

**EXHIBIT DESIGN AT
THE GASKIN MUSEUM OF MARINE LIFE,
NEW BRUNSWICK, CANADA**

by
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Abstract

Public outreach and education can effectively improve human behavior toward the natural environment. While communication between the scientific community and the general public is often challenging, scientists can bring about favorable results by promoting awareness and understanding of conservation goals. Such awareness and understanding are essential in resolving many environmental problems, including the protection of endangered marine mammals. With this in mind, I undertook a project to provide guidance in the development of natural history exhibits at a small museum run by a non-profit research station, the Grand Manan Whale and Seabird Research Station in Grand Manan, New Brunswick, Canada. Using the principles of environmental education and the contextual model of learning as guides, I produced a set of overall objectives for the museum. These included desired learning outcomes (*e.g.* an understanding of the Bay of Fundy ecosystem), as well as aesthetic goals and design principles. With these objectives in mind, I worked with Research Station personnel to renovate the museum space, write exhibit text, design and create layouts for new exhibits, and improve the museum's collections. The project culminated in the production of a document outlining an overall design plan for the Gaskin Museum of Marine Life, along with a discussion of rationale from environmental interpretation and educational theory, and recommendations for implementation and evaluation of the design plan. The results of this work may be applied to similar projects in public outreach and education.

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Introduction

Public education and outreach can be an effective way to improve the conservation of the natural environment. Communication between the scientific community and the general public is challenging, but often brings about favorable results as scientists are able to promote an understanding of conservation goals and objectives. This kind of understanding can be an essential first step toward concrete action to resolve environmental problems.

I set out to explore the role of education in addressing conservation problems in the Bay of Fundy. My project was intended to provide guidance in the development of natural history exhibits at a small museum run by a non-profit research station. The results of this work may be applied to similar projects in public outreach and education.

The Natural Setting: Grand Manan and the Bay of Fundy

The Grand Manan Whale and Seabird Research Station (GMWSRS) is located on a small island in the middle of the Bay of Fundy, nestled between Nova Scotia on the east and New Brunswick on the west. Just a few miles northeast of the coast of Maine, Grand Manan is a popular destination for tourists during the summer months.

The Bay of Fundy provides habitat for a startling variety of marine animals. The North Atlantic right whale (*Eubalaena glacialis*), one of the world's most endangered species, migrates here each summer along with minke (*Balaenoptera acutorostrata*), fin (*Balaenoptera physalus*), and humpback whales (*Megaptera novaeangliae*) (Gerber *et al.* 2000). All are drawn to the high concentrations of prey supported by the Bay's nutrient-rich waters. Northern gannets (*Morus bassanus*), black guillemots (*Cepphus grylle*), and Atlantic puffins (*Fratercula arctica*) are just a few of the seabirds found in this birder's paradise. Grand Manan's location near the mouth of the Bay makes it an ideal spot to study marine mammals, seabirds, and other marine life.

The Institutional Setting: GMWSRS and the Gaskin Museum of Marine Life

I spent approximately three months in residence at GMWSRS during the summer of 2002. The research station had received grant funding to renovate and create new exhibits for the Gaskin Museum of Marine Life, a small natural history museum. While in residence, I worked to enhance the museum's infrastructure, to improve the museum's specimen collections, and to design and create new exhibits.

GMWSRS was founded by Dr. D. Edward Gaskin, a biologist from the University of Guelph in Ontario, Canada who began studying cetaceans (whales, dolphins, and porpoises) in the Bay of Fundy during the 1960s. In 1981, Dr. Gaskin teamed up with a local whale watch company to create the non-profit research station. At that time, studies conducted at the station focused on the North Atlantic right whale and the harbor porpoise, and investigated everything from the feeding habits of whales to the effects of heavy metals on marine mammals.

The staff of GMWSRS have always acted informally as educators. During the first few years, they spoke with curious whale watchers about creatures living in the Bay. Soon, the scientists at the station became known as local experts, and inquisitive visitors asked them to identify everything from spiders to flowers to whales. The research station staff realized that they could do more to educate visitors and local people about marine mammals. In the winter of 1985, the station staff decided to create a small museum display in their living room, and in 1986 it was opened to the public. As additional specimens and artifacts became available, the museum gradually expanded into a converted bedroom and hallway. A small gift shop was opened in 1987, and donations were used to help fund the growing museum.

By the 1990s, the research station was known for its expertise in the hands-on study of harbor porpoises, and for its work with the highly endangered North Atlantic right whale. In the

summer of 2002, a grant from the Canadian federal government's Environment Canada allowed for renovation of the museum, including new displays and exhibits. The grant was part of the Habitat Stewardship Program for Species at Risk (HSP), which was set up by the Canadian Endangered Species Conservation Council in 2000. The grant given to GMWSRS was intended to facilitate habitat protection for the North Atlantic right whale. The HSP is a partnership-based grant program that provides funding for habitat improvement and conservation projects across Canada in order to encourage species conservation. It explicitly identifies the sharing of knowledge and increasing public outreach and awareness as key components of this "carrot-based" program, which uses incentives and education to encourage behavioral change (Environment Canada 2001b). In the Environment Canada listing of activities eligible for HSP grant funding, "outreach, education, extension, and technology transfer" are specifically mentioned (Environment Canada 2001a). Thus, environmental education is used by the administrative branch of the Canadian government as a policy tool in endangered species protection.

Scientists as Educators

Since the early 1970s, environmental education has played an increasingly important role in conservation and environmental protection in the U.S. and around the world. The first international conference on environmental education was convened in Tblisi, Georgia, USSR in 1977. It was organized jointly by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and Environment Programme (UNEP). Sixty-six members of the United Nations participated. The conference resulted in a document known as the Tblisi Declaration, which identified five major outcomes of environmental education. They are

awareness, knowledge, attitudes, skills, and participation (UNESCO and UNEP 1977). These five objectives have provided the framework for environmental education since that time, and are intended to bring about the development of

a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones.

(UNESCO and UNEP 1975)

Since Tblisi, environmental education has come to be seen as a major component of successful environmental protection and conservation. Environmental education programs have been developed in many countries, at all levels of government and in many non-governmental sectors. Education can be an effective component of environmental policy, used as an alternative to or complement of traditional command and control, incentive-based, or disincentive-based strategies. All of these approaches are intended to change the behavior of individuals in relation to the environment. However, educational programs have the unique advantage of changing participants' value systems, making the motivation to care for the environment intrinsic (Santopietro 1995). This can reduce regulatory costs and the need for enforcement while increasing participation and compliance with environmental protection efforts.

In the field of conservation biology, scientists have increasingly been forced to reexamine the ways in which they interact with the general public. More and more, conservation biologists are entering into the world of environmental advocacy, as they see the need for human behavioral change (Salafsky *et al.* 2002). Scientists are increasingly becoming educators who help foster understanding and responsible action. This educational role is not entirely new for scientists, some of whom have long acted as curators of museum collections. Yet the

relationship between museums and scientists has changed as museums have adjusted their educational mission to accommodate new information about how people learn.

The Museum Experience: Educational Theory

While museums are generally intended to educate and entertain the public, the informal nature of their educational setting sets them apart from other more formal forms of education. Visits to museums tend to be brief and infrequent in comparison to other educational activities (Hein 1998). Museums must cater to visitors of all ages, all socioeconomic and cultural backgrounds, and all educational levels. Thus, maximizing the educational value of museums presents some unique challenges.

Hein (1998: 2) argues that educative experiences must be challenging, stimulating, lively, vivid, interesting, and organized. Market research about how people like to spend their leisure time and what attracts people to different sites can instruct us in some aspects of museums, but answering questions about the educational potential of museums is more difficult. The conditions necessary and sufficient for entertainment may be necessary, but certainly are not sufficient, for education (Hein 1998:3). The challenge, then, is for museums to find ways to entertain visitors, and to then translate their excitement and enthusiasm into growth and learning.

Museums have changed a great deal since they first began to appear in the eighteenth century (Hein 1998, Roberts 1997, Hein 2000). As societies began to recognize their responsibility to improve the welfare of all citizens, attention to public education increased. Museums were transformed from storehouses for the collections of social elites or imperialist governments into places that provided education to the masses. By the end of the nineteenth century, public school systems had replaced museums' public educational function, and

museums moved into a more supportive role in educating the public (Hein 1998, Roberts 1997, Hein 2000:5). As today's museums strive to justify their existence and improve their educational worth, administrators, designers, and educators must pay special attention to educational theories about knowledge, learning, and teaching. Carefully crafted museums enhance the experiences of visitors by intentionally and consistently addressing the theories behind their exhibits, layout, and general atmosphere (Hein 1998:14-15).

Any educational theory has three basic components: a theory of knowledge (epistemology), a theory of learning, and a theory of teaching (pedagogy) (Hein 1998:16). Theories of knowledge fall along a continuum between two endpoints. At one extreme is Realism, which claims that true reality exists independently from any ideas that humans have about it. At the other extreme is Idealism, which claims that knowledge exists only in the human mind, and does not correspond to any natural reality. This extreme is exemplified by the idea that a tree falling in a forest makes no sound if there is no one present to hear it. Theories of learning also fall along a continuum between two extremes. At one end is the Transmission-Absorption model of learning, which claims that people learn by taking in small pieces of information that is transmitted to them. The image of empty vessels filling up with knowledge typifies this extreme. At the other end of the spectrum is the Constructivist model of learning, which claims that learners actively construct knowledge in their minds. This extreme focuses much more on the learner than on the presentation of the subject to be learned.

Four Types of Education Theories

The four extremes of knowledge and learning theory combine to form four basic types of educational theory (Figure 1). The first type is didactic/expository education. Under this

traditional model, teachers organize lessons based on their understanding of the subjects' structures, and then present this information to students in a rational sequence. Museums using this type of educational theory will have exhibits organized in a highly sequential fashion, will include a defined beginning and end with an intended

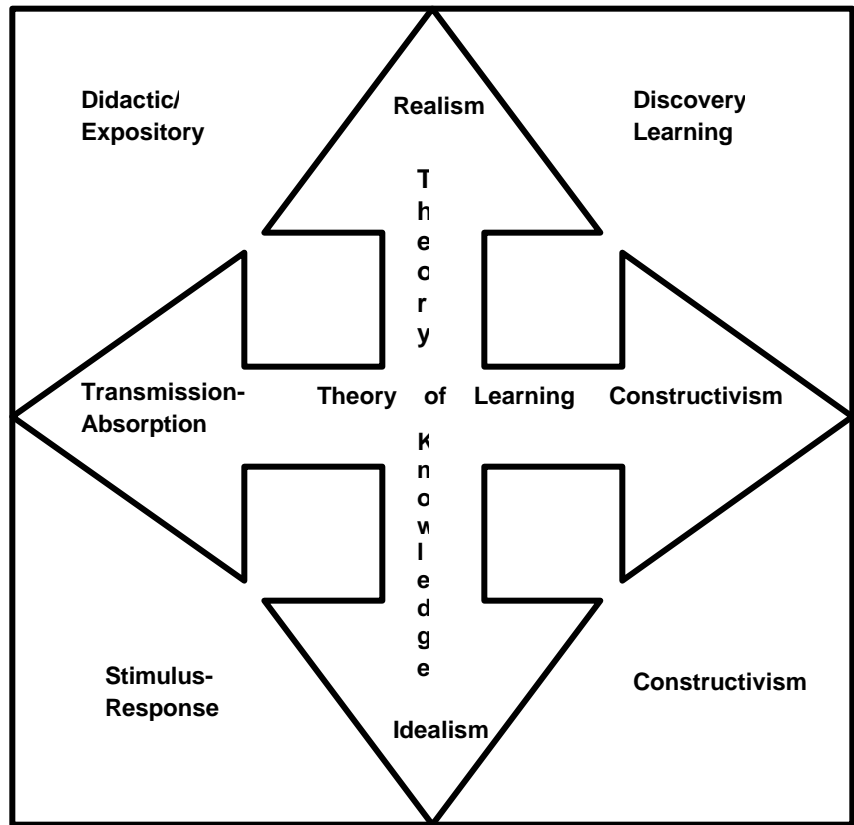


Figure 1. Four types of educational theories. Adapted from Hein 1998.

order, will arrange subjects from simple to complex, will provide labels and panels that describe what the visitor should learn from the exhibits, and will produce associated educational programs that follow a traditional curriculum and include specific learning objectives.

The second type of educational theory is stimulus-response education. Under this model, adapted from behaviorist psychology, training is emphasized in order to achieve outcomes from specific stimuli. Museums using this type of educational theory will again have sequential, ordered exhibits with an intended order and beginning and end, and will provide labels and

panels that describe what the visitor should learn. However, unlike museums based on didactic/expository theory, stimulus-response museums will use reinforcement and rewards to elicit appropriate responses. For those visitors who disagree with the ideas presented in this type of museum, the exhibits may seem like propaganda because they are likely to lack objectivity (Hein 1998:30).

The third type of educational theory is discovery learning education. Under this model, attention is focused on the learner, rather than the subject material. Museums using this approach will have exhibits that allow for exploration and active learning, will provide labels and panels that ask visitors to find their own answers to questions, will produce educational programs that lead participants to specific, acceptable conclusions, and will provide some way for visitors to compare their own conclusions to the “correct” interpretations of the exhibits. Discovery learning exhibits may or may not be arranged with a specific, intended order. This approach is problematic because it tries to get visitors to come to the same conclusions that others have come to, while claiming that each visitor is free to interact with exhibits however they wish to (Hein 1998:32).

The fourth type of educational theory is constructivism. Under this model, learners participate actively to construct their own conclusions and knowledge. Museums using this approach will have many entry points and no specific order, will present a range of different perspectives, will include various active learning methods that allow visitors to interact with objects and ideas, and will produce educational programs that allow participants to experiment, hypothesize, and draw unique conclusions (Hein 1998: 35-36).

These four types of educational theory are carried out through corresponding pedagogies, or theories of teaching. Museums implement a variety of approaches within the framework of

these four educational archetypes, and often combine methodologies that fall into more than one quadrant (Table 1). This may communicate confused or contradictory messages to visitors. However, the quality and effectiveness of museum learning experiences can be greatly enhanced through the adoption of a more intentional, conscious policy that integrates an overall theory of education with a pedagogy that implements the chosen theory throughout the museum’s layout, exhibits, and programs (Hein 1998:14).

Table 1. Characteristics of four educational theories in museums. Adapted from Hein 1998.

Educational Theory	Description	Exhibit Organization	Labels & Panels	Learning Methods	Educational Programs
Didactic/ Expository	<ul style="list-style-type: none"> Traditional classroom-type 	<ul style="list-style-type: none"> Specific order Simple to complex 	<ul style="list-style-type: none"> Describe what should be learned 	<ul style="list-style-type: none"> Teaching content through sequential steps 	<ul style="list-style-type: none"> Traditional curricula Specific objectives
Stimulus-Response	<ul style="list-style-type: none"> Behaviorist training 	<ul style="list-style-type: none"> Specific order 	<ul style="list-style-type: none"> Describe what should be learned 	<ul style="list-style-type: none"> Rewards and reinforcement 	<ul style="list-style-type: none"> Lesson-oriented
Discovery Learning	<ul style="list-style-type: none"> Learner-focused 	<ul style="list-style-type: none"> No specific order 	<ul style="list-style-type: none"> Ask questions 	<ul style="list-style-type: none"> Active and interactive 	<ul style="list-style-type: none"> Specific objectives and conclusions
Constructivism	<ul style="list-style-type: none"> Learners construct knowledge 	<ul style="list-style-type: none"> No specific order 	<ul style="list-style-type: none"> Provide multiple points of view 	<ul style="list-style-type: none"> Active and Interactive 	<ul style="list-style-type: none"> Open-ended objectives and conclusions

Applying Educational Theory to Environmental Education

When choosing the educational theories to apply in a museum, we must consider the purpose of that particular museum. In the case of the Gaskin Museum of Marine Life, a key motivation behind the creation of new exhibits was environmental education, with specific goals of species protection and habitat stewardship for the endangered North Atlantic right whale. Thus, the purpose of the museum included the five major outcomes outlined in the Tblisi Declaration: awareness, knowledge, attitudes, skills, and participation (UNESCO and UNEP 1977).

Environmental education can be defined as planned programs intended to achieve specific objectives, and the receiving and processing of stimuli and information related to the natural world (UNESCO and UNEP 1977). Awareness, which is often said to be a necessary precursor to the other four components of environmental education, can be defined as discovery and perception of, and sensitivity to, the total environment and its problems. Knowledge can be defined as experience and information contributing to an understanding of the environment and its problems. The third component of environmental education, attitudes, can be defined as values, motivations, and concerns that lead to openness and receptiveness about the environment and its problems. Skills can be defined as the development of capability or proficiency in creatively applying techniques such as research, analysis, conflict resolution, and advocacy to address environmental problems. Finally, participation can be defined as any legal, political, economic, persuasive, managerial, or other action taken to improve or protect the environment. For our purposes, participation is essentially synonymous with behavioral change, which is the ultimate desired outcome of environmental education. Research in the field of environmental

education indicates that environmental behavior can be effectively improved through environmental education programs (Zelezny 1999).

In designing effective environmental education in the museum setting, we are concerned with the extent to which those efforts are able to produce behavioral changes. The five interrelated objectives of environmental education can be seen as having certain complex causal relationships, which interact to produce the desired outcome of behavioral changes, or participation (Figure 2). It is important to recognize that the processes involved are iterative, and that preexisting awareness, knowledge, attitudes, and skills affect the success of environmental education, as well as future levels of awareness, knowledge, attitudes, and skills.

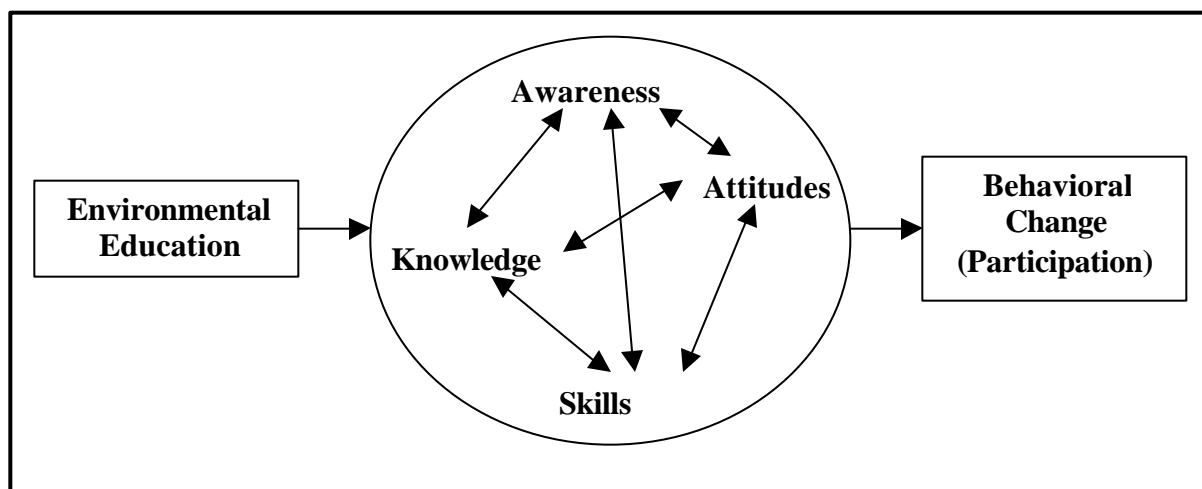


Figure 2. Model of environmental education theory. All arrows represent positive causal relationships (*e.g.*, awareness leads to increased behavioral change).

In general, it is hoped that environmental education will increase the awareness, knowledge, attitudes, and skills of those visiting the museum. We set out to design effective exhibits to accomplish this, with the end goal of increasing behavioral changes toward the environment. Because people can only adjust their behavior in relation to something if they are aware of its existence, increased awareness of the environment and its problems will lead to

increased behavioral change. Increased knowledge about the workings of the environment and the ways that humans interact with the natural world increases behavioral change as people gain a better understanding of the impacts their actions have and the reasons why change may be beneficial. The development of increasingly open and receptive environmental attitudes and motivations encourages behavioral change as people's increased concern for the environment influences their actions. Finally, enhanced skills lead to increasing behavioral change as people develop the tools they need to take effective action.

Because its outcomes include the development of certain attitudes and certain types of action (skills and participation), environmental education shares some of the same problems of a discovery learning educational approach. Environmental education sets out to allow individuals to explore environmental contexts and learn through the construction of knowledge based on interactive, authentic experiences, yet still expects learners to emerge with specific conclusions about how to interact with the environment.

Museums are by definition the site of "free-choice" learning—personally motivated, non-linear learning that allows the learner to direct his or her own participation in the educational experience (Falk and Dierking 2000: xii-xiii, 13). This type of learning is often referred to as "informal," in contrast to the "formal" learning that occurs in traditional (didactic/expository) classroom-based education. Museum visitors are voluntary, non-captive audiences who are not required to pay attention, who will change their attention to something else if they get bored, and who tend to expect a more informal, less academic atmosphere (Ham 1992). Yet while effective free-choice education seeks to acknowledge how learners construct knowledge, environmental education often requires that learners reach specific conclusions from this construction. Thus, while the goal of a museum focused on environmental education may be to base its exhibits and

programs on a constructivist educational theory, it may end up using elements of the other three theories in order to achieve the specific outcomes of attitudes, skills, and participation.

Even if museum visitors are not gaining specific knowledge, they are likely become more aware, adjust their attitudes, and refine their interests. Falk and Dierking (2000:23) argue that “when people like something, they attribute positive feelings and values to it; the result is a high probability that they will choose to follow up on that interest with action.” This is one of the main objectives of environmental education that can benefit most from the free-choice nature of museum visits. People who come to museums generally do so because they find the experience rewarding in some way, and are thus more likely to move from awareness and knowledge about environmental issues to concrete action and behavioral change in order to resolve those issues.

So how can we maximize these positive environmental education outcomes in the museum setting? Educational research has revealed that all learning is rooted in the personal, sociological, cultural, and physical contexts within which it happens. Falk and Dierking (2000) have put forth a Contextual Model of Learning based on this new understanding. They argue that learning happens within a framework of “three overlapping contexts: the personal, the sociocultural, and the physical” (Falk and Dierking 2000: 10). These three contexts are broken into eight main factors:

Personal Context:

1. Motivation and expectations
2. Prior knowledge, interests, and beliefs
3. Choice and control

Sociocultural Context:

4. Within-group sociocultural mediation
5. Facilitated mediation by others

Physical Context:

6. Advance organizers and orientation
7. Design
8. Reinforcing events and experiences outside the museum.

(Falk and Dierking 2000)

Taken together, these factors strongly affect the quality of learning during a museum experience. Research shows us that most learning takes place when individuals are internally-motivated and emotionally satisfied, and that personal motivation increases in supportive environments when learners are freed from anxiety or fear, are given choices and control over their own learning, and are able to meet the challenges of the task (Falk and Dierking 2000). While we cannot control all of these factors in the museum setting, it is important to acknowledge their impact on learning and to address them to whatever extent possible.

Maximizing the Museum Experience: Exhibit Planning and Design

The grant to GMWSRS specified that new museum exhibits should focus on habitat stewardship for the endangered North Atlantic right whale, a population with less than 350 remaining individuals. To carry this out, I produced a set of overall objectives for the museum with assistance from the research station's management team. These included desired learning outcomes (*e.g.*, an understanding of the Bay of Fundy ecosystem), as well as aesthetic goals and design principles. With these objectives in mind, I worked with research station personnel to renovate the museum space, write text and create layouts for new exhibits, and reorganize and preserve the museum's collections.

The large scope of the museum renovation project made it unfeasible to complete all of the necessary work during my time in residence. However, I was able to make substantial improvements in the museum's infrastructure and collections, create a number of new exhibits, and make recommendations for the overall design of the museum.

The Existing Museum Context

As described above, the Gaskin Museum of Marine Life grew out of the interests of researchers at the GMWSRS, who became known as sources of information about the Bay of Fundy's flora, fauna, and physical characteristics. The exhibits in the museum had been gradually developed over the course of several years by several individuals, who had extremely limited funding resources and time. As a result, the museum lacked coherence and the organizing principles of an underlying educational theory. However, the staff of the research station had acquired a large collection of interesting specimens and artifacts.

Because it is housed within the research station, the museum is limited to a very small amount of space available for exhibits. Some of the key problems I encountered in the museum space were inadequate lighting and ventilation, ill-preserved specimens and artifacts, an overwhelming amount of visual stimulus without any clear organization, and an abundance of small text. At the outset of this project, we hoped to address these problems and create a more effective set of museum exhibits.

Guidelines for Exhibit Planning and Design

Consideration of Contextual Model of Learning leads us to several “dos and don'ts” of museum planning and design, summarized in Table 2. As we began work on the new exhibits for the Gaskin Museum, these ideas helped to guide our decisions.

Table 2. Summary of museum planning and design “dos and don’ts” based on the Contextual Model of Learning. Adapted from Falk and Dierking 2000 and Roberts 1997.

Context Factors	Planning & Design Dos	Planning & Design Don'ts	
Personal Context	1. Motivation and expectations	<ul style="list-style-type: none"> • Attract and reinforce intrinsically motivated learners • Provide education and entertainment 	<ul style="list-style-type: none"> • Over-emphasize education over entertainment, or vice versa
	2. Prior knowledge, interests, and beliefs	<ul style="list-style-type: none"> • Provide for the variety of skills, learning styles, and interests of visitors 	<ul style="list-style-type: none"> • Use jargon and obscure terminology that requires a specific knowledge base
	3. Choice and control	<ul style="list-style-type: none"> • Provide flexibility in the organization and arrangement of exhibits 	<ul style="list-style-type: none"> • Mimic traditional educational formats • Force specific viewpoints or approaches on visitors
Socio-cultural Context	4. Within-group sociocultural mediation	<ul style="list-style-type: none"> • Provide spaces and activities that facilitate collaborative learning by groups 	<ul style="list-style-type: none"> • Crowd exhibits together • Structure visits as “solo” activities
	5. Facilitated mediation by others	<ul style="list-style-type: none"> • Provide skilled staff to help interpret exhibits 	<ul style="list-style-type: none"> • Emphasize a single level of complexity
	6. Advance organizers and orientation	<ul style="list-style-type: none"> • Provide information and orientation before or soon after visitors arrive • Give visitors clues about how exhibits are organized and what they might expect to get out of them 	<ul style="list-style-type: none"> • Assume that visitors will know how to approach exhibits
Physical Context	7. Design	<ul style="list-style-type: none"> • Provide artifacts, specimens, and other real objects that allow for a unique, authentic, and multi-sensory experience • Make visitors as comfortable as possible 	<ul style="list-style-type: none"> • Emphasize two-dimensional media, text, and other experiences readily available outside the museum • Place text at heights inappropriate for readers
	8. Reinforcing events and experiences outside the museum	<ul style="list-style-type: none"> • Allow visitors to give feedback 	<ul style="list-style-type: none"> • Expect visitors to be able to articulate what they have learned immediately after visiting

Defining Objectives for the Gaskin Museum of Marine Life

After assessing the existing museum context, our first task was to define a set of learning and aesthetic/design objectives to guide our renovation and design work.

Learning Objectives

The GMWSRS management team wanted the museum to convey information about:

1. the natural history of marine mammals and seabirds,
2. conservation, and
3. current research activities at the station.

More specifically, it was hoped that the museum exhibits would lead visitors toward a basic understanding of:

1. ecological systems in the Bay of Fundy,
2. biology of cetaceans (whales, dolphins, and porpoises),
3. cetacean conservation, and
4. other Bay of Fundy wildlife.

Aesthetic/Design Objectives

The best exhibits are attractive, brief, and clear (Ham 1992). Overall, we hoped to create exhibits that displayed artifacts, specimens, and other focal points and interpreted the meaning and importance of these points of interest, placing them in a larger educational context. These exhibits would be supported by the creation of an archival museum collection, which would be used to store additional specimens and materials in an organized, accessible manner.

More specific aesthetic goals identified by the management team included:

1. clean, white, non-distracting backgrounds,
2. improved lighting,

3. visually-stimulating color photos and graphics,
4. clear, readable text used minimally, and
5. clean, well-preserved specimens and artifacts, including both “hands-on” (interactive) and “hands-off” items.

The Exhibit Approach

For the Gaskin Museum, we decided to organize the exhibits around a “narrative” approach, presenting each display as a part of the “story” of the Bay of Fundy. Falk and Dierking (2000:49) report that “cognitive research demonstrates that, universally, people can mentally organize information effectively if it is recounted to them in a story.” Providing an overriding theme, main message, or interesting story helps people pay attention and organize ideas (Ham 1992). Our overall narrative was a “tour” of the Bay of Fundy as approached by the scientists of the research station. This main story was broken into a set of exhibits, each with its own theme. Each theme was broken into topics supported by various “focal points”—artifacts, specimens, photos, and other visual aids.

An explanation of our preliminary approach to the exhibit themes follows.

- **Theme 1:** Welcome to the Gaskin Museum of Marine Life
 - **Topic:** History of the Grand Manan Whale and Seabird Research Station
 - **Focal points:** Old photos of research station, photos and artifacts from David Gaskin’s collections
- **Theme 2:** Introduction to the staff and current research activities of GMWSRS
 - **Topic:** Brief biographies of current staff and descriptions of their research activities

- **Focal points**: Staff photos, artifacts from research activities (e.g. mock satellite tag, sightings form, etc.)
 - **Topic**: Harbor porpoises and the Harbor Porpoise Release Program
 - **Focal points**: Scale model of herring weir, sample section of purse seine net, Atlantic herring specimen, rototag, video of a release, photos of porpoises
- **Theme 3**: Introduction to unique features and ecology of the Bay of Fundy
 - **Topic**: The Fundy tides and upwellings
 - **Focal points**: photos of high and low tide, satellite photo of Grand Manan and the Bay, photo of upwelling, specimens of krill and copepods
 - **Topic**: Fundy food webs
 - **Focal points**: diagram of food web, specimens and photos of key organisms
- **Theme 4**: Geology of Grand Manan
 - **Topic**: Geologic history of the Bay of Fundy
 - **Focal points**: diagrams of the Bay at various points along geologic time scale
 - **Topic**: Rocks of Grand Manan
 - **Focal points**: rock specimens, photos of sources of rocks throughout the island
- **Theme 5**: Introduction to the characteristics of cetaceans
 - **Topic**: Whales, dolphins, and porpoises are mammals

- **Focal points** : photo and specimen of hair follicle, x-rays of harbor porpoise flipper
 - **Topic**: Cetaceans have special adaptations
 - **Focal points** : diagrams, photos, and specimens of cetacean skeletons, streamlined body shape, and blubber
 - **Topic**: Whales are large animals
 - **Focal points** : life-sized replica of humpback whale flipper, minke whale skull
 - **Topic**: Cetaceans fall into two groups, toothed whales and baleen whales
 - **Focal points** : photos and diagrams of various representative species, specimens of baleen and teeth, minke whale skeleton, white-sided dolphin skeleton, adult and juvenile harbor porpoise skeletons, specimens of various prey species
 - **Topic**: Introduction to evolution of cetaceans
 - **Focal points** : time line and diagrams of cetacean ancestors
- **Theme 6**: Right whale conservation and habitat stewardship
 - **Topic**: Introduction to right whale biology and ecology
 - **Focal points** : photos of right whales, various specimens from right whales, right whale baleen plate, range map
 - **Topic**: Right whales as an endangered species, and what can be done to protect them
 - **Focal points** : photo identification matching game, photos of entangled whales, map of shipping routes and whale habitat

- **Theme 7:** The rich variety of wildlife in the Bay of Fundy
 - **Topic:** Introduction to Fundy pinnipeds
 - **Focal points:** preserved fur seal pup, various specimens (pelt, etc.), photos of pinniped species in the Bay
 - **Topic:** Introduction to Fundy seabirds
 - **Focal points:** photos and specimens of guillemot, black-backed gull, puffin, gannet, etc.
 - **Topic:** Introduction to Fundy fish, invertebrates, and plants
 - **Focal points:** photos and specimens, wharf piling with tidal zonation and associated species

Evaluation of Museum Effectiveness: Rationale and Methodology

My initial plans for the Gaskin Museum renovations included a period of evaluation and assessment of the exhibits' overall effectiveness. However, time constraints did not allow me to complete this portion of the project. Nonetheless, I have made some recommendations about how the research station staff might conduct evaluations in the future.

Any museum or environmental education program can benefit from an assessment of its effectiveness in meeting its main goals and objectives. The field of museum research has expanded to include a variety of evaluative methodologies, including visitor studies focused on exhibit/program evaluation and visitor surveys, as well as sociological and educational research (Roberts 1997, Hein 1998). Evaluations can range from highly formal, carefully constructed research studies to more informal opportunities for visitors to provide comments and feedback.

All can be helpful, and even the simplest evaluation is likely to give new insights into how the museum experience can be improved upon.

Hein (1998) provides a detailed overview of methods for studying museum visitor experiences, and places all methods into three basic categories (Table 3). The first category is observing what visitors do in the museum. The second is soliciting written or oral comments from visitors, and third is examining some outcome of visitor activity. As in any research, each type of evaluation has advantages and disadvantages which should be explored before any method is implemented. It is important to use systematic data recording and analysis procedures to reduce subjectivity, and it is often best to use several different methods to increase the power and reliability of the results (Hein 1998). Given the contextual nature of learning, it is also important to consider the effects of visitor motivations, post-visit experiences, and other factors (Falk and Dierking 2000).

Table 3. Examples of museum studies methodologies. Adapted from Hein 1998.

Observation Methods	Language-Based Methods	Outcome-Based Methods
<ul style="list-style-type: none"> • Tracking and timing visitor movements • Experience sampling • Counting handouts taken • Visual tools (photography, etc.) 	<ul style="list-style-type: none"> • Surveys or questionnaires • Comment cards or journals • Pre- and post-tests • Interviews • Focus groups 	<ul style="list-style-type: none"> • Recording and analyzing visitor conversations • Meta-analysis of research

Significance of Evaluation

Museums face increasing pressure to increase their educational role, justify their existence, and thus prove their worthiness as a recipient of public and private funding (Hein

1998, Roberts 1997). For the Gaskin Museum of Marine Life, whose chief goal is environmental education, evaluation of the effectiveness of their exhibits should focus on the impacts of exhibits on visitors' awareness of environmental problems, knowledge about the environment, attitudes about conservation, skills to address environmental issues, and participation in conservation-related activities. A thorough understanding of the museum's effects on visitors will not only provide justification of, and direction for, continued educational efforts, but will also have positive impacts on the Bay of Fundy and other environments.

By using environmental education to inform citizens' beliefs and values related to environmental protection, governments may save money by reducing the need for expensive regulation and enforcement in the long term while more effectively changing citizens' behaviors. According to economist George D. Santopietro (1995), policies that use environmental education may have the advantages of "more effective enforcement and operational costs and the internalization of desired value changes." Thus environmental policies which include environmental education components, such as the Canadian HSP grant to the Gaskin Museum, may be less expensive and more effective than policies without educational components. The more effective the education, the greater the environmental benefit.

Recommendation for Evaluation of the Gaskin Museum of Marine Life

Approximately ten thousand people visit the Gaskin Museum each year. Most of these are tourists who visit Grand Manan and the Bay of Fundy for a short time. Aside from casual observation, little has been done to improve our understanding of these visitors' motivations in coming to the museum, behaviors while visiting, reactions to exhibits, or changes in awareness, attitude, knowledge, skills, and participation related to the environment. The museum does not currently charge an entry fee, but rather asks visitors for donations. However, as the museum

grows and improves, the management team hopes to begin charging a minimal fee to support the development and maintenance of new and existing exhibits. Thus, a more systematic evaluation of the museum would be highly beneficial, pointing out areas for improvement and revealing information about the museum's visitors.

For the Gaskin Museum, I recommend a preliminary observational study that tracks and times the movements of visitors through the museum. This would give a better understanding of how a typical visitor uses the exhibits, and would allow for more targeted follow-up evaluation. I then recommend the use of a two-part visitor survey in which a small sample of visitors is asked to complete one short questionnaire immediately after visiting the museum, and is then sent another short questionnaire several months later. This survey should include questions targeting the visitors' demographics, motivations for visiting, and overall reactions to the museum, as well as any changes in the five basic outcomes of environmental education. The research station lacks the substantial funding and available personnel necessary to complete a scientifically rigorous evaluation, but even this type of small-scale study would help in the further development of the museum.

Conclusion and Application Beyond Grand Manan

The scientists of the Grand Manan Whale and Seabird Research Station have taken an admirable leading role in public outreach and education. In creating the Gaskin Museum of Marine Life, they are attempting to fill a vital role as interpreters, taking important messages from conservation biology and environmental studies to the public at large. A conscious look at educational theory, visitor studies, and environmental education has helped to inform the development of more effective exhibits.

The scientific community is facing an increasing call to advocacy and outreach in solving the world's environmental problems. The Gaskin Museum is just one small response to this call. Yet this project's attempt at addressing the need for effective environmental education provides useful insights into the ideas that should be considered when undertaking such an endeavor. Furthermore, the success of GMWSRS in educating the public sets a positive example for other scientists, environmental managers, and communities to follow. In working to protect the environment, even small-scale efforts can make a substantial difference.

My research for this project has revealed one startling constant in the complex world of epistemologies, pedagogies, visitor studies, and design principles. Roberts puts it best when she states that “no matter how carefully crafted an exhibit, no matter how visitor friendly its design, the visitors who use it will still make their own sense of it according to their own terms” (1997). We can only do so much to improve the educational and entertainment value of a museum—the rest is left up to the individual visitor. And just as we can't please every visitor all of the time, those involved in creating museum exhibits must also be willing and ready to sacrifice personal preferences, to negotiate and compromise. The decisions and processes involved require significant investments of time, energy, and resources, and the underlying worldviews of decision-makers often make consensus difficult to come by. Yet at the Gaskin Museum of Marine Life, and in any other place where public outreach and education are made a priority, the outcome—positive steps toward solving environmental problems— is something upon which we can all agree.

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