

Considering this project had four female group members, one of our limitations was a gender bias in the research, particularly the "Critical Analysis of Existing Exhibits." It was extremely difficult at times to coordinate and organize the project. With additional academic courses, work, and extracurricular schedules, groups meetings were limited in time, number and length. Finally, a lack of access to resources further limited our literature review and analyses. Trent University's online database did not have access to journals such as *Curator: The Museum Journal* and it was constantly a challenge to find access to these publications from other sources. There were also several books published specifically about the design of traveling exhibits, and components of effective exhibits. Unfortunately, we were unable to gain access to these resources as well, considering Bata Library and Peterborough Public Library did not have them. Access to the following resources would have been helpful to improve the extent of the discussion throughout this project:

- Ansbacher, T. (1998). "John Dewey's Experience and Education Lessons for Museums" Curator: The Museum Journal, 41: 36–50.
- Diamond, J., Luke, J.J., & Uttal, D. (eds.). (2009). "Practical guide: Tools for museums and Other informal education setting." 2nd edition. Lanham, MD: AltaMira Press.
- Smithsonian Institution, Office of Inspector General. 2001. "Financial Management of Traveling Exhibits". Audit Report Number A-00-03. Washington, D.C.
- Stein, J., Dierking, L.D., Falk, J.H., & Ellenbogen, K. (eds.) (2006). "In Principle, In Practice: Insights - A Museum Learning Resource." Annapolis, MD: Institute for Learning Innovation.

Finally, another limitation was the subjectivity in our rating processes of the exhibits. It was difficult to find a method that did not use personal opinion in relation to the exhibits, and therefore the next steps for this would be to develop a method that uses a more objective approach. Adding to the subjectivity of our findings is the fact that we are all female of

approximately the same age and cultural background. In completing our critical analysis of existing exhibits, what we may find effective could be different than that of a younger, older, male or culturally diverse viewer. As a result, it was difficult for us to determine what effective exhibits in terms of inclusiveness were.

5.3 Future Research Directions and Recommendations

In the future, it is anticipated that this wetlands project will provide an example for the creation of the next three exhibits of Gamiing Nature Centre's environmental outreach programming (Gamiing, 2011a). These exhibits include; the "Backyard Biology Exhibit (Biodiversity)," "Geoscape (Local geologic history, soils, watershed, water quality)" and finally the "Cultural Exhibit (Settlement, farming, indigenous studies)" (Carrothers, Gamiing, 2010). After each of the units are designed, the fifth unit will be an "Environmental Stewardship Kiosk," which will link the exhibits through an interactive community based arts program (Carrothers, Gamiing, 2010). The wetlands project has undergone much research, and Phase I and specific parts of Phase II have been completed. It is recommended that future research involve the completion of Phase I for the remaining exhibit themes listed above. Phase II will be completed for all four themes and the actual building of the exhibits, and linking the final product to local school groups and/or community members will represent the completion of the project in its entirety including the final phase, phase III.

In acknowledging our research limitations, we have expressed concern that our results are subjective, gender biased, and not culturally or age representative. In order to gain a more broad representation of exhibit analyses, we recommend that a study be conducted more thoroughly on visitor experiences with museum exhibits. In our study, we based our data analysis solely on personal opinion, which, as a result is likely to encompass subjectivity. It is recommended that surveys are conducted for a more thorough analysis of what exhibit components visitors find effective.

Additionally, in consideration of our time constraints, we recommend that Gamiing consider and consult the additional resources and materials publicly available in conjunction with our findings. Though we have provided them with a vast amount of knowledge, it is important to acknowledge that materials, ideas and innovations are constantly changing and being updated.

Due to a lack of resources and background knowledge in exhibit construction, we were unable to provide Gamiing with detailed estimates of costs associated with designing and creating this wetland traveling exhibit. Considering such, we suggest that a future research project be conducted to estimate the costs, and provide a more detailed materials list.

Finally, we would like to further suggest that in order to determine the local needs and experiences of Gamiing's clientele, that Gamiing design and implement a satisfaction survey for their school visits/programming, site visitations and exhibit showings. This would be a good project proposal for a future Community Based Education project and would aid in the effectiveness of Gamiing's educational contributions to the community. This would also provide Gamiing with feedback on what is and isn't effective in their existing programing which will further increase their chances of acquiring revenue and funding.

6.0 CONCLUSION

The objectives of the research project were to provide the Gamiing Nature Centre with valuable insight towards design and implementation of a wetlands traveling exhibit; including various programming opportunities. Completion of the project included presenting the host, as well as the course professors, with a manual and relevant programming that will support the proposed traveling exhibit. The design manual includes a summary of "Components of an Effective Traveling Exhibit," which was written based on our research findings. We formed our ideas for the exhibits based on our textual analysis as well as our practical museum research. The manual includes five exhibit programs; "Little Critters and Wetland Plants," "Wet and Wild Water and Land Animals," "Wetland Functions," and "Danger Zone - Threats to Gamiing Wetlands" as well as a "Centre Kiosk" with concluding activities. All components of the wetland traveling exhibit are displayed in a birds-eye view drawing of the exhibit floor plan on pages 4-5 of the wetland exhibit traveling manual. The following pages include more detailed descriptions and drawing of our proposed exhibit designs, activities and information.

The layout of this exhibit focuses around a central component which is the importance of wetland stewardship for Gamiing's local marsh wetland. Each of the four exhibit sections mentioned above will be various entry points to the Centre Kiosk. The final manual is based on rigorous research conducted throughout the duration of this project, acquired through literature reviews, textual analyses, oral interviews and the critical analyses of existing exhibits. The

manual and overall report have been developed to help the Gamiing Nature Centre in applying for funding which will support programming within the Center and be useful in providing a visual element to persuade outside organizations on the importance of environmental education specific to wetlands.

Additionally, the manual and overall report helps display the extent to which the Gamiing Nature Centre wishes to aid in such interactive and interpretive education within their local community. Another purpose for the manual and overall project is to provide Gamiing with substantial information that can be used to support the need for funding, and to assist the Gamiing Nature Centre in obtaining funds to complete all initially proposed exhibits. The completion of these exhibits will hopefully aim to bring revenue to Gamiing, and financially support environmental stewardship of local wetlands. Other forms of dissemination included presentations within Trent University, Geography 4700 lectures, Peterborough's "Knowledge In Action Forum" and our final presentation at Bagnani Hall Traill College, in which our host organization, and Trent Centre for Community-Based Education staff, were all invited to attend.

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8.0 APPENDIX

The Canadian Canoe Museum Exhibits and Programming

The Canoe Museum has some amazing exhibits that reach both children and adults. There are a variety of activities that focus on all ages and levels of learning, and this was really helpful in assisting us in developing our own exhibit design ideas. The amount of role playing stations is substantial for younger visitors. There are also a lot of detailed information displayed through movie screens and audio recordings for older audiences. Overall, we gained a lot of knowledge from these displays. We were also fortunate to view some of the Canoe Museum programming for a grade two class on a field trip. This was very helpful in understanding what students at this age found exciting and intriguing at the museum, and how their attention was captivated in order to expand their knowledge base.

FIGURE 11: TRAVELING AROUND CANADA
Students were able to sit on a map of Canada and roll a large dice to decide where a fictional character in a canoe got to travel to (The Canadian Canoe Museum, 1/22/2010).

FIGURE 12: HUDSON'S BAY TRADING POST
Role playing station set up to mimic a Hudson's Bay trading post (The Canadian Canoe Museum, 1/22/2010).

FIGURE 13: INTERACTIVE TEPEE

This tepee represented another interactive station where visitors could role play (The Canadian Canoe Museum, 1/22/2010).

FIGURE 14:ARTISAN WORKSHOP

The museum had a number of artisan workshops available at an extra cost. You learned how to make robes, personalize canoe paddles, mitts and more within these specific workshops (The Canadian Canoe Museum, 1/22/2010).

FIGURE 15: DRESS-UP

An image of even more items that were used for role playing and dress up activities (The Canadian Canoe Museum, 1/22/2010).

FIGURE 16: TRAVELING AROUND CANADA2
Fictional character in his canoe and his log cabin (The Canadian Canoe Museum, 1/22/2010).

FIGURE 17: CLIMBING INTO A CANOE
Interactive exhibit where student could practice climbing into a wooden canoe using the proper technique (The Canadian Canoe Museum, 1/22/2010).

FIGURE 18: CANOE BUILDING
This is a canoe building station. Here students learned how canoes are built and the materials that are commonly used throughout history and in modern society (The Canadian Canoe Museum, 1/22/2010).

FIGURE 19: HISTORICAL CLOTHING

The clothing displayed was used as a role playing station to dress up in clothing that used to be worn by early settlers (The Canadian Canoe Museum, 1/22/2010).

FIGURE 20: WEAVING

Able to use the equipment to practice weaving a voyager sash (The Canadian Canoe Museum, 1/22/2010).

FIGURE 21: SNOWSHOE WEAVING

Station that allowed participants to practice weaving a traditional snow shoe (The Canadian Canoe Museum, 1/22/2010).

The Ontario Science Center Museum Exhibits and Programming

The Wetlands and Ontario Ecosystems exhibit gave us lots of insight into how we could create displays for Gamiing. There were lots of examples that helped us decide how to best display our information. The Children's Play and Discovery Zone at the Science Center was an extremely interactive and visually appealing space. It was an age restricted exhibit where adults were only allowed when "accompanied by a child". The exhibits utilized all sense; we even got sneezed on by one of them! (The Ontario Science Center, 2/04/2011).

FIGURE 22: MAP OF GREAT LAKES
Map of the great lakes that lit up showing spread of invasive species. Effective visual aid. (Ontario Science Center, 2/4/2011).

FIGURE 23: INVASIVE SPECIES
Chart on the spread of invasive Species across the Great Lakes and into Wetlands. (Ontario Science Center, 2/4/2011).

FIGURE 24: "WHAT GOOD'S A WETLAND?"
Simplified information tables without too much text. (Ontario Science Center, 2/4/2011).

FIGURE 25: WETLAND FACTS
Wetland facts board. This was effective as the information was coupled with pictures. (Ontario Science Center, 2/4/2011).

FIGURE 26: FROG SOUNDS
This was an amazing station where visitors could press to hear what each frog sounded like. (Ontario Science Center, 2/4/2011).

FIGURE 27: FISH TANK

FIGURE 28: FISH TANK

This fish tank would be a great example for Gamiing's traveling exhibit as it is just the right size. It had native fish and turtle species and fact cards about each of them.
(Ontario Science Center, 2/4/2011).

FIGURE 29: INSECT SPECIES

Different ways of displaying: different insect species (Ontario Science Center, 2/4/2011).

FIGURE 30: ANIMAL SKULLS

Display of different Animal skulls, frog, mouse, mink behind plex-glass(Ontario Science Center, 2/4/2011).

FIGURE 31: SOIL TYPES

This showed how ground water moves through different soil types. This would be an effective way to show soil types of wetlands (Ontario Science Center, 2/4/2011).

FIGURE 32: MAGNIFICATION SCREEN

This sort of magnification onto a screen idea was suggested to us for the wetlands exhibit. (Ontario Science Center, 2/4/2011).

FIGURE 33: MOLDING DISPLAY BOARD

FIGURE 34: MOLDING DISPLAY BOARD

Figures 19 and 20 are a display board that molds to your hands, face, feet, etc. An excellent tool for learning about different animal prints (The Ontario Science Center, 2/04/2011).

FIGURE 35: SPACE UTILIZATION

An excellent example of space utilization as everywhere you looked there was something to attract your attention and look at. Objects were quite large however which is important in ensuring that there isn't too much detail and creating a sense of overload (The Ontario Science Center, 2/04/2011).

FIGURE 36: "HOLD A GORILLA'S HAND"

This was a great way for children to see how big animals were and what their hands look like in comparison to their own hands (The Ontario Science Center, 2/04/2011).

FIGURE 37: INTERACTIVE CAMOUFLAGE

FIGURE 38: INTERACTIVE CAMOUFLAGE

Figures 23 and 24 show an amazing way to illustrate to young children how animals use their skins to camouflage in the wild. Very interactive, with little restrictions on use (The Ontario Science Center, 2/04/2011).

FIGURE 39: MINI-SUPERMARKET
This child-sized supermarket was complete with removable props; groceries, grocery carts, a checkout line, etc. This is a great space for role playing. It was combined with elements of the Canadian Food Guide for nutrition lessons (The Ontario Science Center, 2/04/2011).

FIGURE 40: PUPPET STAGE
A great puppet stage for wetland critters and creatures (The Ontario Science Center, 2/04/2011).

FIGURE 41: ROLE PLAYING AND EXPLORATION
An example of an interactive space applicable to wetlands that can be used for role playing or exploration (The Ontario Science Center, 2/04/2011).

The Ontario Federation of Anglers and Hunters Museum and Exhibit Programming

This exhibit was inviting, simplistic and creative. It was excellent for children and museum staff explained that it was really successful with the summer camps. The detective exhibit made learning about invasive species fun and interesting as opposed to simply reading information on a plaque; it was laid out as though it was a cops and robbers hunt (Hunters and Anglers, 01/28/2011).

FIGURE 42: FISH AQUARIUM (Anglers and Hunters 1/28/2011).

FIGURE 43: REAL ANIMALS CUSTOM MADE BY A TAXIDERMIST (Anglers and Hunters 1/28/2011).

Detective Exhibit:

Invasive Species

FIGURE 44: INVASIVE SPECIES CHART

This was an invasive species chart. It was really fun for children as it had a detective theme (Anglers and Hunters 1/28/2011).

FIGURE 45: "ONTARIO'S MOST UN-WANTED"

This detective theme presented a fun way of looking at invasive species (Anglers and Hunters, 1/28/2011).

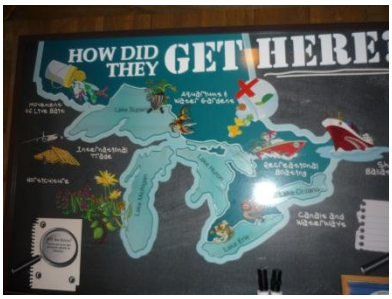

FIGURE 46: COLOURFUL MAPS

A simplified, colourful and easily understood map explaining how invasive species entered Ontario (Anglers and Hunters, 1/28/2011).

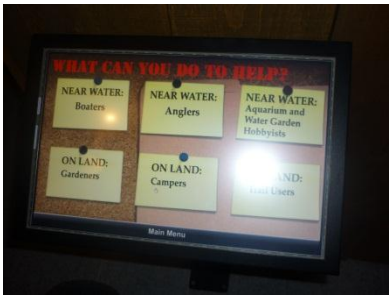

FIGURE 47: DIRECTIONAL CARDS

Cards displaying directional cues and explaining "what you can do to help" (Anglers and Hunters, 1/28/2011).

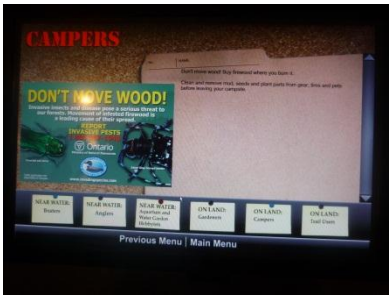

FIGURE 48: DETECTIVE CASE FILES

The whole exhibit was set up like a detective case with files. This was a very fun and interactive way to explain invasive species and teach visitors how they can help in the fight to protect native wildlife species (Anglers and Hunters, 1/28/2011).

FIGURE 49: "BOOK 'EM"

Continuation of the detective theme, and helps to really excite the children and get them involved (Anglers and Hunters, 1/28/2011).

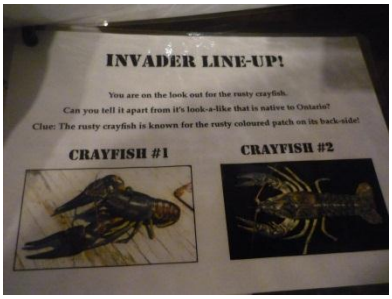

FIGURE 50: "INVADER LINE-UP"
"Invader Line-Up" cards made the species easily identified and understood (Anglers and Hunters, 1/28/2011).

FIGURE 51: COLOURING TABLE
Colouring table for young visitors. Pictures of Ontario species could be coloured and posted on the wall or taken home (Anglers and Hunters, 1/28/2011).

Laurie Lawson Outdoor Education Centre

This outdoor education center had activities not only indoors, but also very much utilizes the outdoors to get children involved in finding critters in the woods and streams and learning from a very hands-on approach. The following demonstrate how interactive, hands-on and engaging this outdoor education center is.

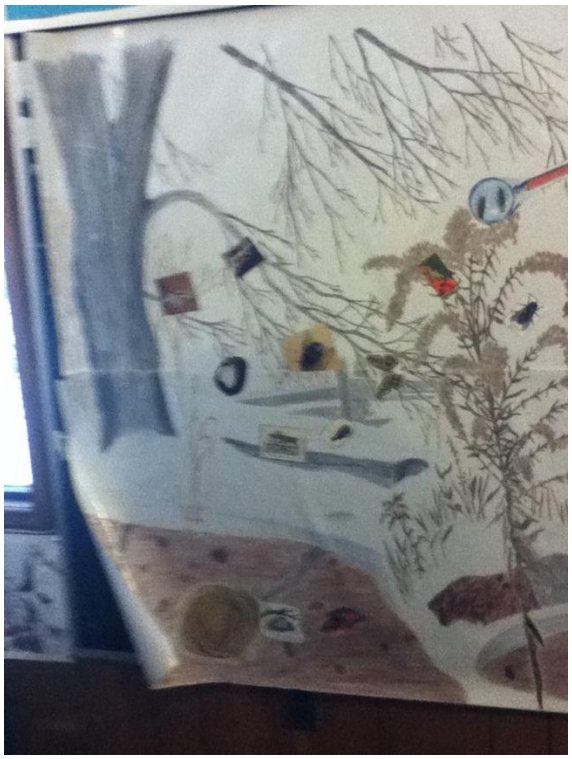

FIGURE 52: MAGNETIC BOARD

Magnetic Board displaying various and interchangeable images where magnets are placed in specific locations that relate to the theme. (Laurie Lawson Outdoor Education Center, 01/26/2011).

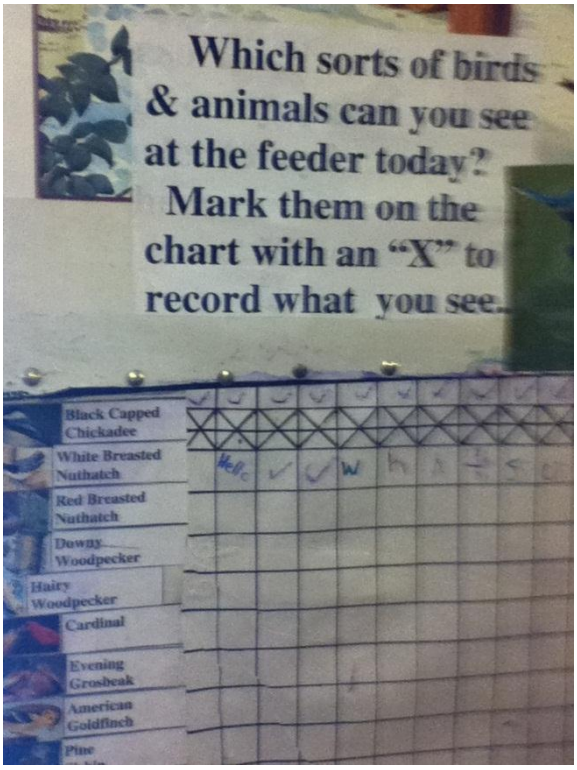

FIGURE 53: TYPES OF ANIMALS AT THE BIRD FEEDER

Chart recording the types of animals, seen through the window to the left of the display, on the feeders. Some of the birds are quite similar, and a display nearby is used to help differentiate the various species. (Laurie Lawson Outdoor Education Center, 01/26/2011).

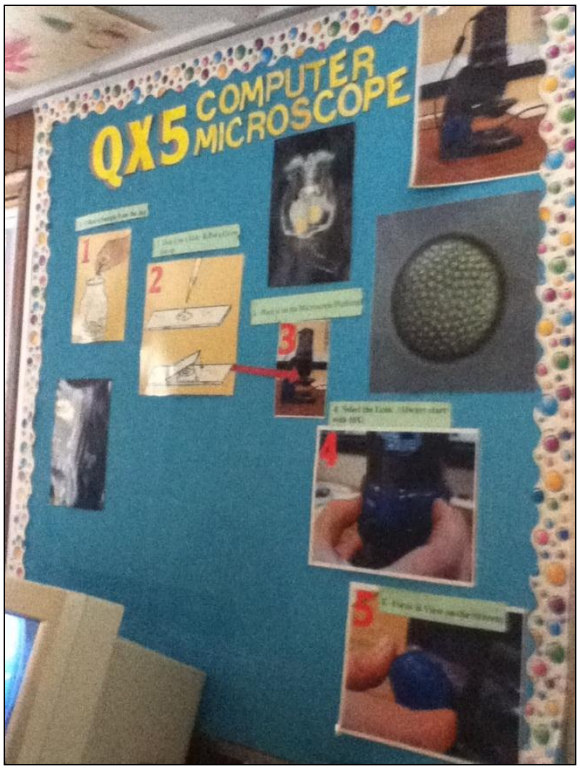

FIGURE 54: QX5 COMPUTER MICROSCOPE

The QX5 Computer Microscope is a portable device that can be used for scientific aspects to lesson planning (Laurie Lawson Outdoor Education Center, 01/26/2011).

FIGURE 55: EFFECTIVE BULLETIN DISPLAY
Bulletin board displaying mostly pictures, with books below that provide more detailed information (Laurie Lawson Outdoor Education Center, 01/26/2011).