SCIENCE WORLD ROADSHOWS: A STUDY OF EFFECTS IN ONE COMMUNITY

by

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Abstract

This paper presents a review of the impact of SCIENCE WORLD's travelling Roadshows program on one community. The Roadshows program is a non-formal science education program performed in school auditoriums for approximately 100 elementary students around British Columbia, Canada. In March, 1994 the Roadshows performed two Science Carnival Shows - a potpourri of fun science demonstrations for Kindergarten to Grade 3 students and one Arcs and Sparks show about electricity for Grade 4 to 7 students. The community in this study was a school in the Lower Mainland of British Columbia as well as the children, teachers, parents, administrators and surrounding libraries and toy stores.

This study revealed that the Roadshows had a small impact on the community as a whole and a significant impact on several individuals. Through interviews of 12 Grade 5 students, their parents and teachers, it was found that discussion about the Roadshows continued over a 4 week period. Discussions took place between many different people in the study plus other family members not interviewed. Almost all of the comments about the Roadshows were positive. Students enjoyed the show and liked science more after the program. Many of them said they would "do more science" because of the Arcs and Sparks show and they said they knew more about science and learned a variety of specific things about electricity through the Roadshows presentation. They also learned about the dangers of electricity and three pieces of information about electricity which were taught in the show.

Some parents felt that the program had a large impact on their sons or daughters. Parents saw changes in their children including an increase in self esteem, a new positive opinion of science, more discussion about science and interest in science fair projects on electricity. Most teachers felt the program was a positive experience for their students.
This study shows that non-formal science education (sometimes referred to as informal science education) has its place in the world of science education.
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Chapter 1 Introduction

"Nowadays, the effectiveness of every type of educational institution is in question. Museums are no exception." (Boyd, 1991, p. 4). Not only is the effectiveness questioned, but there are other questions raised. What exactly are museums doing and what kind of impact are they having on people who experience them? This study will illuminate the kind of impact the "Roadshows", an outreach program from SCIENCE WORLD British Columbia, is having on an audience and the community beyond. The term Roadshows is used in the plural as the name of the program. The community for this study is composed of Kindergarten to Grade 7 school students, their friends, teachers, families and community in the vicinity of a school. They are the focus of this study and, as a group, will be considered the "community" being investigated.

One of the motivating factors behind studying the Roadshows is to provide information to the science centre community and SCIENCE WORLD about the impact of this program. Over the past five years, questions have arisen from a variety of sources about the type of impact the Roadshows have on participants. To gain information, SCIENCE WORLD has used feedback, such as positive reactions from audiences and evaluation forms received from teachers, to obtain an impression of the program. These mechanisms indicate that the program is well received. However, there has been no conclusive evidence that the program has an impact on the audience members because no study had been performed until 1994. Time and effort was being put into a program that had no proven effect and so proof was a motivator for this study. In addition, the literature on travelling presentations from science centres is slight, so there is no reference point from which to judge the impact of the Roadshows program previous to this study.
In order to give a context to this study, the introductory chapters will provide details about SCIENCE WORLD, outreach, the Roadshows, and the relationship between the Roadshows and programs in other science centres.

1.1 Science World

SCIENCE WORLD is a non-profit, informal science education institution that was first opened on May 6, 1989. Its mission is to "inspire a greater appreciation of science and technology through the presentation of science exhibitions and demonstrations, informal educational activities and province-wide outreach programs" (SCIENCE WORLD Business Plan, 1994, p. 1). According to a study conducted on SCIENCE WORLD in 1989 by Marktrend Marketing Research Inc., 80% of the 507 people surveyed said that they were aware of SCIENCE WORLD. These people were randomly selected from the Lower Mainland of Vancouver indicating that SCIENCE WORLD is indeed well known in this area. Forty-nine percent of these people said that they "definitely" or "probably will visit SCIENCE WORLD this year" (p. 6). This percentage increases significantly for families with children: 68% for families with children 4 to 9 years old and 78% for families with children 10 to 14 years old. This indicates that SCIENCE WORLD is a draw for families within the Lower Mainland. In 1994, another study found that of the 312 people surveyed, there was a general awareness of SCIENCE WORLD in the Lower Mainland (Market Reach, 1994). Approximately 75% of people surveyed had visited SCIENCE WORLD and 49% intended to visit if they had not already. In this 1994 study, only 9% said they were not interested in SCIENCE WORLD. These studies show the popularity of SCIENCE WORLD within the Lower Mainland of Vancouver.
People are likely to visit SCIENCE WORLD according to the 1989 study (Marktrend, 1989) because they are interested in science or science exhibits (21%). Of those people who did visit SCIENCE WORLD, 63% thought that hands-on science demonstrations and exhibits were very interesting. In the 1994 study (Market Reach, 1994), 96% of the people surveyed agreed that SCIENCE WORLD was a place for children to learn and 80% thought that SCIENCE WORLD was fun. In the Market Reach (1994) On Site Study, overall 93% of the people surveyed rated their visit as good or outstanding. In the 1989 study (Marktrend, 1989), there were however, approximately 40% of people surveyed who said that they were not interested in science exhibits. These are the people who do not visit SCIENCE WORLD. This number is high and these are the people and their families Outreach hopes to reach.

1.2 Outreach
At SCIENCE WORLD, Outreach means to reach out into the community by travelling programs to the people of British Columbia. The Outreach programs are an extension of those offered within SCIENCE WORLD. In partial fulfillment of the mission to reach people who do not visit SCIENCE WORLD, the Outreach Division of the Education Department was created in 1992. Travelling to the communities of British Columbia characterizes the Outreach Division of SCIENCE WORLD. Outreach sends programs such as the Roadshows, as well as travelling exhibits and hands-on boxes to the schools, community centres, libraries and festivals throughout British Columbia. Regularly scheduled rentals of materials and travelling performances are administered by the Outreach staff.
The term outreach has been used by many other science-oriented organizations in North America in the same way SCIENCE WORLD uses it. In addition, outreach programs travelling from central locations have been in existence for many years. Alexander (1979) points out that outreach, or going out into the communities, has been a new part of museum activities in the last half of the twentieth century, making museums community cultural centers for the community. Even in 1954, the Roberson Centre for the Arts and Sciences at Binghamton, New York "circulated package exhibits designed for classroom use, and [sent] live performances to the schools of the region" (p. 220). The Virginia Museum of Fine Arts established in 1934, has several "art-mobiles" that carry exhibits throughout the state.

Since outreach programs have become better known in the last 20 years, Canadian science centers have created their own outreach programs. The Ontario Science Centre has travelling exhibits and shows in the form of a Science Circus. They also had a travelling classroom program called Science-on-Wheels for many years. These programs are similar to SCIENCE WORLD's Roadshows program that has been running since 1984. They are similar because they transport materials and staff to a variety of communities for the purpose of stimulating interest in and awareness of science. They are also similar because they endeavour to teach interesting science in an innovative and enjoyable way.

The Vancouver Museum had an outreach program called the Museomobile, the H.R. MacMillan Planetarium in Vancouver has Starlab and Community Astronomy outreach programs and the Vancouver Aquarium has an Aquavan program. These programs have some similarities to SCIENCE WORLD's programs as well because they take science materials and staff into the communities of British Columbia to increase science education
and awareness about a variety of science topics. The existence of these programs also shows the interest and demand of science centers, aquaria and planetaria to travel to the people of the area they serve. Many other science centres, museums and informal science education institutions around the world have outreach programs responding to similar needs.

There have been very few tallies made of the outreach programs which exist, but the Cumberland Science Museum did a survey to find out how many science museums in the Southeast of the United States had outreach programs and what kind of programs they offered. According to The Mobile Program Survey conducted by the Cumberland Science Museum in Nashville, Tennessee (Bradshaw, 1988), 28 of the 41 centres surveyed, or 68% had mobile outreach programs. Another 20% of those museums surveyed said that they planned to have mobile outreach programs in the future. Only 12% said that they had no plans to have outreach programs. Therefore, potentially 88% of the museums surveyed will have outreach programs in the future. This shows a trend toward increased outreach programs for the future in the southeastern United States. Even in Vancouver in the past year, SCIENCE WORLD staff have been approached by several other organizations for advice about starting up outreach programs this year (1994).

1.3 Roadshows

Roadshows are described as live science education presentations which travel to schools around British Columbia. These programs encourage audience participation and focus on exciting, fun and interesting science and technology demonstrations. A teacher from SCIENCE WORLD presents the Roadshows in a gymnasium setting to children of various ages. Some of the purposes for the program are to i) show that science can be fun and
interesting, ii) show that science is relevant to everyone's lives - it is all around us; iii) foster positive attitudes about science; iv) show that anyone can be a scientist; v) show that scientists are not necessarily men in white lab coats who wear glasses; vi) introduce interesting science content; vii) demonstrate that science is a process of inquiry; viii) stimulate curiosity and encourage questioning; ix) present positive role models to encourage interest in science and science-oriented careers, x) increase awareness about science and technology; xi) assist students in becoming more scientifically literate.

Teachers in British Columbia schools are the predominant consumers of the Roadshows. They choose from eight different presentations which are designed to cover a specific area of science for a specific age range of students. The schools pay $400 for 3 one-hour presentations in a day. Each presentation can involve up to 100 students per presentation, resulting in a maximum of 300 students participating in the program in one day.

Schools call SCIENCE WORLD to make bookings several months in advance. The programs chosen by the schools vary, but the most frequently selected shows include Arcs and Sparks and the Science Carnival show. Over the past five years, the Roadshows in general, and specifically the Arcs and Sparks show, has been sponsored by B.C. Hydro's PowerSmart programs. As a result of this sponsorship, the content of the show has been about electricity, conserving energy, being Power Smart, and being safe around electricity.

The equipment used in the Arcs and Sparks show is unconventional from a classroom stand-point. For example a Plasma Ball is used. The Plasma Ball is made from a large electrode bathed in air and sealed in a glass dome. When it is turned on, the globe shows ionizing air in the form of lightning-like purple sparks. This piece of equipment is used to
gain the attention of the audience and to demonstrate how a fluorescent light bulb can be
lit up by the electromagnetic field surrounding the Plasma Ball. Children learn some
properties of electricity from this demonstration: electricity cannot be seen or heard, only
the effects of electricity can be detected. In addition, this demonstration shows how little
energy it takes to light up a Power Smart fluorescent bulb.

The other main demonstrations used in the Arcs and Sparks show are the Jacob’s Ladder,
the Tesla Coil, the Van der Graaf Generator, liquid nitrogen and other smaller
demonstrations. Photographs of the first four pieces of equipment can be seen in Appendix
1.1 as Figures 1-4. A full script of the Arcs and Sparks show is provided with the list of
demonstrations used in the Arcs and Sparks show and the Science Carnival show in the
Appendix as well.

The Science Carnival show is designed for the younger students in Kindergarten to Grade
3. It is designed to give them a potpourri of fun science demonstrations whereas the Arcs
and Sparks show is presented only to the older children in Grades 4-12 and focuses on the
single topic of electricity.

Equipment for shows is usually packed into a van, and sent off to a school somewhere in
British Columbia. Sometimes, the equipment is sent by truck and the performers are flown
to a destination. Over the past 6 years almost every school district in British Columbia has
received the Roadshows (216,000 people). This is a testament to the popularity of the
program and interest in the Roadshows.
In order to illuminate the effects of the Roadshows program, this study will focus on the impact on one community from a single set of three Roadshows programs in one day at one school in the Lower Mainland of Vancouver. This study will not be represented as an evaluation of the program's efficacy, rather it will examine the influence of the program in one location. This study will look beyond the events in the gymnasium to the classroom, school and home life of the children who experience the Roadshows and into the community. The presentation that the Grade 5 students attend will be the focus in this study. It is recognized, however that all three Roadshows programs performed at the school may have an influence on the school and community and will therefore, be considered in the study as well.

The purpose of this study is to ascertain if the Roadshows have an impact on the audiences it serves. "Effect", "influence" or "impact" in the context of this study refers to what is recalled, retained or vocalized by the participants in the study about their experiences related to the Roadshows. For the Roadshows participants, it is expected that there will be retention of program content and experiences in the short term (up to 4 weeks). The retention will result in an increase in discussion about science with other people who do not participate in the program. The Roadshows presentations will have an effect on more people in the community than those children and teachers who attend the presentation. These expectations will be examined through the following questions:

1) Do the students who participated in the Roadshows show more interest in science as a result of the Roadshows program?
2) Do the students change their ideas about science following the Roadshows?
3) Do the students ask more science oriented questions following the Roadshows?
4) What conversations and discussions do the Roadshows stimulate?
5) What thoughts do the students have of the Roadshows?
6) Do students remember program content and their Roadshows experiences after 4 weeks?
The impact of the Roadshows will be gauged by the answers to these questions.

Chapter 2 Literature Review

The Roadshows have similarities to many programs in other informal science education institutions. The Roadshows share common goals with other programs, share similar content, are similar in format to the programs of other centres, have similar feedback from participants, and share common methods of presentation. In addition, the Roadshows share similarities to other informal science programs due to the number of years they have been in existence and the number of grades of students with which they work.

There are many science centres around the world and of these, many have outreach programs. However, few studies have been completed on the programs offered to customers. In order to find out what information is available on outreach programs in science centres around North America, a survey was constructed, then conducted by fax and phone (See Appendix 1.2). This survey was designed to gather information on programs similar to the Roadshows. Thanks to the Denver Museum of Natural History for providing their contact list, faxes were sent to many of the large American museums, but the questionnaire targeted Canadian science centres and museums. Twenty museums were faxed or phoned and responses were received from fourteen (70% return). Some subsequent phone calls were made so details could be obtained about programs. This method was fairly successful at collecting unpublished information. To add to this information, descriptions from program brochures were used to assess similarity of
programs to the Roadshows. In addition, personal experience at the Ontario Science Centre, and visits by SCIENCE WORLD staff to the Pacific Science Centre added to the information.

The information about programs in other science centres has been compiled and will be compared to information on the Roadshows program. The details from all sources show that there is a similarity between SCIENCE WORLD's Roadshows program and other science centres' and museums' outreach programs. This information in itself is valuable because it shows the consistency in informal science education. Below is a comparison of the programs and evaluation findings from these other centres.

The Ontario Science Centre, the Pacific Science Centre and SCIENCE WORLD all have had auditorium programs for eight years or more. These organizations have catered to a wide age range of students. The majority of the bookings for these programs are elementary schools, with older grades having the minority of bookings.

2.1 Outreach Program Goals
Because many science centres' outreach programs cater to school audiences, their goals are related to these audiences. The programs are designed to introduce topics to students, to introduce the science centre staff to the schools and to introduce attitudes about science to students. These are some of the goals of the Roadshows. The most important goals of the Roadshows are to increase interest in and awareness of science and technology. The other main goal is to show that science and technology can be fun and interesting.
The Discovery Centre in Halifax, Nova Scotia has a program which travels exhibits and demonstrations. This program has a goal of promoting the awareness of science and technology, reaching people around their province especially in outlying areas and especially reaching youths. They hope to promote the importance of scientific and technological education.

According to a study conducted on the Ontario Science Centre's Science Circus (Gillies, 1981) the purpose of this outreach program was to travel materials to allow people in areas distant from the Ontario Science Centre the opportunity to "rediscover" science while having fun. The Circus was also seen as an extension of the Ontario Science Centre which has the mandate to "stimulate interest in science and technology through greater perceptual awareness and to show visitors that learning can become fun" (p. 2). This mandate is not very different from that of SCIENCE WORLD which is to inspire a greater appreciation of science and technology through the presentation of science exhibitions and demonstrations, informal educational activities and province-wide outreach programs. In order to accomplish these mandates, both SCIENCE WORLD and the Ontario Science Centre Science Circus travel staff to present demonstrations. Participation is encouraged in the demonstrations presented.

Science education and appreciation are a focus for the Pacific Science Centre. Much of the education focus is related to the curriculum set by Washington state. This educational focus is similar to SCIENCE WORLD's, but SCIENCE WORLD does not tie the education focus specifically to the British Columbia government mandated school curriculum. SCIENCE WORLD believes that it should offer an extension to the
curriculum and not be bound to it. Many of the topics used in the Roadshows programs, however, are very compatible with provincially mandated curricula.

Another goal of the Pacific Science Centre is to be a "catalyst for science learning". The centre hopes to "support and encourage the efforts of students and teachers to learn about science" and to increase the impact of their van program. This is done by leaving more materials behind and by training teachers. (Pacific Science Centre Van Program Training Manual, 1991, p. 2). Many of the goals and components of this organization's programs are similar to SCIENCE WORLD's. SCIENCE WORLD has also been trying to increase the impact of the Roadshows by providing more pre-activity and post-activity packages to the schools. In addition, a newer component to the Outreach area at SCIENCE WORLD is the focus on teachers to increase the impact of a visit by SCIENCE WORLD. The workshops are designed to assist teachers in their efforts to learn science and to learn with their students in the classroom. Often after a Roadshows presentation the past two years, teachers' workshops were presented. Now a full teachers' institute for learning science is being offered to teachers in the summer. SCIENCE WORLD believes that if teachers are "turned-on" to science, then they can more effectively excite students about science.

The Museum of Science and Industry in Florida has a program that is similar to the Roadshows. The goals of the Florida centre are to promote scientific inquiry through hands-on activities, to educate and inform teachers of the ease and adaptability of teaching hands-on science and to complement Florida's statewide program (A. Carregal, personal communication, August 9, 1993). A hands-on focus is also a goal of the Roadshows program.
The goals of the programs at Science North are to "provide stimulating learning opportunities and experiences throughout Northern Ontario ... for residents and tourists, which involve people in the relationships between science and technology and everyday life with a Northern emphasis" (N. Chaisson, personal communication, July 29, 1993). The relationship between science and technology is not explored very thoroughly in the Roadshows program, but providing stimulating learning opportunities and relating science and technology to everyday life are both something the Roadshows try to do.

The goals of the Carnegie Science Centre outreach programs are to allow the children to have fun, expose them to a central concept and excite them about science. The program also strives to show the applications of science in every day life. The Carnegie Science Centre staff are less concerned that the children absorb a lot of content (D. Bateman, personal communication, July 11, 1994). These goals are very similar to those of the Roadshows. The least important goal of the Roadshows is to impart content knowledge.

The Exploratorium outreach goals are to extend the learning experience beyond the walls of the Exploratorium and to take their product to community organizations, especially those that are under-represented in the Exploratorium visitor population (personal communication, August 1994). The Roadshows have travelled the province of British Columbia in an endeavour to reach those who do not or cannot visit SCIENCE WORLD in Vancouver.

The main aim of the Australian National Science Centre, the Questacon, is to raise public awareness and understanding of science and technology. "It has set out to make science understandable, interesting, fun and perhaps most important of all, relevant to everyday
life" (Questacon brochure, p. 1). These goals are similar to those of SCIENCE WORLD and the outreach endeavors of many of the other science centres.

A survey of science centre program goals in the Southeastern United States performed by the Cumberland Science Museum found that all science centres included educational services and promotion of their own museums as goals. An average of 68% of those museums surveyed had a goal to service non-museum attendees. While SCIENCE WORLD recognizes that serving non-museum attendees is a function of Outreach, the programs are not generally advertised this way. The Outreach program from SCIENCE WORLD is advertised as showing British Columbians a sample of what SCIENCE WORLD in Vancouver has to offer.

According to the survey by the Cumberland Science Museum, an average of only 4% of the museums had a goal for school outreach, but an average of 40% used schools as their program sites. In contrast, SCIENCE WORLD and the twenty museums surveyed for this study, focus outreach programs on school audiences and use schools as the venues. This could change for SCIENCE WORLD in the future. The whole community could participate in a program at the school.

The Roadshows program is not unique in its endeavour to take informal, hands-on and enjoyable science programs to school children. SCIENCE WORLD is part of a community of science centres which share many goals for outreach. The Roadshows not only share similar goals with other science museums, but also share topics chosen for outreach programs.
2.2 Outreach Program Themes

Electricity is a very common theme amongst science centre auditorium programs. It is one of the most popular themes of the Roadshows programs. The Science Museum of Minnesota's Museum on the Move program focuses on the topic of electricity for older children. A title for one such program is "Electricity (A Shocking Display)". The description of this program includes sparks flying, hair standing on end, and shocks. Discoveries of electricity and demonstrations of devices are used in the program as well. "Students will gain an appreciation for what electricity is, they will explore the properties of charged bodies, and enjoy seeing the push and pull of electrons" (Science Museum of Minnesota program guide, p. 1). These descriptions are very similar to the Roadshows Arcs and Sparks show description. The Arcs and Sparks show uses interesting demonstrations to look at static and current electricity, how dangerous electricity is, how to conserve electricity and be Power Smart. The Power Smart initiative is from B.C. Hydro. It promotes the awareness of energy conservation. SCIENCE WORLD's Arcs and Sparks program is presented for students in Grades 4 and higher due to the complex nature of the topic.

One of the classroom programs the Pacific Science Centre presents is called "Charged Up" and is presented for Kindergarten to Grade 8 students (Pacific Science Centre program guide, p. 2). The program is about electricity, what it is, how it travels, how to generate it and how to convert energy from one form to another. Another set of programs examines magnetism and the relationship between electricity and magnetism. There are many similarities between the ideas in the electricity show at the Pacific Science Centre and the Arcs and Sparks show presented by the Roadshows.
Some of the Oregon Museum of Science and Industry programs are based on physics including energy, matter and forces, and electricity. Some of their programs are partially sponsored by the Oregon Governors Electric Safety Council (Oregon Museum of Science and Industry Outreach brochure 1991-92). This sponsorship and focus on energy and electricity is similar to the Roadshows' BC Hydro sponsorship and focus on energy and electricity.

The Carnegie Science Centre has programs on electricity which are divided up into current electricity and static electricity programs. These two areas of electricity are covered in the Arcs and Sparks show SCIENCE WORLD presents. The contrast between current and static electricity is one of the themes of the Arcs and Sparks show.

Electricity is a common theme amongst travelling science centre programs. In the future it would be interesting to see if the reasoning behind choosing this topic is similar for the institutions mentioned here. SCIENCE WORLD has a goal to focus on relevant natural phenomena. This is one of the reasons SCIENCE WORLD uses electricity as a program theme.

2.3 Outreach Program Formats
The programs presented by science centres around North America not only share similar themes, but also share similar formats and methods of presentation. The formats are usually presentations in an auditorium with large groups of students, numbering one hundred or more. The presentations are enjoyable and educational. They use materials that are interesting and equipment that is not usually used by teachers in the schools to teach science. The presentations are taken to the schools by a van or other large vehicle.
A survey performed by NEON (National Educational Outreach Network, 1992) found that 60% of the 17 outreach programs surveyed had a company van to transport their materials to venues. More than one-third of the programs presented by the institutions in the NEON study presented assembly type programming, most of the rest of the programs were reported as classroom programs and a few were combinations of both types. The centres involved in this survey were those who attended the 1992 Association of Science and Technology Centers conference. The findings from this survey are similar to those found in the Denver Museum of Natural History study. In contrast, however, the Roadshows present more auditorium or assembly type programs than classroom programs.

The Museomobile from the Vancouver Museum resembled the Roadshows in its large auditorium format. The Museum sent vans to schools where they presented programs for children in school auditoriums (L. Bartley, personal communication, August, 1994). This is where the similarity to the Roadshows ends, however. The Museum used stations set up in the gymnasium, to which the children circulated. Forty children were allowed into the gym with 10 children at each of four stations. At the stations the children could handle many of the artifacts brought to the school. The Roadshows encourage the children to handle some of the equipment at the end of the Roadshows, but stations have not been a format tried by the program.

Another American museum which has a travelling school assembly program is the Science Museum of Minnesota. Their program is called Museum on the Move. This program is
45 to 50 minutes long for up to 300 Grade 2 to 6 students. Electricity is the theme for the older students. The younger students have a 35 minute program with different themes than those for the older students (L. Thomas, personal communication, August, 1994). The Minnesota centre's auditorium format and content focus is similar to the Roadshows, but the groups in the Roadshows are smaller in number. One hundred students or fewer are involved in the Roadshows. Roadshows are advertised as an hour long, but shows with a very young audience often end earlier if the children have short attention spans.

Ohio's Centre of Science and Industry, Columbus, has a format for their Outreach program which is quite different from the Roadshows, but similar to other centres. The only similarity to SCIENCE WORLD's program is the assembly introduction presented for students. The introduction is shorter than the Roadshows program, however, being only 15 minutes long. After this introduction the children are divided into groups and circulate to 12 stations. Parent volunteers are trained for an hour in the morning before a presentation to assist with the program (D. Bateman, personal communication, July 11, 1994). These volunteers then work at the stations and five or six students visit each station. About 100 students circulate through the stations and participate in hands-on activities. Some of the stations may be self-guiding and the presenter may circulate around to assist the use of the stations. All stations are supplied by the museum, even the carts to make up the physical structure of the stations. In contrast, the Roadshows do not supply the tables, benches and chairs for the presentation. If these materials are used during the Roadshows for the audience members, the schools are asked to supply them. This request decreases the already large amount of materials being shipped by truck or transported by van for the Roadshows. Another science centre, the Carnegie Science Centre has bags of materials, banners and PVC tubing, so that the transportation is minimized as well (D.
Bateman, personal communication, July 11, 1994). The Roadshows have several crates of materials and one banner to transport, all of which fit into a long passenger van.

The Ontario Science Centre, operated a travelling auditorium program called Science-on-Wheels which travelled staff and materials in a passenger van to schools. The program was similar to those offered in-house at the Ontario Science Centre in Toronto and resembled the Roadshows as well. The auditorium format was similar to the Roadshows. The materials were more easily transportable than the Roadshows equipment, however. The equipment for the Science-on-Wheels program usually fit into one box per show unlike the Roadshows electrical equipment which travel in several large crates. In fact, the Science-on-Wheels program usually shared its equipment with the in-house programs at the Ontario Science Centre resulting in shows having even less equipment than was sometimes needed. Most of the time this sharing of equipment has been avoided by the Roadshows so that the staff have the freedom to present any demonstrations which are part of the show. The format, method of presentation and audience were essentially the same for Science-on-Wheels (personal experience) and the Roadshows.

The Monterey Bay Aquarium has an outreach program called the Aquaravan which also has some similarities to the Roadshows in format. The Aquarium's programs are classroom and assembly-oriented. There are five different themes which are offered for children in Kindergarten to Grade 6 (P. Rutowski, personal communication, August, 1994). The Roadshows assembly programs had six different themes presented for children in Kindergarten to Grade 12, so the Roadshows are wider in audience scope. All the Roadshows are considered an introduction to topics which the teachers should follow-up with in the classroom, but the Monterey Bay Aquarium programs use their assembly
programs as an introduction to their own labs. There is more guaranteed follow through with the topics from the Aquarium than from SCIENCE WORLD in this case. The style of the Aquarium's assembly program is also different from the Roadshows because theirs are theatrical in nature. The Roadshows are entertaining, but not written as a play. The Aquarium programs are one half hour long for up to 200 children at one time. After the assembly, the children divide up into groups of 32 for the labs of 45 minutes. There are also 60 minute classroom programs. The Aquarium travels programs with water and animals into schools in two counties in California. The Roadshows have rarely travelled live animals, but travel the whole province of British Columbia.

The Pacific Science Centre has an extensive outreach program which includes presentations to groups in schools. The Pacific Science Centre's overall outreach program has been running since 1973 (Pacific Science Centre program guide, personal communication, D. Calderon, August, 1993). Their program is a touring van program similar to the Roadshows. As of 1991, the Seattle based van program had been running for 12 years. One of the travelling outreach programs is called Science on Wheels. There is an assembly component as well as classroom lessons and exhibits in this program. One of the packages is called Physics on Wheels. It starts off with a 30 minute auditorium introductory program just as the Monterey Aquarium does. Students, teachers and other adults are encouraged to attend this light-hearted program that includes some role-playing. Later, classes are divided up into 32 student groups for 45 minutes. These classroom sessions are focused on one specific topic. The program is very staff intensive, however and this is one of the reasons that SCIENCE WORLD has not departed to this format for the Roadshows.
The Carnegie Science Centre in Pittsburgh, Pennsylvania has auditorium programs where 175 children participate at one time. The auditorium programs from this centre are more popular than their classroom programs due to pricing structure (D. Bateman, personal communication, July 11, 1994). The Roadshows, for a few years, also offered classroom workshops, but the auditorium programs were more popular. It is suspected that this was also due to the pricing structure of the programs. More children could be accommodated in the auditorium presentations from SCIENCE WORLD making these programs more cost effective.

The Carnegie programs are presented by certified teachers for Kindergarten children and older grades. In 1993 and 1994, only certified teachers were presenting Roadshows due to the sponsorship by the British Columbia Ministry of Education. Previous to that, permanent SCIENCE WORLD teachers and trained performers from the Guest Services staff presented the Roadshows. Teachers have been involved in the writing of the programs and training staff to present these shows on the road since they began in the early 1980's. At the Carnegie centre, the maximum spread in a group of students for their programs is three grades. This maximum three grade spread for presentations is also a criteria for the Roadshows. With this requirement, the performer has a better chance to prepare and present the information appropriately for the age level of the students in the audience.

The Science Museum of Minnesota also has a program that has an auditorium component about electricity, but the time frame of the program is larger than the Roadshows. In this program, the Museum staff are in a school for a week visiting classrooms. The students learn about static, magnetism and current. The program is called a "residency" program
where extended visits are the pattern (Museum of Minnesota program guide). This format most resembles another program run from SCIENCE WORLD called the Scientists & Innovators in the Schools program. With this program, scientists go into classrooms and sometimes visit a school for extended periods of time. While it is true that the Roadshows are sometimes in schools for more than a day, the staff usually sees different children during each show. Sometimes during the Roadshows children from other schools visit the school where the presentations are taking place as well, warranting SCIENCE WORLD to visit the school for several days. The lengthy visit with the same children has not been a part of the Roadshows program,

Fermilab or the Fermi National Accelerator Laboratory in Batavia, Illinois does research in high energy physics to answer the question "how does the universe work?" (Lederman, 1987, p. 111). It also has a program similar to the Roadshows, but it is offered in a limited time frame, not all school year-long as the Roadshows are. The Fermilab program is designed as a component of their Science and Technology Week celebrations. It is a 'science magic show' for elementary students. Not all students from one school attend, however. There is a selection process where two students in Grades 3 to 6 are chosen per school and they attend the program with their parents. Rarely is there an occasion where all the students in a school cannot attend a Roadshows presentation. If, in fact, the school cannot fit all the children into the programs then the school has to decide that only certain grades of students will attend the Roadshows. This is not an optimal situation for the school or SCIENCE WORLD because there are students left out of the excitement. This situation is not common, fortunately.
With the Fermilab program, the selected students travel to the lab and are entertained by high school science teachers about the "wonder and magic of science and then they are given a kit with information from the show to share with other children in their classes back at school" (Lederman, 1987, p. 117). With the Roadshows, the only time children need to travel is if the children are seeing the show at another school in their area. From the Roadshows perspective, it is more efficient within a school district to have the students travel to the school where the Roadshows are set-up. The Lab uses the term outreach for their programs because they are reaching into the community. The community, however travels to them, unlike the outreach programs of many science centres. Therefore, the format and description of the Fermilab program is not as similar to the Roadshows as first appeared.

The Oregon Museum of Science and Industry has a large Outreach component which travels programs from the centre in Portland. They have classroom programs of one and two hours in length, exhibits, a portable planetarium and 10 different assembly programs that they travel. Their assembly programs are similar in format to the Roadshows. They present programs in a gymnasium for more than 100 students. The programs use interesting and fun science demonstrations. Many of the themes of their programs are similar to the Roadshows and the style of the program is also similar. They use entertaining and exciting demonstrations to teach science concepts. Their programs are often dramatic and many of the demonstrations are similar to those used by SCIENCE WORLD (personal experience, ASTC Conference, 1994).

The H.R. MacMillan Planetarium in Vancouver also has outreach programs which travel around the province of British Columbia. These include a portable telescope and a Starlab
that simulates a planetarium (personal experience). These programs travel extensively, but the experiences do not resemble those supplied by the Roadshows in format or content. The large extent to which they travel British Columbia provides the only known parallel to the Roadshows.

Science North's outreach programs travel from Sudbury around Northern Ontario. Their Discover Dinosaurs program is presented in a school gymnasium for 60-75 minutes. The school groups who attend the programs are smaller than those in the Roadshows and eight tables of materials are used instead of demonstrations for large groups. Science North also has other science programs on various topics based on Science North's in-house topics (N. Chaisson, personal communication, July, 29, 1993).

The Exploratorium in San Francisco has a children's outreach program that is similar in minor aspects to the format of the Roadshows. The Exploratorium presents programs using four staff for groups of between 10 and 30 people. This is a high staff to participant ratio. The Roadshows had two years where four staff were presenting the programs, but each staff presented one program for 100 students or fewer (personal communication, August, 1984). Occasionally, two staff would present a show together, especially during training. Infrequently, one or two staff would also present classroom workshops for groups of 30 or fewer students on topics such as Making Tracks or Mirror Mirror. These workshops allowed each child to participate and the staff to student ratio was higher in these classroom programs. As mentioned earlier, they were not booked frequently, however.
The Exploratorium's programs are all hands-on workshops where people build things. This program has been running for about 6 years as a half-time program. This year (1994) they will be making it into a full-time program. There is a great deal of demand for their program and it is so popular that people want them to make repeat visits (personal communication, August, 1994). This type of demand has also occurred with the Roadshows, but only for the auditorium programs. The Exploratorium travels to many sites in the San Francisco Bay area, Richmond, and Oakland. They do not service the entire state. In the future, the Exploratorium hopes to focus their energies on six or seven sites intensively instead of being drawn to hundreds of sites around their area. This concept has been proposed for the Roadshows as well.

From surveying science centres, it is evident that there is little variation in program format. Many centres offer auditorium presentations. Some of these have stations and some do not. The number of children attending these programs varies from 30 to 300.

2.4 Outreach Program Feedback

Feedback from auditorium programs at various science centres show similarities. Feedback from the Roadshows has been mostly positive. Teachers like the programs because the shows are participatory in nature, there are a variety of topics covered, the approach the staff take with the students is positive and the pace of the program is appropriate. On the evaluation forms given out to teachers (see Appendix 1.3), they rated the performers well on their enthusiasm, presentation style and ability to explain main points. Teachers often commented that special students had their needs met by the Roadshows staff. The teachers thought that the programs were appropriate for their students and rated the Roadshows highly for educational content and student interaction.
The Travelling Teacher Program from the Vancouver Aquarium took animals, water and staff into schools until late 1994 and received positive feedback about their program as well (D. Gibbs, personal communication, August, 1994). Because of their presence in the schools and the fact that they travelled around British Columbia by road, the Travelling Teacher program was similar to the Roadshows. The Vancouver Aquarium received feedback from teachers saying they found the program to be valuable. Teachers also said that it was an advantage to the schools that the Aquarium travelled to the them instead of travelling the students to the Aquarium. This advantage has been vocalized numerous times about the Roadshows programs as well. Often buses are difficult to arrange for schools and the cost of transporting students into Vancouver is prohibitive. It is possible that outreach is becoming more popular because of the mounting difficulties for teachers in arranging field trips to city centres from outlying areas. The Roadshows have been attempting to serve these people who have not been able to come to Vancouver to visit SCIENCE WORLD.

The Oregon Museum of Science and Industry has been collecting evaluations on their assembly programs for approximately 10 years and has found that the responses to their programs are mostly positive as well. About 80% of their surveys rated their programs at the top of the scale (6/6). Only about 10% of the respondents gave a 5/6 and about 5% gave lower marks for the program. This was mostly because it was not what they expected. The questions on the questionnaires ranged from what people thought about the choice of topics, if the program matched their expectations, if the program could be made better and if the concepts were usable for the teacher. Comments received were those
from both children and teachers. Teachers' comments included "the best ever", "fantastic" and "thank you for visiting" (S. Robertson, personal communication, July, 1994).

A study performed by the Oregon Department of Education in 1992 had teachers interview students for two weeks after the Oregon Museum of Science and Industry's assembly program had been to schools. The study found that 87% to 92% of students both understood the material in the programs and retained the science concepts for up to 2 weeks. Content was the focus of this study. (S. Robertson, personal communication, July, 1994).

The Monterey Bay Aquarium uses evaluation forms to collect information on their programs. The results show that teachers have high praise for the programs. There is little constructive criticism about the programs, however. The question categories on the evaluations include students' interest level in the program, relevance to the students, appropriateness of the information level, rating of the instructor and ability of the instructor to keep the children's attention. The results showed that the majority of the participants gave high marks to these categories and the program was meeting people's expectations (P. Rutowski, personal communication, July, 1994). Most of the questions on the Aquarium's questionnaire resembled those used for the informal Roadshows evaluation forms. The Aquarium found the response to the questions was generally positive with few concrete suggestions for change. SCIENCE WORLD has had similar results to its questionnaires. SCIENCE WORLD should, however add to its evaluations the question "does the program meet your expectations?".
Science North gives out evaluations on a regular basis to participants in their outreach presentations. From these evaluations, letters and drawings, they have received information about their programs. Many people in Northern Ontario think that Science North's programs provide a community benefit and are excellent experiences for children (N. Chaisson, personal communication, July, 29, 1993). These types of comments have been heard about the Roadshows as well while in British Columbia communities.

Evaluations forms completed by teachers on the programs from the Science Museum of Minnesota show positive feedback about the program content and the presenter. Teachers liked the interaction and student participation in the programs. They also liked the fact that the programs kept students' interest and that the demonstrations were those teachers may not be able to present themselves. The teachers were pleasantly surprised that the centre was able to combine fun and learning with such a large group of students. Content learning is one of the objectives of the program, and according to the teachers, the program meets this objective. The electricity program was evaluated for objectives by teachers and their opinion was that it should be presented for grades older than Grade 1 or 2 due to the complexity of the concepts. The program is, therefore, now presented for the older students (Museum on the Move brochure and L. Thomas, personal communication, November, 1994). Also due to the complexity, electricity concepts in the Roadshows are presented mostly in programs for older students.

At the Carnegie Science Centre the evaluations show that the participation aspect of their outreach program is what the teachers like the most. In addition, the shows are rated highly for their ability to educate and entertain the students. No formal evaluations have been performed on the program, but the positive feedback from the informal
questionnaires and the constant demand from their school market has told the Carnegie Science Centre that they are doing the right thing in their programming (D. Bateman, personal communication, July 11, 1994). The high demand and many informal evaluations that the Roadshows have received have also given SCIENCE WORLD the impression that the Roadshows are a good product.

The Museum of Science and Industry in Florida has received feedback in the form of letters, phone calls, drawings and media write-ups which "indicate that schools and groups find the program both entertaining as well as educational" (A. Carregal, personal communication, August 9, 1993). SCIENCE WORLD also receives feedback in the form of letters, drawings, media write ups and phone calls for the Roadshows. The Museum of Science and Industry found that their program is "a useful adjunct to the science curriculum" (A. Carregal, personal communication, August 9, 1993). SCIENCE WORLD also believes that the Roadshows are well designed to supplement the school curriculum in British Columbia.

The Monterey Bay Aquarium has performed an analysis of their evaluations confirming that their outreach programs are successful. (P. Rutowski, personal communication, July, 1994). A study was performed on the evaluation results and questions asked. The study found that the survey questions did not encourage critique and that several of the questions were not answered. It was also suggested that the questions should be more specific to receive more relevant information. It is suspected that many museum evaluations suffer this plight. SCIENCE WORLD's evaluations, however are fairly specific and do imply the goals of the program in the questioning. Most of the questions are answered on the SCIENCE WORLD questionnaires.
The Vancouver Museum issued evaluations to the teachers whose students participated in their outreach programs. The teachers were asked to return the evaluations the day of the program, guaranteeing almost 100% return of the questionnaires. Feedback was predictably good. The questionnaires asked if the children learned things from the program and if they enjoyed it. Generally high ratings were given for these categories (L. Bartley, personal communication, August, 1994). Similar reactions have been received from teachers about the Roadshows.

Criticisms were few on the Museum's evaluations, but teachers thought there were too few children involved in the program and too much physical space was taken up by the program. Occasionally, the Roadshows also received this criticism. Some schools where the Roadshows have visited found it a problem to have their gym time suspended while the Roadshows took place. In addition, some schools were frustrated with the Roadshows accommodating only 300 students in one day when they may have had more students in the school. These comments are not surprising, however and fit the trend of evaluations received by other informal science education facilities.

The Ontario Science Centre is the only Canadian museum found to have a formal study performed on its informal science education outreach programs. An evaluation was performed on the Science Circus (Gillies, 1981). The Circus, provides comparison to the Roadshows because it was an extensive travelling science education program which involved some demonstrations. The demonstrations performed were similar to the Roadshows, but shorter in duration (personal experience). However, the Circus demonstrations were performed in public settings in contrast to the Roadshows which are
almost always performed in school gymnasiums. Occasionally the Roadshows have been presented in malls and other venues, but most of the evaluations have been collected from school events. Often the Circus was set up in a town arena and the local school children visited the arena and the Circus.

The Ontario Science Centre's Science-on-Wheels program most resembled the Roadshows, however, no evaluation has been performed on this program. It is unfortunate that many of the questions asked about the Circus are not directly relevant to this study, however some valuable lessons were learned about this type of program from the study.

The Ontario Science Centre Science Circus was studied when it visited the Science Museum in London, England. The Head of Education at the Science Museum, Dr. Anthony Wilson, said he learned some lessons from the Circus. One of the lessons was that an objective of the Circus was for the participants to have fun. The visitors were to have a good time and the materials used should be enjoyable because "the educational merit might follow" (Pizzey, 1987, p. 26). The staff of the Circus thought that teaching science was not the primary concern of the circus because if it were, there would be no guarantee of fun. The Roadshows also strive to engage the children in a fun experience. SCIENCE WORLD has always tried to make the Roadshows demonstrations as enjoyable as possible for the audience while providing educational content at the same time. The difference here is that the content of the programs in the Roadshows is designed to be both educational and enjoyable, not one at the exclusion of the other. The evaluations of the Roadshows indicate that the program is successful at doing both.
The study performed on the Circus also found that the people who visited the Circus enjoyed themselves and the teachers thought it was worthwhile. These responses are very similar to reactions to other science centre programs such as the Roadshows. However, because the Circus had many exhibits, it is not clear in the evaluation if the responses were about the exhibits and the demonstrations together.

Evaluations from informal science education programs would be more useful if the programs' descriptions, goals and evaluation results were compiled and published by host institutions. Many of the evaluation results discussed here were interpreted by science centre staff without having a report to read. In addition, this information was only available by individually contacting each institution. The evaluation forms themselves would also be more useful if they had an added statement about the goals of the programs so that there is a context within which the teachers could base their comments, suggestions and criticisms. In many cases, the teachers may have thought they were ill-equipped to give constructive criticism on a program of which they knew little. Encouraging constructive criticism from the teachers could also result in more comments from the teachers. While positive evaluations are valuable, constructive criticism stimulates change and is valuable to the performers, sponsors and supervisors of an informal science education program such as the Roadshows. Constructive criticism can be more thoughtful if the goals of a program are understood.

There have been several informal surveys performed on science centre outreach programs. These surveys indicate trends and a few specifics about what is working in informal science education. They also provide a wider context in which to view the Roadshows. The Roadshows program is only one of many outreach programs offered in North
America. A survey of the Southeastern United States showed 68% of centres surveyed had outreach programs (Bradshaw, 1988). This indicates how many outreach programs there were in 1988 in one localized area. Potentially there are many more mobile outreach programs around North America in 1994.

The Denver Museum of Natural History also performed a survey of museums in the United States. The results of the study showed that schools were the primary customers of outreach programs. Next most common were community centres, civic groups, businesses and libraries, hospitals, senior's groups, and special education groups (N. Bovee, personal communication, July 12, 1994). The Roadshows target schools, but perform shows in many of the other types of sites named in the Denver survey as well. Most of the outreach programs surveyed by the Denver centre had a style of delivery that was dependent on a company van or truck (about 93%), next most common was the use of staff vehicles. SCIENCE WORLD uses both transport truck and company van for the Roadshows.

Most of the museums in the survey served 5-50,000 people, similar to the numbers served by SCIENCE WORLD's Roadshows. Over the past 6 years, the Roadshows have served over 216,000 people. Most of the Outreach programs surveyed by Denver charged a fee of between $300 and $400, but almost as many were free or charged more or less. The Roadshows charged $400 per day in 1992, 1993 and 1994.

The National Educational Outreach Network surveyed 17 organizations and found that the average charge for programs was only $173, lower than the $300 to $400 range of the other study and lower than the Roadshows fee (D. Bateman, personal communication, July 11, 1994).
These different surveys highlight the fact that geographically separated outreach programs can be similar. The contents, goals and methods are all very much alike. The key elements to these successful programs appear to be participation, fun and learning. The programs are well received because the format is both educational and entertaining. Considering there is very little literature explaining the methods and few opportunities for staff at various science centres to discuss their programs together (due to lack of funding or time), it is interesting that there is such a similarity in the questionnaire results from various places. Bateman at the Carnegie Science Centre remarked that the similarity probably indicates a successful formula for programs and that the markets are also producing demands for these successful formulas (personal communication July 11, 1994) (see Appendix 1.4 for all centres contacted).

2.5 Previous Roadshows Program Study

It is valuable to be able to compare the similarities between the Roadshows and programs from other science centres because comparisons between programs are lacking in the literature. In addition, there had never been a study on the Roadshows until 1994. In early 1994, a study was required by the sponsors of the Roadshows program in order to find out if the program was attaining its goals. The evaluation was performed by EDUCOM, a contracted external evaluator, and the study used quantitative methodologies. The study provided answers to questions about teacher and student satisfaction with the program and student attitudes toward science. The results of this study will be considered here. The study is one of the first quantitative studies performed on a travelling science show from a science centre, and it is also the first formalized study performed on the Roadshows. The
questions asked in this quantitative study, however are different from those asked by the current qualitative study. Therefore, comparison between the two studies are limited.

There were two main areas of findings in the EDUCOM (1994) study. These were teachers' opinions about the Roadshows, and the student attitudes before and after the presentations. The sample sizes were 1000 students and 54 teachers. The evaluations were performed within 4 weeks of the Roadshows presentations. "Teacher responses to the key aspects of the program [were] overwhelmingly positive" (p. 8). Seventy percent of the teachers thought the "experiments were relevant to their [teachers'] everyday life" (p. 9), 70% "thought that they were more aware of the importance of science and technology as a result of the SCIENCE WORLD program" (p. 8), 80% "believed that the demonstrators were able to communicate that science is a way of thinking - a process" (p. 8), 89% thought that "science concepts were clearly explained" (p. 8) and 96% of the teachers "believed that the presentation was suitable to the age of the students" (p. 8). Eighty-nine percent of the teachers thought that the students were very much involved and active in the presentation. Seventy-one percent of the teachers agreed with the statement that the "students' attitude toward science ha[d] become more positive" (p. 11). Ninety-eight percent of the teachers "would recommend the SCIENCE WORLD program to other schools" (p. 9) and 100% "were pleased that they and their students participated in the program" (EDUCOM, 1994, p.9).

Students participated in pre-Roadshows interviews and post-Roadshows interviews. The purpose was to find out if there were changes in their attitudes toward science. The results showed that there was no substantial gain in positive attitude toward science for either primary or intermediate students (EDUCOM, 1994). Both primary and intermediate
students showed positive pre-Roadshows scores on questions such as "science is fun", "we all depend on science", "I am curious about how things happen", "I like to figure out why things happen", and "I feel good about science". It was also determined that "gender [did] not play an important role in student attitude change" (EDUCOM, 1994, p. 15). These are the only conclusions relevant to this study.

In summary, the teachers showed satisfaction with the program and there was no obvious conclusion about the children's satisfaction with the program or an obvious change in attitude about science shown by the children.

This formal evaluation and the previously discussed information, unpublished works and reports have provided new information about travelling science centre performances. This cursory look at the information available has given a context in which to place this qualitative study, but there is an even broader context which can also provide some illumination on the realm of informal science education.

2.6 Science Education: Where Science Centres Fit
Science centres fit into a larger context of museums. The museums community is larger than the science centre community and therefore provides a larger perspective. Museums, are researching their contributions to science education even more than are science centres. Patterns have emerged in the museum education research which help in the understanding of science centres' role in educating people about science

Two main themes in the literature have emerged as the most relevant to the study of the Roadshows. These two areas focus on some of the shortcomings in the traditional science
education system. They are i) how teachers are currently teaching science in the school system and ii) what students need in order to be able to learn science. These issues are relevant to the structure and function of the Roadshows.

The literature points to a problem with the way that science is being taught (Cajete, 1988; Helgeson, 1988; Science Council of Canada, 1984). Many teachers, especially at the elementary level, have an insecurity about teaching science (personal experience presenting teachers' workshops). This can lead to science being a low priority subject in the classroom. In addition, the way teachers teach science may be the way they learned it. They may have learned science in a way that caused them to not like it as students themselves. The science they learned may have been only fact driven and quantitative with no room for uncertainty, true experimentation or excitement. The teachers may have learned science in an environment where closed-ended questions were the only ones asked and there were always single right answers to these questions. This may have been a negative learning experience for them and may, therefore be the reason they do not want to teach science themselves.

"Science is rarely taught adequately (if at all) in elementary schools across [Canada]" (Science Council of Canada, 1984, p. 10). Coverage of science topics in schools is poor. Students are not becoming more aware of science and technology issues because the subjects and issues are not being taught. Helgeson (1988) discusses data from elementary science educators and states that there is a low level of coverage of science topics. This may be due to the "abstract nature" of some sciences according to that author (p. 1). It is possible that the teachers who do not have the expertise are shying away from teaching the
sciences in their elementary classrooms. This results in students receiving little exposure to science in their elementary school years.

Helgeson (1988) reveals that knowledge, comprehension, skills and attitudes were rated in this priority order by teachers. "It appears from these data that learning science is still heavily dependent on the ability to recall specific pieces of information" (Helgeson, 1988, p. 2). The emphasis still lies on gleaning science facts. If the children are expected to "glean" scientific facts then teachers believe that they too need to know the scientific facts themselves in order to teach science.

Teachers' insecurity about scientific content is one of the reasons that the Roadshows are very popular with teachers. The programs are booked most often in elementary schools where the teachers usually do not have science degrees. When asked if they teach science in their classrooms, many of the teachers who book the Roadshows programs say no, although the number of yes answers is increasing. Therefore, some of the only science that these teachers' students may experience is through the Roadshows. The Roadshows come with science equipment, trained science teachers and facts. The teachers may, therefore be assuming that the Roadshows come with experts and all the scientific content a child would ever need to know. The teachers need to be told that the Roadshows teachers are not experts, but rather presenters of some basic science principles, questions and processes. This may be difficult because the SCIENCE WORLD staff do know more science content than many elementary teachers. Perhaps if the Roadshows emphasis on process is highlighted in contrast to a focus on content, teachers will not expect their students to leave the Roadshows with many scientific facts as is sometimes the case (personal experience). It is hoped that the teachers will see that there are other ways to
teach science, than to focus just on the facts. In addition, the Roadshows program stimulates the excitement in their students about science. If the teachers can see the importance in stimulating curiosity and excitement in students without a lot of facts, then the Roadshows have provided a valuable experience.

In addition to being exciting and thought provoking, science can be viewed as a process of inquiry. In the education system, teachers should not be expected to have all the answers, but rather be willing to explore an idea with their students. However, teachers still think that they must have a firm background in the subject in order to teach it (personal experience). According to Helgeson (1988), teachers of Grade 5 students rated "science inquiry - observing and measuring" (p. 2), as the highest instructional objective. Teachers recognize that science inquiry is an important goal. In addition, these "basic inquiry skills are emphasized heavily at all levels" of curriculum (Helgeson, 1988, p. 3), but getting it taught well is another issue. Inquiry does not necessarily get taught in school just because it is in the curriculum or because the teachers think it is important. The teachers need to believe that they are able to teach it and they want to teach it. Cajete (1988) believes that motivation is a two way street, that students and teachers alike must be involved in the process of learning.

From Helgeson's 1988 study it appears that inquiry is not dealt with on a concrete level with teachers and perhaps more teacher training on methods of using inquiry learning in the classroom are in order. According to the Science Council of Canada (1984), "teachers complain about the lack or ineffectiveness of inservice programs for their own development" (p. 10). This inservice training is another area where SCIENCE WORLD's Outreach programs are excelling. Teacher workshops on the process of science inquiry are
being presented by SCIENCE WORLD and the programs are meeting positive responses from teachers. The teachers still think that they need the facts (and they do need some), but the concept of discovering the answer with their students is a new one for them. It is a shift for teachers to not be the expert all the time. Increased exposure to science and the process of science through the workshops and Roadshows may help teachers see the relevance of this change in teaching style. The benefit of this revelation may be better science teaching and better science learning in the classroom.

According to Lisowski (1985), one method that has worked well to increase science education through the schools is provocative, open-ended questioning. Results have shown that students often take the discussions from these questions out of the classroom with them. Open ended activities are also recommended as a way of bringing technology and society issues into the schools. Asking the audience open-ended questions and using provocative activities that stimulate open-ended questions are techniques used by the Roadshows to encourage thought about science. Open-ended questions in the Roadshows have been seen to stimulate discussion about science beyond the classroom (personal experience). Children have been overheard talk to parents, teachers and peers after the Roadshows performances about the demonstrations. This indicates that the Roadshows are stimulating discussion after the one hour presentations. The children show interest in the science from the Roadshows and are enthusiastic when talking about it. These discussions have the potential to increase science education according to Lisowski (1985). If teachers learn how to ask these open-ended questions, then perhaps they would be assisting their students in learning science both inside and outside the classroom.
Another area that science educators should be concerned about is sex equity in science education. The Science Council of Canada (1984) states that many girls still do not consider science careers as viable options for them, and so do not choose science courses. Labour Canada (1986) has found the same problem. Helgeson (1988) found that both the 1970 and the 1986 scores of boys and girls in science showed that there were differences in the scores that girls and boys received in science - with the boys obtaining higher scores than the girls. Not only has the gap between boys and girls scores in science not changed greatly, but there also can be seen a widening of the scores between boys and girls as they progress from elementary to secondary grades. There have been numerous recent studies on this issue and the discussion is still very divided about how to deal with the problem. Awareness of the issue is the first step and now the Ministry of Education in Ontario has come up with several steps to help teachers concretely deal with this sensitive and complex issue (Science Council of Canada, 1982).

One way the Roadshows deal with this issue of sex equity in science is to have female role models for all the students and teachers to see. The female teachers use all the equipment with skill and confidence. Some of these teachers have science degrees and some do not. It is important to elementary teachers to know that science attracts both men and women and that not all SCIENCE WORLD employees are those with science degrees. After the Roadshows, there is often an opportunity for the SCIENCE WORLD staff to discuss their background with the staff of the schools visited. This way the teachers in the schools can see that even without a science background both women and men can teach science and teach it well.
Both the male and female Roadshows teachers are very careful to use examples that are non-sexist during the shows and encourage and choose both male and female volunteers from the audience. Both boys and girls are encouraged equally to ask and answer questions during the programs as well. When teaching little children, sometimes the pieces of technology in the shows are anthropomorphized and the Roadshows performers try to use both female and male names for the pieces of equipment. By modeling these non-sexist science teaching techniques, it is hoped that both the students and the teachers in the audiences will benefit. It is hoped that science is well portrayed as both a male and female endeavor, relevant to all their lives. These methods are the only ones, however that are used during the Roadshows to address the issue of sex equity in science education. There is little information on the impact of the Roadshows in relation to gender equity.

Gender equity in the science classroom is being recognized as important. With this change, there will need to be more support for teachers to learn how they can try to teach in a way that is equitable for both sexes. There will be controversies about what this type of teaching will look like, but increasing awareness about gender equity is the first step. The Roadshows may be able to assist in increasing awareness about gender equity in science education.

Another area which can affect the teaching of science is the linguistic abilities of students. Linguistic differences and difficulties for students "can add to the problems which they encounter in science and math especially if the student comes from a predominately [non-english] language-speaking background", "consequently, learning science or math becomes not only a problem of acquiring new words but also one which requires learning an entire specialized language" (Cajete, 1988, p. 2). Our ever changing multicultural
society in Canada provides an environment in the schools where language is an issue in all subject areas. For children with language difficulties, science also presents an added challenge due to the vocabulary specific to this area of study.

The Roadshows teachers recognize that language may be a barrier in their presentations. To help overcome this problem, the Roadshows teachers are very animated. They use body language, facial expressions and hand signs to contribute to the understanding of the verbal messages. When explaining information to volunteers, the Roadshows teachers always check for the volunteer's understanding before proceeding, by asking them questions. SCIENCE WORLD is also fortunate to have had some multilingual teachers and teachers who have worked with some special needs children. These teachers are then able to use their skills during a presentation where necessary. This is especially valuable when explaining safety to volunteers. Usually teachers in the school visited by the Roadshows tell the Roadshows teachers if there are students with special needs or language difficulties. This advance information is used to modify the program to accommodate those needs where possible. If the majority of the students have English as a second language, then the program is presented at a slower pace with a simpler vocabulary. More hand signs are used to help explain what is happening in the show and fewer concepts are covered. If the children in the audience have hearing aids, the Roadshows performer will wear the companion unit for the hearing aid to assist that child, children with pace makers are asked to sit at the back of the gym so that the electrical equipment will not affect the pace maker. These are the most common accommodations that are made for children with these needs.
While teachers in the classroom often have some background in helping children with special needs or English as a second language, they may not have enough training to use these skills in relation to a subject area they are also unfamiliar with. Support for teachers in the form of training will help teachers become more comfortable tackling the challenge of science in their classroom along with the many needs of their students. While teacher training and exposure to new teaching styles are important, it is equally important what priorities teachers set for their students. Helgeson (1988) uncovered information about teachers priorities and found that teachers rated attitudes about science below knowledge, comprehension and skills. This indicates that some teachers believe that students' attitudes about science and technology are the lowest priority when it comes to instructional objectives. The Roadshows, on the other hand, address attitudes about science as one of the highest instructional objectives. One way that the Roadshows address science attitudes is to present positive role models. The Roadshows teachers demonstrate that they like science and that science is fun. The teachers allow the students to be noisy and enthused about the science they see. This is an attempt to break the stereotypical image that science is boring.

Teachers in the schools need to see that positive attitudes about science are important in order for their students to want to learn science. Positive attitudes can translate into motivation to learn. Students need to have motivation to learn science. Appropriate teaching styles can help students become motivated and hence more easily learn science. Teachers can help students enjoy science and see reasons to learn science by providing relevant examples of science at work.
According to the Science Council of Canada (1984), students who are enthusiastic about science and have high marks, complain that there is no challenge at school. This indicates that even those motivated students with a good attitude about science, may be turned off science. Without more attention paid to science in the schools, these students will lose their interest in science. Those students who are not enthusiastic about science can become even less interested in science if motivation to learn science is not addressed.

Maintaining motivation in students is discussed in the literature by Cajete (1988). He describes problems that must be overcome in the educational system so that American Indian students will be motivated in science and math, but his ideas could be applied to any students. Students of all ethnic backgrounds could be avoiding science because of conflicts between home and school about school's purpose and importance (Cajete, 1988). This problem exists in all schools to a greater or lesser degree depending upon the population from which the student body is drawn.

It is difficult for the Roadshows to address conflict between home and school, however, some attempts are made in the program to address this type of conflict. These efforts are i) to encourage the students to stay in school, ii) to encourage the students to tell their parents about what they have seen and iii) to encourage the students to work with their parents when doing science experiments. SCIENCE WORLD hopes that these methods stimulate the dialogue between parents and children about school and science. The Roadshows teachers also encourage the schools to involve the parents with the presentations. The schools can have the parents volunteer to help set the program up or have the parent's advisory committee help to pay for the program. It is hoped that this type of encouragement will increase the involvement parents have with their children's science
thus decreasing potential conflict between home and school and increasing student motivation to learn science.

Motivation is not only limited by home-school conflicts, but can also be limited by the learning styles of the students. Students are recognized as "having unique learning characteristics by which they perceive and process information" (Cajete, 1988, p. 1). Only one approach to teaching science will certainly not appeal to all learners. There are learning styles which reflect the way that children are used to learning at home. These should be considered when teaching science according to Cajete (1988). Story telling, art, practical example and experiential learning are techniques that many children would be familiar with outside the school. "These modalities should receive serious consideration for use in enhancing motivation in science and math" (Cajete, 1988, p. 2).

The Roadshows use several different methods to motivate students to learn science. The Roadshows teachers use a teaching style which appeals to many learning styles. The teachers often tell stories, use practical examples and let the children experience natural phenomenon for themselves as Cajete recommends.

The Roadshows use many experiential teaching techniques in the presentations. Many audiences members are asked to participate in the program. Questions are asked of the group and polls are taken of opinions to involve the audience. Audience members are asked to share ideas with neighbours and they are also asked to participate as a group by making sounds or experimenting using their hands while sitting. These methods are used to try to address the variety of learning needs in a large group and to try to have as many audience members physically and mentally participating in the program as possible. By the
enthusiasm exhibited during the programs, the indication is that the children have fun
during the show and that they are involved. This experience may be motivating for the
students.

Blosser (1990) says that learners should be involved in programs. Many students would
most likely have fewer difficulties learning science and math if they were taught in a
concrete manner with variety and familiar methods. "For greater effectiveness, the teacher
should begin with concrete examples and practical applications which lead to the abstract.
In addition, emphasis should be placed on course content which is functional and relevant
to daily living" (Cajete, 1988, p.2). A science lesson which takes these points into account
could appeal to more students of a variety of backgrounds than those lessons that do not
consider them. Involvement, practical examples and variety can be motivating for students.

The Roadshows try to present practical examples during the presentations and focus on
the concrete before discussing the abstract. In addition, the Roadshows use a variety of
multi-sensory demonstrations. The Roadshows teachers use demonstrations which have
auditory, visual, olfactory and action-oriented components. The Roadshows use
equipment such as a Van der Graaf Generator, a Plasma Ball, and Tesla Coil to produce
spectacular special effects. The interactions with these phenomena are multisensory, where
touch, sight and sound are the most commonly accessed senses. The variety of stimulation
in the Roadshows is a priority for the program. This variety can provide motivation to
learn science and also ensure accessibility to the information for a range of learners.

The Full Option Science System (FOSS) is a program run by the Lawrence Hall of
Science, National Science Foundation and Encyclopedia Britannica Educational
Corporation for young students. It focuses on learning about science and considers accessibility to ideas an issue. The program is "multisensory in design so that disabled students can experience science in mainstreamed settings" (Blosser, 1990, p. 4). The multisensory design works well for any students, not just those who are disabled. Multisensory activities allow students with a variety of learning styles to receive information about the demonstrations. The activities also allow students to be highly stimulated and involved with the science and technology in the shows. The multisensory approach is used by the Roadshows to provide a fun, interesting experience, full of variety, which helps students learn. The Roadshows give new ideas to innovative students and also presents conventional science in new ways which may appeal to students who are normally turned off science.

Cajete (1988) has other recommendations for making a learning situation enjoyable and more comfortable for students. He states that many American Indian students may show caution when approaching a new situation or activity and that lessons should be made informal, open and friendly. Informal, open and friendly describe the Roadshows presentations. The Roadshows teachers chat with the students and teachers before a show, they talk about themselves openly when appropriate. The SCIENCE WORLD teachers are those with excellent interpersonal skills. The responses from the children and teachers in the schools are positive. The children often hug the Roadshows teachers when they are leaving.

Cajete (1988) also identifies the relationship with the instructor or teacher as an area which could be improved to heighten motivation. He thinks that students respond best to teacher support providing gentle direction and that students may become motivated
because of a personal relationship with a teacher. The Roadshows teachers do not stay long enough in a school to build a long lasting relationship with the students. However, if the students visit SCIENCE WORLD and see these Roadshows teachers, the students always run over and say hello. During the shows, the Roadshows teachers quickly develop a positive rapport with their audiences and always give students encouragement. The Roadshows teachers encourage the students in ways they may not experience in their classrooms. They encourage active participation even if it means creating noise and some chaos. They encourage open questioning and participation by all students including those students who are ridiculed by their peers. They encourage answers even if they are wrong. They encourage questions about things that the students may not normally question. The Roadshows teachers try to foster a non-threatening environment where students have freedom of expression and where there is no "dumb question". SCIENCE WORLD often receives detailed thank you notes from children and teachers commenting on how nice the presenters were. These responses show that the Roadshows teachers are accomplishing their attempt to be friendly and that they have developed a good rapport with the children even within the short time they are at the school. This positive experience with the Roadshows teachers may increase the motivation of the children who participate in the program to learn science.

The Roadshows teachers present science in a way that is fun, motivational and informal. Lucas (1991) says that informal sources of information and entertainment can supply scientific knowledge to people. Druger (1988) also says that informal science education settings can both entertain and educate. They can "reinforce self-confidence in problem solving, capture imagination, encourage exploration and discovery and provide the joys of learning" (Druger, 1988, p. 37). Informal science education programs which use hands-on,
experiential approaches are recommended by several studies (Blosser, 1990; Lisowski, 1985) as appropriate for teaching science. The informal nature of the program is of benefit to the students. According to Maarschalk (1988), the learning experience outside the classroom such as this can be classified and studied. Some organizations classify this type of experience as informal science education.

SCIENCE WORLD refers to the Roadshows program as an informal science education program. McManus (1992) has noticed as well that "museum professionals, especially science museum professionals, refer to their institutions as places of informal education" (p. 165). This is usually in contrast to the formal or school system.

The term informal education is used several different ways in the literature, however. It is defined in Maarschalk (1988) as resulting "from situations where either the learner or the source of information has a conscious intent of promoting learning - but not both" (p. 136). This definition is vague, but has an element which applies to the Roadshows. It is suspected that often the students do not attend the Roadshows with the intention of learning. While the Roadshows teachers intend for the students to enjoy their science experience with the Roadshows and perhaps learn some of the information presented, learning content is not the primary focus of the program. Learning that science is fun and interesting is what SCIENCE WORLD hopes that the students will learn from the program.

This use of the term informal education has some similarities to how Maarschalk (1988) recommends the term be used. She recommends that informal science education be defined as "education that is given in situations in life that come about spontaneously, for
example, within the family circle, the neighbourhood, and so on. A typical example of informal science teaching arising from formal science teaching would be school pupils in a bus or coffee bar spontaneously discussing a topic or problem posed in the class" (p. 137).

In the Roadshows there is spontaneous discussion both during and after presentations. This, however is not solely the reason that SCIENCE WORLD uses the term informal education to describe its programs. Informal education is partially used to describe what the programs are not. They are not presented as formal classroom lessons, there are no rules about what must be learned, there is no pressure to learn. There is however, an attempt to make science and learning about science, fun. Informal is also used because of the unstructured and sometimes unconventional manner in which the science in the Roadshows is taught. Informal education does not completely describe the Roadshows, but does relate to some of the activity in and around the Roadshows.

Maarschalk's (1988) definition of non-formal education, may describe the Roadshows better. "Nonformal education is education that proceeds in a planned but highly adaptable way in institutions, organizations and situations outside the sphere of formal and informal education, e.g. in-service training, field tips and museum visits, educational television and radio, etc." (p. 137). This definition describes the non-structured nature of the Roadshows program. The Roadshows can be described by both informal and nonformal education, but overall nonformal describes the Roadshows format best. According to Maarschalk (1988) there is great power and attraction in both the nonformal and informal science education realms and "informal science teaching ... provides noteworthy and useful entry point for research" (p. 140). Often the question arises, where does informal science teaching fit into the science education of a population?
Informal learning situations are social settings. Falk and Dierking (1992) state that a "social context ... influences what and how we learn" (p. 109). "Learning is a special type of social behavior and museums are a special kind of social institution for facilitating it" (p. 109). "Social forms of education can be highly effective in teaching everything from concepts and facts to skills and attitudes" (p. 109). This social context is provided by the Roadshows due to the informal nature of the teaching and learning. The children discuss things with their friends before and after the show, and they are often encouraged to chat with their neighbours during the show about things they are watching. Therefore, the informal nature of the Roadshows contribute to the science education of the children.

According to McVoy (1987), one-third "of the responsibility for an improvement in science education should be shared by the 'informal' community" (p.146). She thinks that "much of the actual learning that goes on is a direct result of the stimulation that takes place on a visit to the museum" (p. 146) or perhaps because of exposure to an informal education experience. She also believes that "the museums, through their outreach programs, can increase the effectiveness of their ... scientific information" (p.146). Outreach programs, she says can nurture the teachers "and their ability to encourage the natural enthusiasm, creativity and curiosity of a child" (p. 146). Outreach can motivate teachers to motivate their students. Outreach "can make a difference in science education" (p. 151). "If most major museums could extend beyond the boundaries of their cities and states, the scientific/educational network would be stronger and more committed, therefore more effective. This is outreach in the true sense of the word" (McVoy, 1987, p. 151).
Through the literature, it has become evident that there are difficulties with teaching and learning science. The informal and non-formal education available through outreach programs such as the Roadshows have the potential to assist in science education. Many problems in science education are addressed through the format and presentation style of the Roadshows. As an addition to the science education in the traditional school system, the Roadshows program provides a rich supplement. It exposes young people to more of the variety science can offer, to a new way to look at the world around them, to new ideas, to the joy of science, to ways to ask questions. There is a possibility that children may come away from the Roadshows with some questions, some ideas about how to make a hypothesis, they may be able to explain some phenomena, may want to tell people about what they experienced, they may understand that, as students, they can participate in science oriented endeavours and they may be motivated to learn more science. There is a possibility that the Roadshows may be making a valid contribution toward the science education of the students who attend the program.

The first two introductory chapters of this thesis have examined some of the main issues relating to informal, non-formal and formal science education relevant to the Roadshows program. This review has provided a context for the qualitative study on the impact of the Roadshows program. This detailed study is not a goals assessment, but rather an attempt to provide a rich view of the world of a travelling non-formal science education program. The format deemed the most valuable for this study is a qualitative methodology.

Chapter 3 Methods

There were several stages involved in the design and implementation of the methodology for this study. First, it is important to make clear how the method was refined by considering the input from pilot studies. After the pilot studies are discussed, the format of
the study will be delineated. Following this section will be an outline of how analysis of the data was accomplished. A brief discussion of an alternative analysis method is also included.

3.1 The Pilot Studies
Several pilot studies were performed to help define the purpose and content of the study on the effects of the Roadshows on one community. The first pilot study was designed to test the feasibility of a study using a constructivist approach. The pilot study was of the development and implementation of an interview questionnaire. The questionnaire was used with children before and after an electricity show at SCIENCE WORLD. Some information was obtained about what the children knew about electricity before and after the show, but the information was not useful to this study. However, the process of conducting the pilot study was valuable. The researcher learned that interviewing children was difficult. It was found that the choice of respondents determined the results i.e. an exceptionally bright student was easy to interview, but did not give information that one would expect from a "typical" student. The interview environment was distracting due to the noise and the general melee around the theatre where the show was held. Impromptu interviewing was not successful, especially when the children were with their parents on a Saturday. The children did not necessarily want to participate in the study and it was very difficult to locate them following the show.

Feedback from the pilot study provided valuable information which helped determine future research directions. It was decided that the children should be chosen in advance so that they were available for both the pre-show interview and post-show interview sessions. The interviews needed to be conducted in a quiet place, with the children of varying abilities. The questions needed to be revised to elicit a richer response from the children.
The next two pilots studies assisted in the design of the study. One pilot study explored the limitations and strengths of the recording equipment to be used in the interviews. The equipment included a tape recorder and a PZM microphone commonly used in research. This pilot study was conducted in a local school in the winter of 1993. It took place in the gymnasium of an elementary school which had previously booked the Roadshows.

From this experience it was learned that the gymnasium was not a satisfactory location for interviews. The gymnasium was found to be a central location in the school where the children frequently visited. In addition, it was difficult to ask and answer questions in a space that echoed and it was difficult to hear the answers clearly on the tape after the recording was made. The researcher learned that the PZM microphone system worked well in an area without echoes.

This pilot study gave the researcher experience working with the school administrators to coordinate the interviews with the teachers. After arranging the interviews at the pilot school, it was clear that precise organization was needed to arrange the interview schedule with the chosen study school. In addition, it was also clear that the children needed information at the beginning of the interviews to help relax and be at ease.

Children who participated in the Roadshows for this same pilot study were requested to send drawings to SCIENCE WORLD. The children's drawings were similar to those received by SCIENCE WORLD in the past and showed commonalities in terms of objects drawn. That is, of the many objects seen in a Roadshows presentation, some three or four were most commonly depicted. It also showed that by asking for drawings, there was a good response from the school.
The final pilot study was conducted in another local school in the winter of 1993. The purpose of this study was to see if the questions were worded in a way that resulted in useful responses, to see if the interviewer was interviewing effectively and to see if the questions were the right ones to ask. It was found that the interviewer contributed more than was necessary to the conversations in the interviews and frequently talked over some of the children's answers.

It was learned that it was inappropriate to interpret the answer a child gave during an interview. Repeating the child's answer worked to obtain clarity over the microphone, but it was not helpful to rephrase the answer, especially if that rephrasing changed the way the child intended the message to be taken. It was found that it was more valuable to listen and ask questions which gave the children two options - yes they did agree, or no they did not. It was also learned that the questions asked were shallow and did not address issues the researcher wanted to expose. The experience highlighted the need to read further about the ways to conduct interviews. This reading was done with insights gained from the pilot study. As a result, a new group of questions were formulated (Appendix 2.1).

3.2 The Study

Choosing a school for the study took several steps. The school had to be one which had already booked a SCIENCE WORLD Roadshows performance in the Spring of 1994. Secondly, the school needed to be within the Lower Mainland for repeated visitation by the researcher, but far enough away from SCIENCE WORLD that the students were not regular visitors to SCIENCE WORLD.

Many schools within one Lower Mainland School District had booked Roadshows, so the School Board was asked to nominate a school which could be used in the study. The
Board Office personnel spoke with the principal at that school, and he agreed to house the study. These decisions were made in January, February, 1994. The chosen school had already booked three Roadshows for March 17, 1994. The school name, the names of the teachers and students will not be used in this study. There were approximately 280 students in the school with approximately 15-20 staff.

The school was in a rural area with a horse boarding business nearby, a town hall not far away and many fields around the school. The school was a "typical" school, in that there was always something other than classroom work going on in the school. The following lists the other things that were going on in the school which were competing for the teachers' time during the study.

Spring break preparations and follow-up; holidays; painting of the classrooms and moving of rooms; report cards; Spring Fair; staff birthdays; St. Patrick's Day celebrations; adjusting to demands of a new principal; arranging sessions for special students including hearing impaired students and those in need of counseling; librarian on holidays; substitute teachers in to cover teachers who were ill; Easter celebrations; Easter break preparations and follow-up; staff meetings; discussions with parents and PAC members; field trips to swim and participate in other activities outside the school.

The study was conducted over a 5 week period starting on March 10th, 1994. The pre-Roadshows interview was conducted on the 10th of March, one week before the Roadshows presentations on March 17th. There were three shows on March 17th. Two Science Carnival programs were presented for the students in Kindergarten to Grade 4. Only the K-1 students attended the first Science Carnival Show. In the second show, the Grade 1,2,3 and 4 students attended. The Grade 5 class, where the interviewed students
were from, attended the Arcs and Sparks show along with the Grade 6 and 7 students. This show was the last Roadshow performance of the day.

Following the Roadshows, the children were interviewed three times more. There was a post-Roadshows interview on the 18th and 28th of March and on April 14th. Drawings and written comments were collected from the students and questionnaires were collected from the teachers over the 5 week period.

There was a change in the number of interviews after the study was initially planned, due to the dates that the school Spring Break fell on. Originally, only 3 interviews were planned, but 4 were conducted to make the study complete.

Information was gathered from many different groups in this study. All children who saw the Roadshows were involved in the study. They were asked to make drawings and answer questions about the Roadshow they saw. Twelve children from one Grade 5 class were interviewed. Teachers of students who saw the Roadshows filled out questionnaires and discussed some of their opinions with the researcher. The Principal of the school and other school staff were also asked to fill out the questionnaires. Parents of the above 12 Grade 5 students were interviewed over the phone. The local public librarians were also interviewed over the phone, as were the merchants of nearby toy stores. These merchants were visited at their stores. All together, approximately 300 people were involved in the study.

Before the Roadshows, 12 students were chosen from one Grade 5 class. The children were chosen using the following criteria: an equal number of boys and girls, able to articulate their ideas, willing to converse with an adult, and of a variety of abilities and
performance levels. Permission was granted from their parents for them to participate in the interviews (see Appendix 1.5 for sample forms).

Of the 12 children chosen, 6 were interviewed before the Roadshows. This same group of 6 students was interviewed three more times after the Roadshows. In each of the three interviews after the Roadshows, 2 new students were also interviewed. This meant that during each interview after the Roadshows there was a total of 8 students interviewed.

The reason that only 6 children were interviewed before and 8 were interviewed after the show was to guard against the interviews themselves creating a learning environment. If the children who were only interviewed once remembered details about the Roadshows, then it would be shown that the interviews were not the cause of their learning about the Roadshows.

Before the Roadshows, three girls and three boys from the Grade 5 class were interviewed to see if they recognized pictures of the equipment which were to be used in the Arcs and Sparks presentation - a Van der Graaf generator, Tesla Coil, Plasma Ball, the Jacob's Ladder (see Appendix 1.1 for the photos, see Appendix 2.2 for the pre-Roadshows questions.). The children were asked to explain what the equipment was, what its function was and how it was used. This gave base-line data on the children's knowledge of the Roadshows equipment which could be compared to their answers after the Roadshow.

On the study day, there were three Roadshows performed. At the end of each of the three Roadshows, all the children were given the researcher's home phone number and encouraged to call or to leave a message if they had any questions about the science from
the presentation. This was one way to see if the children had questions about science elicited by the presentation.

Following the Roadshows, teachers gave each student a piece of paper with a few questions on the front and nothing on the back (Appendix 2.3). The children were asked to fill in their first names only and their grade. They were also told that the faces on the piece of paper were going to be used to tell the researcher how they felt about the Roadshows presentation. The children were asked to circle one face of the three provided, to indicate how they felt. Their choice of the drawing of the sad face meant they did not like the show. Their choice of the happy face meant they did like the show and if they chose the straight face, it meant that they had not decided what they thought about the show. They were to choose one face without discussing their choice with their friends.

Each child who participated was also asked to draw a picture on the other side of the paper about the Roadshows presentation they saw. They were asked to draw something about the presentation to show to someone who could not attend the Roadshows. This was to indicate what part of the Roadshows were most memorable for the children.

The day following the presentation, on March 18th, 1994 the original six students from the same Grade 5 class, plus two new students were interviewed and shown the same photographs of the equipment as the pre-Roadshows group. These students were asked if they recognized the equipment, asked to explain what the equipment was, what its function was and how it was used. Direct reference to the Roadshows experience was minimized to see if the children made the connection between the pictures and the Roadshows themselves. The questions used for this first post-Roadshows interview are presented in Appendix 2.4, March 18th.
These same students were asked what face they had circled on the piece of paper they were given after the show and why they chose it. They were also asked about their drawings. They were asked why they drew what they drew and were asked details about what they drew.

Ten days following the Roadshows, on March 28th, 6 of the same students from the Grade 5 class, plus 2 of the new students were again interviewed. They were shown the same photographs of the equipment and asked similar questions to those asked in the previous post-Roadshows interviews. Memory of the Roadshows event was tested with this group. They were also asked if they had talked to anyone about the Roadshows (see Appendix 2.4).

Four weeks after the Roadshows, on April 14, 1994, the same six students and two more new students were interviewed. They were shown the same photos and asked similar questions. At the end of the interview session, the children were thanked for their participation and given two passes to SCIENCE WORLD. They did not expect this reward.

The interviews were all audio taped and transcripts were made of the interviews. Approximately 60 hours of audio tapes were transcribed to accurately represent the interviews on paper (sample transcripts are presented in Appendix 2.5).

All teachers saw the Roadshows except the teacher of the Grade 5 class, who was not available. The teachers were asked to keep a log book, for four weeks after the
Roadshows, of student comments, questions and activities related to the Roadshows (Appendix 2).

The teachers were asked to answer several questions on a written questionnaire. The questionnaire was used because the teachers were too busy to be interviewed in person. The questions were based on those already prepared for an oral interview with the teachers. The questions and responses are presented in Appendix 2.6. The Principal was also given the same written questionnaire. The questions dealt with issues of the Roadshows impact on the study participants.

The teachers were also asked to do numerous small things to assist in the research process:- Ask the students to do the drawings, fill in the blanks on the reverse side and circle a face, explain what the faces represented, collect drawings, find the researcher and give drawings to the researcher, listen and record comments in the log book, attend the presentation, respond to the questionnaire about the program, attend a meeting to hear about what the research was about.

The Grade 5 teacher in addition to the above tasks, was asked to do the following:- select students, send home permission forms to the parents, collect the permission forms, call some parents when permission forms were not turned in, allow 12 students to leave class for 4 interviews over a month period, remind students to go to interviews, find a substitute student for an interview when one student was sick, receive calls from the researcher, answer questions from researcher on the questionnaire, have the students provide comments about the show, answer questions about the Roadshows from the students.
In order to assist the teachers during their hectic days, written information was prepared delineating all the requirements from them for the study. This was placed inside their log books for convenience.

The parents of the 12 children interviewed at school were also involved in the study. The parents received permission forms approximately 2 weeks before the study. These forms asked for their permission for their son or daughter to participate in the interviews. The form also asked if the parents would accept a phone call to discuss the Roadshows. Approximately 1 week after their children saw the Roadshows, the researcher called the parents to find out if their children talked to them about their experiences with the Roadshows. The researcher was particularly interested if the children had talked about the Roadshows without prompting. After an explanatory preamble, several questions were asked of the parents (see Appendix 2.7) about how their children reacted to the Roadshows and if there was any visible effect on their sons or daughters. The parents were also asked if the program had any effect on them.

Librarians were also asked questions about the Roadshows. The librarians worked at the public libraries in the area. The school librarian was unavailable for interviews. Following the Roadshows, the librarians were asked if there was a change in the number of science books asked for and taken out of the library by children. The number of books was monitored for 4 weeks after the Roadshows presentation took place. The librarians were also asked what topics seemed to be the most popular and if there had been any children's questions related to the Roadshows (i.e. questions about a Plasma Ball).

Merchants of local toy stores close to the school, were interviewed in person or by phone. They were asked questions about children coming into their stores and asking about
buying Plasma Balls or other unusual pieces of equipment found in the Roadshows. The clerks were asked to call the researcher if they received any interesting requests from students. The stores were called again by the researcher after 4 weeks.

The methodology used in the study was designed to solicit responses about the impact of the Roadshows on the children or others in their families and in their community. Each week the interviews involved a different set of questions. The questions asked depended upon the answers from the previous interviews as well as what needed to be ascertained. Some questions were planned from the beginning of the study to be a part of several or all interviews. The researcher tried to limit the number of spontaneous questions that were asked during the study, other than using new questions to probe answers for further information.

3.3 Methods Analysis

In order to make sense of the large amount of data collected for this study, the findings were grouped then analyzed and synthesized. The data was collected in the following formats:- transcripts of interviews, children's drawings, Likert scale faces, teacher questionnaires, answers to questions from parents, librarians and toy store clerks and miscellaneous observations by the researcher. These formats provided the first grouping of the data.

The transcripts provided the bulk of the information to be analyzed. The transcripts were made by listening to the audio tapes and typing the conversations word for word. This information was sorted by date and student, categorized by question answered then placed into tables.
During the process of transcription the writer perceived patterns and categories of data other than those relating to specific individual questions. These categories related to the questions addressed in the study as outlined in Chapter 1, page 8. An example of a category is "What conversations took place between the children and their friends?". There were some data that fit into more than one category, but for simplicity, were placed in only one location and discussed in relation to that category.

The categories for the tables were created to show comparisons between the answers the children gave in the interviews. In particular the results from before the Roadshows were compared to the results from after the Roadshows. Statements made by the children were compared to see if there was a change in their ideas (i.e. Before - "I don't like science". After - "I like science").

Some of the categories in the tables were in the form of questions resulting in yes and no answers as data in the tables. Some data in the tables required further analysis even after being placed in an appropriate category. This analysis sometimes involved calculation of percentages in order to formulate conclusions (Table 27 in Appendix 3).

Much of the information in the transcripts was taken directly from the transcripts and placed into the tables verbatim (i.e. see line 360 in Appendix 2.5 and Table 1 in Appendix 3). Sometimes extracted phrases, comments or a synopsis of what the student said was put into a table under the appropriate category. Often several statements were combined to give the entire picture of what a student said (i.e. see lines 14-37, Appendix 2.5 and Table 1, Appendix 3 for students A and B).
To make the tables from the transcripts as uncomplicated as possible the interviewed children were assigned letters. The first interviewees were given the first letters of the alphabet. Aliases were used for reference to other children mentioned during the interviews. Mr. or Mrs. were used for the staff names at the school. Parents were referred to as A's mom or B's dad. Other nomenclature used included dates from specific interviews. Below are the dates of the interviews and which students were interviewed on which days. The students were interviewed in boy/girl pairs to help discern voices on the audio tape and to provide balanced responses to the questions.

<table>
<thead>
<tr>
<th>Date</th>
<th>Interview Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 10th Pre-Roadshows</td>
<td>Subjects A and B, C and D, E and F</td>
</tr>
<tr>
<td>March 17th</td>
<td>Show</td>
</tr>
<tr>
<td>March 18th first Post test</td>
<td>Subjects A and B, C and D, E and F, G and H</td>
</tr>
<tr>
<td>March 28 second Post test</td>
<td>Subjects A and B, C and D, E and F, I and J</td>
</tr>
<tr>
<td>April 14th third Post test</td>
<td>Subjects A and B, C and D, E and F, K and M</td>
</tr>
</tbody>
</table>

Subject L was chosen to be interviewed on April 14th, but was unable to attend the interview. Therefore, student M was substituted in his place.

After tabulating the transcripts and comparing the responses from the children before and after the Roadshows, more comparisons were made with the other forms of data collected.

The drawings were used to find out what the students remembered from the Roadshows. The drawings were tallied by counting all the pictures of one exhibit or demonstration. Categories were made according to the pieces of equipment used in the Roadshows. Most of the demonstrations were distinguishable from one another by the way they were drawn. Best guesses were made by the researcher as to the identity of each drawing based on the
experience of seeing many Roadshows drawings by children over the past two years. All drawings from this study were considered in the count. There were very few that could not be identified. Of the 175 sheets of drawings collected from the children, 5 drawings of pieces of equipment were not identifiable.

Percentages were calculated for the number of drawings of one piece of equipment over the total drawings made for one show (see Table 27 in Appendix 3). The highest percentage of drawings for one piece of equipment was determined to indicate popularity of that piece of equipment with the students.

On the back of the piece of paper with the drawings were questions for the students. These questions included a Likert scale of faces. The Likert scale was used to collect the children's reactions to the program. According to McMillan and Schumacher (1989), the most widely used method of collecting beliefs or opinions is the Likert scale. A variation of the Likert scale is the Semantic Differential which is used to "elicit descriptive reactions toward a concept or object" (p. 261). It does not require descriptors. The scale used with small children has no descriptors. No descriptors were used in the Likert scale for this study (Appendix 2.3). The scale used had three points with happy, neutral and sad faces. It was kept simple specifically for the children's ease of understanding. The children chose a face which best described their reaction to the show. Gillies (1981) in the Ontario Science Centre Science Circus study used a similar Likert scale and this type of scale has been used for studies of this nature for years. The only limitation with this scale is the self-reporting nature and the interpretation of the question itself. It is possible that the children would see the faces as having somewhat different meanings than were given by their teachers. The teachers were asked to tell the children
that if they circled the happy face it meant that they liked the show, the sad face meant that they did not like the show and the neutral face meant that they had not decided.

The number of happy, sad and neutral faces was tallied. The face which had the most number of responses indicated the most common reaction of the children to the Roadshows.

The responses to the teachers' written questionnaire along with the responses from parents, librarians and toy store clerks were considered when interpreting all the results of the study. This information either confirmed or contradicted the findings from the tabulated data. By considering all the information together, conclusions were drawn about the impact of the Roadshows on the community. There were also conclusions drawn about the impact on individual children. These conclusions were drawn using the transcripts and comments from the children's parents, looking at the child's drawing and Likert scale response. The teachers' comments, toy store clerks' comments and librarian's comments were not used to determine impacts on individual children. The comments from many of the adults in the study were not tabulated, but rather interwoven into the findings of the study.

3.4 Alternative Analysis Method
An attempt was made to use a new qualitative analysis software program for Apple Macintosh computers called HyperQual (Padilla, 1993) to assist in the categorization of the data. In order to use this program, one needs System 7.0 on a Macintosh and 4
megabytes of RAM (Padilla, 1993). This was not a limiting factor, but the 30,000 characters per field was limiting and therefore, precluded the use of the program for analysis. Because the number of questions per student was large, and therefore each interview had many pages of information in the form of answers, it would have been too time consuming to break up each question for each participant for each repetitive interview and insert it into an appropriate field in the program. The potential for tagging key words and collecting the bits of information in relation to each key word was what stimulated the initial use of this program, but the amount of data in this research proved too large. With smaller chunks of information, this program would prove more useful. It is, however, refreshing to realize that the human mind is still more useful in collecting together relevant groups of information. Recent developments in computer software still cannot replace the mind of a researcher. A computer "find" command is very useful in collecting information for the researcher, but the memory and synthesis that a person has to offer to an analysis cannot be replaced by any software program, yet.

3.5 Qualitative Methodology Inspected

In the process of deciding on the methodology for this study, some issues about qualitative methodology came to light. A brief review of the strengths and weaknesses of this methodology will add to the understanding of the research performed on the Roadshows.

According to Filstead (1970), qualitative methodology is an approach that "is constructed in such a fashion as to yield verifiable knowledge about the empirical social world. In order to predict behavior, sociologists have to understand ... complex process. To understand these complex processes, sociologists must obtain information relevant to the various attitudinal, situational and environmental factors that compose the real world for those under investigation" (p. 6). This study attempts to obtain information which will lead to the understanding of the impact of the Roadshows on one community. In order to
provide the reader with a fuller appreciation for the context in which the study has been performed, the study describes the environment in which the study has taken place as recommended by the literature.

Filstead (1970) also suggests that "it is no simple task to acquire this wealth of knowledge; whether it can ever be completely acquired is problematic", so the more information the researcher is able to collect the "more accurate will be [the] interpretations and predictions of human behavior" (p. 7). He feels that qualitative methodology "advocates an approach ... which requires the researcher to interpret the real world from the perspective of the subjects of [the] investigation" (p. 7). In this study, many different methods are used to collect information in order to try to see the world through children's perspectives and the perspectives of those adults around them. Interviews, drawings, and discussions with those who know the students are used to glean information about how the children see the Roadshows. These bits of information form the pieces of the puzzle to be put together.

Filstead (1970) takes a supportive stance "on the issue of subjective understanding as an essential criterion for the validation of data and as a crucial component of the research process" (p. 7). He also advocates "qualitative methodology as a legitimate approach to both theory construction and the research process" (p. 8). Since 1970, there has been increased legitimization of the qualitative approach, but there are always doubts by people about how relevant this type of research is. Because of the type of information that is needed for this study, this form of research is the only way to effectively study the Roadshows and its impact on a community. Even though some quantitative measures are present in this study, the richness of the experience cannot be condensed to numbers. It is also thought that a combination of both qualitative and quantitative methods can give a full feeling for the situation under question.
One of the reasons that qualitative research has been questioned about its validity is because of the subjective nature of the work. Becker (1970) deals with this issue in a very practical manner. He says that it is true, sociologists are "caught in a crossfire" (p. 15). They are told not to "take sides" on an issue and to be "neutral and do research that is technically correct and value free. Others tell them their work is shallow and useless if it does not express a deep commitment to a value position" (p. 15). This researcher wrestled with the same question. Becker (1970) helps to put the problem into perspective. He says that the dilemma is an illusion. "For [the dilemma] to exist, one would have to assume, as some apparently do, that it is indeed possible to do research that is uncontaminated by personal and political sympathies" (p. 15). He says that this is not possible and therefore, the important question is which side is the researcher on, not whether or not the researcher is being objective.

Which side is this researcher on? Because the study looks at a program run from SCIENCE WORLD and the researcher works for SCIENCE WORLD, it is obvious that the bias here is in support of the program being investigated. By making this bias explicit, it will raise doubts as to whether this bias will "seriously flaw" the work (Becker, 1970, p. 16). In fact, the questions could be as strong as suggesting that the findings could be distorted and therefore bias the entire work (Becker, 1970). It is also a possibility that readers will think that the researcher will be hesitant in publishing the information which would damage the group studied, in this case SCIENCE WORLD and the Roadshows program. While it is true that there may be a temptation to leave out information that does not show the program in a favorable light, Becker (1970) points out that this is not typically the result of qualitative research where the bias is obvious. In the case of the Roadshows, in early 1994, there could have been more temptation to suppress unsupportive information because of the impact on the program, but in late 1994, funding
has determined that the program cannot continue. Therefore, whatever is discovered in this study will probably not influence what happens to the program. In addition, the study was never designed to be an evaluation of the attainment of the goals of the program. Instead it was designed to be an in-depth study of the experiences children have with the program, and to see if their experiences carry messages from the program into their community. Furthermore, if any pitfalls of this program can be found because of the study, it will only give SCIENCE WORLD and other informal science education facilities information to improve future science presentations. Finally, SCIENCE WORLD does not claim that the Roadshows program makes an impact on the community in which the program takes place, therefore if no impact is found, the program is not proven to be a failure. SCIENCE WORLD would hope that there is some small effect on the students, but does not necessarily expect it. From these statements it is clear that the study does have a bias, but the information will not be unusable because of the bias. Having the bias known will prepare the reader. In addition, institutions such as SCIENCE WORLD may be able to use findings whether they are in support of the program or not.

Due to the researcher's bias, however, it is true that this researcher may be guilty of changing the outcome of the study. The researcher may not have asked certain questions during the study that would reveal unfavorable information. Or, the researcher might have "introduce[d] loaded questions" in a set of interview questions, or "act[ed] in some way ... such that people would be constrained to tell ... only the kind of thing [the researcher is] already in sympathy with" (Becker, 1970, p. 23). Becker(1970) suggests that "all of [the] research techniques [should be] hedged about with precautionary measures designed to guard against these errors" (p. 23). This researcher did try to add precautionary measures to avoid the most obvious errors. One precautionary measure was to include two other people to evaluate the questions before they were used in the interviews. By ensuring the interview questions were not "loaded questions", some facts have been produced that go
against the researcher's bias. This may indicate that the fail safes worked, but there are still conversations that took place during the interviews where the researcher caught herself leading the interviewee. Other times this leading was only evident upon inspection of the data.

According to Becker (1970), "similar feelings that our work is biased, occur in the study of schools, hospitals, asylums and prisons" (p. 17). "It is easily ascertained that a great many more studies are biased" (p. 19). Perhaps every study should be performed by two people, one with a bias in favour of a program and one who is not in favour. Therefore, the reading audience have the two extreme biases from which to see the study.

Somewhere between the two biases may lie the truth about the situation. It is unrealistic, however, to expect studies to be viewed from both perspectives, so we accept bias as a part of a study. "There is no position from which sociological research can be done that is not biased in one or another way" (Becker, 1970, p. 22). It is the hope of this researcher that the point of view that has been taken still allows the research to stand up to the scrutiny of colleagues as a good scientific study and that the "unavoidable sympathies [have not] render[ed] [the] results invalid" (Becker, 1970, p. 23).

Becker says (1970) that it is "something of a solution to say that over the years each 'one-sided' study will provoke further studies that gradually enlarge our grasp of all the relevant facets of an institution's operation" (p. 25). In this case it are fortunate that two different studies, including this one, have been performed on the Roadshows. One study looks quantitatively at attainment of some of the program's goals and the other examines the Roadshows qualitatively to give a thorough view of a specific community which received the Roadshows. These views are complementary. But having two studies on the same program and outlining one of the researcher's biases does not address the biases in the study from other sources.
Where are the other sources of bias in the study, beyond those of the researcher's? Who is trying to please others within the structure of the study? The researcher may in some way want to please several people connected to the study. These people could include her employer, the SCIENCE WORLD staff who presented the performances, the sponsors of the program and future sponsors of the program. The people being interviewed may want to please the researcher because she is from SCIENCE WORLD, or they may want to make their school sound positive by answering the questions in a certain manner. Students might want to please their teachers, or their parents, or their peers. The teachers may want to please the School Board Office that recommended the school, or may want to please the principal. In all cases it is recognized that the answers that the people have given may be loaded with hidden agendas or they may not. This will not be known. It is important, however, to acknowledge that these potential hidden agendas may exist and may limit the usefulness of the research.

It has been recommended by Becker (1970) that to "satisfy the demands of our science" we always need to make "clear the limits of what we have studied, marking the boundaries beyond which our findings cannot be safely applied" (p. 25). In the instance of this study, it is relevant to one community who had the Roadshows program visit. The study may or may not apply to other schools, other communities and other programs. The generalizability of the study will depend upon the similarities of other schools, communities and programs. In addition, this study focuses on the view of the Roadshows program through the eyes of the students who participated in the shows with some input from their parents, teachers, principal, as well as input from toy store clerks and librarians in the area. The perspectives are varied, but still focused through the students' eyes. The variety of perspectives enhances the study results and makes them more useful and perhaps more generalizable.
The study is not seen from the point of view of the performer of the show, the Parent Advisory Committee, the School Board staff or parents of students in any grades other than Grade 5. Therefore, this study in the strictest sense only applies to some of the school's students, parents, teachers and community members. Upon examination of the results, however, there may be parallels that can be made to other settings.

According to Blum, (1970), "a well constructed interview is likely to yield some time, often when least expected, the kind of information which gives a real understanding of attitudes. A long intensive interview is, by itself, a good way to get deeper insights rather than superficial, biased verbalizations" (p. 88). "Indeed, it gives not only verbal responses but a whole behavior pattern" (p. 88). In order to be able to accomplish a long intensive interview, it is essential for the interviewer to have a good rapport with the interviewees. The researcher is an outsider and so needs to "overcome distrust" in order to proceed with the interviews (Blum, 1970, p. 90).

In this study, as in most qualitative research where there is an interviewer involved, the interviewer is an outsider (Trice, 1970). The school staff and students are all new to the researcher and the school has never had any prior contact with the researcher. According to Trice (1970), this is an advantage because people "will not hesitate to make certain private views known to a disinterested outside observer" (p. 77). The school, has had contact with SCIENCE WORLD, however, because of making the Roadshows booking ahead of the planned research date. This makes the school somewhat familiar with SCIENCE WORLD.

The researcher is certainly an observer and an outsider. Some teachers did not hesitate to talk to the researcher, but this researcher found that being an outsider had a distinct
disadvantage. There was no relationship on which to build rapport with the staff. This was a detriment to the study because the researcher had to ask for commitments from the teachers. It was especially difficult when it came to asking for the information to be turned in to the researcher. No feedback was available about the technique used to solicit the information from the teachers except from questions asked directly such as "how is the log book coming along?" to which the answer was "not very well" in many cases. In another instance, the "cold shoulder" and "not you again" type of look was the only other indication that the request for information from the researcher, was causing a problem.

The support from the principal was of minimal advantage when the teachers were being asked to support and participate in the study. It was apparent that the principal was responsible for overburdening the teachers prior to the beginning of the study, so the addition of the study was not a positive event. The researcher, did not have this insider's knowledge until late in the study.

The researcher was an outsider in the school, but at the same time, was an insider because of intimate knowledge of the Roadshows. Everyone who has taught a Roadshows presentation has an insider's view on the program, but as manager, organizer, trainer, observer and previous teacher of this type of program, the researcher of this study has a unique inside perspective. This was always taken for granted and thought to be a disadvantage because of being too close to the topic. Indeed it may still be a disadvantage in the analysis of the work by "dulling the investigator's powers of observation and analysis" (p. 32), but according to McCracken (1988), the familiarity also "has the advantage of giving the investigator an extraordinarily intimate acquaintance with the object of study" (p. 32). "This acquaintance gives the investigator a finesse of touch and delicacy of insight" (McCracken, 1988, p. 32). In comparison to the reader who is not involved in SCIENCE WORLD programs, indeed the researcher is an insider and has the obligation to open up this new world of interest.
According to Mann (1970), the "researcher's own actions are as much a part of the study design as the research instruments used" (p. 120). "Human relations mistakes made by researchers ... live long lives" (p. 120). "It appears that researchers can afford fewer mistakes when working in relatively small closed systems of relationships than when working with people in less meaningful systems of relationships" (p. 120). Researchers need to develop a better understanding of the skills of working with other people, not only to gain and maintain access to research situations, but also to accomplish the objectives of a particular study.

In this study, the researcher tried to balance the needs of the study with the needs and time constraints of the students, staff and parents in the study. To help accommodate these people, phone calls were made to parents at their convenience, teachers were given longer than originally planned to respond to the questionnaire and to write in the log books, the researcher tried to help the Grade 5 teacher with the schedule of interviews by sending each group of students back to get the next group. In addition, the interviewer tried to write instructions down for the teachers and the administrator and assisted their understanding with follow-up phone calls. Even with these extra measures, made to assist the people in the study, it was still obvious that the study was inconvenient for many of the adults and put added pressure onto their busy schedules. This was particularly true for a few parents and most of the teachers. In one case, a teacher just flatly refused to write anything in the log book and wanted to give it back to the researcher. The researcher asked her to keep it just in case something came up, but emphasized that if there was nothing in it that was fine. This teacher did not seem happy, and it appeared that she just stuffed the log book into her mailbox and never removed it again. The antagonism toward the researcher was obvious, and it is unclear if the researcher could have done more to
change this situation. The children, on the other hand, did not seem to be inconvenienced by the study. They actually enjoyed being allowed to leave class and liked the interviews.

It was awkward when the data collection for the study depended upon the cooperation of people. It should be expected that some people do not want to be a part of a study. Perhaps more experience on this researcher's part could have made the situation better. The informal nature of the collection of information from the teachers may have been a problem. In most cases, however, there was full cooperation and willingness to help the researcher. Some participants went out of their way to assist the researcher to provide information. Regardless of the amount of help the researcher received from participants, the researcher needed to be as sensitive as possible to the way the participants were feeling about the research.

The behaviour of interviewers affect informal data collection and also affect the responses by participants in interviews. "The interviewer's manner and role can strongly affect what the interviewee chooses to tell [her], as can be the situation in which the interview is conducted" (Becker, 1970, p. 104). According to Becker (1970), an interview may be judged successful "precisely to the degree that it elicits cynical rather than idealistic attitudes" (p. 104). This may apply more to older students and adults than younger children who have not learned cynicism. "By being warm and permissive, by expressing idealistic notions one's self, and subtly encouraging their expression on the part of the student, one might well gather a set of data which would picture the student as .... intrigued by the mysteries of science ... in short, which would draw heavily on this part of the student's repertoire of mixed emotions" (Becker, 1970, p. 104). This could easily have happened in the interviews with the students in this study, although the researcher did try to limit the amount of "expressing idealistic notions". It was likely obvious to the students what the researcher thought about some questions. They probably knew that the
researcher thought both men and women should be scientists, that a positive experience with the Roadshows was a favorable response, that it was also good if they remembered things from the show and desirable that they learned things from the show. It was difficult for the researcher to play a neutral part when the students were giving their answers. "That's good" would often be said by the researcher when desirable answers were given. It was not realized how frequently this was said, however, until the recordings of the interviews were listened to and the transcripts were made. Naturally the responses of the students would be based on their desire to say the right thing. Some students had to be reminded a few times that the interviews were not tests and that they were not being judged for their ability to remember things. Students were even heard chastising themselves for not remembering things. Therefore, the interview situation and the behaviour of the interviewer affects the interviewees answers in ways which cannot always be expected.

Blum (1970) said that one of the problems with interviews is that "the interviewee may adjust his answers to those he believes the researcher to expect" (p. 87). It is also true that volunteered information from the researcher can affect later answers from the interviewee. Blum (1970) found that it is "likely that some of [the] answers influenced the interviewee's response to similar or related questions which came up later in the interview" (p. 87). "It is naive to assume that biases due to the personality of the interviewer and the nature of the questions asked could be avoided. Each interviewer is stereotyped, and responded to accordingly. And each question evokes a certain emotional reaction which affects the interviewee's answers. By giving the interviewee a chance to ask questions, these factors are brought to the surface where the researcher can deal with them" (Blum, 1970, p. 87). The interviewer encouraged the children to ask questions of the interviewer and some of these revealed what the children were thinking about the interview.
It is an interesting fact that interviewers are judged by the people of a study by such characteristics as "age, sex, race, perceived class, and other factors" Mann (1970, p. 120). "The expectations that others receive from these cues may limit markedly what a researcher can do in the early phases of a project" (p. 121). Upon reflection, this may have been what this researcher encountered in this school as well. The researcher may have been seen as a young female teacher, doing a master's thesis at the University of British Columbia and working for SCIENCE WORLD. This image may have had positive and negative effects upon the people involved in the study. Those subjects of the study who responded well to the researcher initially were the students, and the young teachers. One young teacher was also starting his Master's at UBC. He seemed to respond well to the researcher on a personal level, but did not take the time to respond to all the requests for the study, so other constraints in the study situation may have had more impact on him in this situation than the researcher.

It is possible that the older teachers felt somewhat threatened by the researcher's presence. The method of the study and the young researcher pursuing a Master's degree may have bothered the teachers. Naturally this will never be known, but Mann's statement about limiting what a researcher can do rang true in this situation. Mann (1970) also refers to studies where "the age role expectations of the people" in the study put the researchers at a disadvantage (p. 121). "It was disturbing to some, therefore, when they saw that a relatively young group was to have major responsibility" (p. 121). The older teachers of the study school were the ones with which "human relations" were more difficult for the researcher in this study. During one situation, an older teacher asked the researcher to move rooms after the interviews had already been set up. The reason given necessitating the move was so that a deaf student could have a quiet space to work. This situation appeared to be more about control than about the needs of a student. It is also possible, however, that this is an incorrect assessment by the researcher as well. It may be possible
that the researcher has more trouble working with older teachers and it is not the older teachers that have trouble working with the younger researcher.

Mann (1970) related another situation which is applicable to this study. The situation is that the people in a study have no experience with a researcher and so they "responded to [the researcher] in role relationships which they [do] understand" (p. 121). In Mann's study the women responded to the young male researcher as if he were a son. Perhaps in this study, the older women teachers also reacted to the researcher as a daughter. Perhaps they resented this "daughter-figure" asking them to do things. This is all conjecture, however. "Since people ... are at least suspicious of others whom they cannot place in an occupational niche with which they are familiar, it is clear that we need to learn how to develop quickly in others an understanding of the job of social researcher" (p. 122). "We need to do much more at the beginning of any research project than we have in the past towards clarifying what our research values and objectives are, how we plan to go about getting our data, and how long the study will take" (Mann, 1970, p. 122). Even though many details were explained to the participants of this study, in hind sight, even more could have been explained to the staff. It will never be known, however, if taking this extra time with the teachers would have made them more agitated about using their valuable time, or if it would have made them more comfortable with the components of the study and their roles.

While Mann (1970) encourages the researcher to have initial contacts with the leaders in the system to be studied to increase the acceptance of the researcher, this contact can also create animosity. The teachers in the study school appeared to be pushed into participating in the study when they had no time for it. Even though the School Board and the Principal supported the project, the teachers were those most affected by the study and they had no say in being a participant or not. They had to do most of the work and may have resented
the "top-down" approach to participating in the research. It is also true, however, that the support of the Principal and the School Board were essential for the study to take place. An outsider could never set up the "formal and informal channels of communication" within the school and community without the assistance of the key people, such as the Principal and secretary in the school (Mann, 1970, p. 124). Therefore, there are positives and negatives to the researcher's contact with the key authorities.

Because there is no way of knowing all the ways that a study has impacted a school it is prudent to make the participants feel that their efforts were appreciated. As a way of showing appreciation at the end of the study, the researcher provided the school with a plaque, a card, a cake and passes to SCIENCE WORLD. This thank you hardly seemed enough for all of the time and effort by the school, but it was an attempt to keep feelings positive. As Mann (1970) says, "it is not uncommon to hear of accounts of poorly conducted studies years after those studies occurred" (p. 120). Ending on a positive note is the least a researcher can do for the participants in a study where the researcher disrupted their schedules for several weeks.

In between the personal interactions with staff, students and others, there was data collected for this study. The interviews were the forum for the collection of most of the data. The conclusions of the study are therefore, based on analysis of "verbal responses to questions put by an interviewer" (Deutscher, 1970, p. 27). "Those responses may be written or oral and the questions ... range from forced choice to open ended, but the fact remains that what we obtain from such methods are statements of attitude, opinion, norms, values, anticipation, or recall" (Deutscher, 1970, p. 27). An important assumption is made about this data that is collected. "The assumption must be made that verbal responses reflect behavioral tendencies" (p. 28). "This inferential jump from verbal behaviour to overt behaviour appears to be tenuous under some conditions" (p. 28). While
subjects do talk about doing something, for them to actually do it is another matter. According to Deutscher, (1970), "we do not know under what conditions a change in attitude anticipates a change in behaviour" (p. 35). Therefore, even if the students said that they would do more science after seeing the Roadshows, for instance, they may not act on this statement. By the same token they may act on it, they may want to and never do, or they may have said they would do something and not meant it at all. All possibilities seem realistic. Each child is different in the follow-through from his or her word to action. This study was not designed to follow-up with the students to see if their actions reflected their comments in the interviews, but according to Deutscher (1970), it would not matter because "we have not developed a technology for observing, ordering, analyzing, and interpreting overt behavior - especially as it relates to attitudes, norms, opinions, and values" (p. 35). To be sure, since 1970, advances have been made in advancing the behavioural sciences, but it is still difficult to evaluate overt behaviour. The students' words must, therefore, be taken at "face value" for representing the students intentions to act.

The method that has been chosen for this study is qualitative research, taking into account the strengths and weaknesses of the methodology. Clinard (1970) puts this decision into perspective with his statement that "the important question about research is not the technique used, but the essential nature of the problem under investigation and the degree of its relevance to the search for adequate generalizations" (Clinard, 1970, p. 65).

McCracken (1988) agrees that "it is the objective of every piece of qualitative inquiry to capture not just the particular but also the general properties of human discourse" (p. 52). While qualitative studies can be viewed as having limited ability for generalizations, their value in providing understanding of a given situation can be immeasurable due to the depth of understanding. In fact, McCracken (1988) feels that qualitative research is "not intended to capture issues of ... generalization" at all but rather it "tells us what people
think and do, not how many of them think and do it" (p. 49). There is some contradiction in McCracken's (1988) argument, but it can be interpreted as, one cannot say how many other people will behave in the same way as in a particular qualitative study, but it is the hope of a qualitative researcher that the information may give insight into more situations. It is the hope of this researcher that, indeed the understanding of this one situation will broaden the understanding of the role of informal and nonformal science education taken into the schools.

This study will consider what the students are taking away with them from experiencing the Roadshows. Some of what the children may be taking away will be affective. The affective domain is often an area deemed impossible to study. According to Falk and Dierking (1992), "attitude is ... often neglected in traditional views of learning, yet it is increasingly apparent that feelings, beliefs, and attitudes strongly influence learning" (p. 103). To deal with the interpretation problem with respect to feelings in this study, instead of avoiding the area all together, the researcher has asked very direct questions to the students and depended upon the children to make their own conclusions about the way they feel. These responses are taken at "face value" with minimal interpretation from the researcher. Interpretation is performed for some of the children's comments where necessary, but mostly for those which are content related. A consideration of the affective responses by the children to the program is deemed important to the study because "the way a person feels during an experience becomes an integral part of his memory of that experience" and "personal feelings, beliefs, and attitudes form much of the basis for motivation, a key ingredient in the museum learning process" (Falk and Dierking, 1992, p. 103). The cognitive focus in this study is also justifiable on the basis of remembering experiences. There is, of necessity, content which is related to these memories. The memories will then give a clue about what impacted the students and what did not. It is
the researcher's belief that only the qualitative methodology will reveal the rich experience that these children have with the Roadshows both cognitively and affectively.

Chapter 4 Findings
This chapter presents the findings from student's drawings as well as the findings from interviews with students and adults. Many of the data can be presented in the context of more than one of the original study questions (Chapter 1, page 8), but to facilitate simplicity and clarity and decrease duplication, the data will only be presented in relation to one question. This chapter begins with statements about the students and their experiences with science.

4.1 Students' Background and Experience with Science
Student A, male, was talkative and eager to show what he knew. He was quick to answer the interview questions and talked at length about both related and unrelated information.

Student B, female, was eager to show what she knew, but the researcher believes that sometimes this student fabricated information for her answers. She was quick to answer the questions. During some of the interviews she squirmed a great deal. In addition, her allergies affected her.

Student C, male, suffered from a cold for at least two of the interviews. He was quick to answer the questions. He was friends with student F.

Student D, female, almost always repeated the answers of student C unless she was asked to answer the questions first. The researcher tried to elicit her answers first wherever possible to see what her answer would be without the influence of the other student. If student C's answer was given first, student D usually agreed with him. She seemed shy and unsure of herself.
Student E, female, was self assured. She suffered from a cold for at least one interview. Her mother taught in the school.

Student F, male, was often mistaken (by the interviewer) for subject C. This annoyed him. The boys were similar in looks, build and abilities. In addition, student C always preceded student F in the interview sequence except for the last session.

Student G, female, was included in later interviews but did not participate in the earlier ones. She was friends with student I. She belonged to Girl Guides.

Student H was male. His father worked for BC Hydro.

Student I, female, belonged to Brownies. She previously lived in Ontario. She was friends with Student G. Her brother was in Grade 2 and her sister was in Grade 4 in the same school. She skied with her family during the Spring Break. Her mother is a member of the Parent Advisory Committee with student K's mother. She was independent in her views and did not seem to be influenced by student J.

Student J, male, had a trampoline at home. His brother was in Grade 1 at the same school.

Student K, female, was labeled by staff and her mother as learning disabled. She was quick at answering the questions in the interview and had good recall of the Roadshows. Her mother was a member of the Parent Advisory Committee. Her younger brother also attended the same school.

Student L, male, was not interviewed due to illness.

Student M, male, was a last minute substitute for student L. He was considered by his teacher to be learning disabled. He was obviously confused during the interview and answered the questions about the show without having attended.

To provide information about the students' experiences with SCIENCE WORLD, the group of students who attended the Arcs and Sparks show were asked to raise their hand if they been to SCIENCE WORLD. Of the Grade 4, 5, 6, and 7 students, about
75% (69/92) of the students put up their hands and about 13% (12/92) indicated that they were members of SCIENCE WORLD.

Information collected from the interviewed students before the Arcs and Sparks Roadshows program is presented in Table 1 (Appendix 3). In answer to the question "Have you been to SCIENCE WORLD before?" all of the twelve interviewed students said they had been to SCIENCE WORLD in the past. All twelve students said they liked it. Throughout the interviews SCIENCE WORLD was mentioned by the interviewees in several different ways. Eleven students said they had seen the equipment used in the Roadshows at SCIENCE WORLD. Student A said he wanted to go to SCIENCE WORLD on two different occasions. Student B wanted a membership to SCIENCE WORLD. Student A also said that SCIENCE WORLD and the SCIENCE WORLD show (Roadshows) came to mind when he thought about the word science.

Table 1 shows a variety of comments about SCIENCE WORLD and the OMNIMAX® Theatre including "it is cool" and "I had fun". All the interviewed students had positive experiences at SCIENCE WORLD. The students spoke to family members, teachers, fellow students and their friends about SCIENCE WORLD, its exhibits and movies. According to the interviewed students, their teachers used the exhibits at SCIENCE WORLD to relate to what was being taught in the classroom.

The sleep over or Camp-Ins program at SCIENCE WORLD was mentioned by interviewed students. Those who had attended the program said it was a positive experience. For some students, the sleep over was the only experience these students had with SCIENCE WORLD. The interviewed students said they asked questions
during SCIENCE WORLD visits or following. The students asked why and what questions. One student said SCIENCE WORLD taught her a lot.

Table 2 (Appendix 3) also gives information about the students previous experience with science, in this case through the Roadshows. Only student B knew the name Roadshows before the present study began. She had seen a Roadshows program previously when she was very young, but did not remember much from the experience. "I just know it was fun" was all she said.

Table 2 indicates that students were familiar with the Roadshows. Students knew the name Roadshows and if the Roadshows had visited their school previously. Many of the students had only heard the Roadshows name from their teachers before their interviews on March 10th as a part of the study. Some students said they heard the name Roadshows from their parents due to the school newsletter that was sent home. Eight of the twelve students interviewed said that they had heard about the Roadshows.

The teachers spoke to their students about the Roadshows before it visited the school for this study. The teachers liked the Roadshows and wanted the Roadshows to return to the school according to student K. It is unfortunate that one of the teachers told the students that the Roadshows program was good before the students saw it. Without knowing it, the teachers may have influenced the student's opinions. The Principal, Mr. H., and the Grade 5 teacher, Mr. B., had seen the Roadshows previously at other schools. The Roadshows had never visited this school before March 17, 1994.

Table 3 (Appendix 3) shows that the students had experiences with science through museums and other science oriented places. The 12 interviewed students had been to
some 13 different science oriented places. Four students said they had not been any places related to science.

These data show something of the students' past experiences with science at SCIENCE WORLD and other places.

4.2 Students' Curiosity and Interest in Science.
The researcher thought it was important to make some judgment about students' interest in science before and following the Roadshows. Various questions were asked in the interviews to solicit information. The findings are presented below.

Tables 4 to 7 (Appendix 3) indicate the students views about science. One hundred percent (6/6) of those students asked about science before the show thought that science was sometimes a hard subject, but not always. Of the students who were asked about scientists, 78% (7/9) students said that scientists did not really need to be especially smart. Only 22% (2/9) students said that scientists are smart.

The stereotypic view that science is a very hard subject and that only really smart people do well in science did not seem to exist for these students before the show. Their opinions about science were positive before the show.

Table 5 (Appendix 3) shows that 92% (11/12) students said they liked science before the show. One hundred percent (11/11) of the students stated they liked science following the show. One of the students who did not like science before the show, liked it following the show.
Students were asked about the science they did at home before and following the show to help reveal their interest in science. Table 6 (Appendix 3) compares the science that was done at home by these students before and following the Roadshows. The table includes hobbies, but does not include science fair projects.

None of the students interviewed before the Roadshows said that they experimented with electricity. Forty-five percent (5/11) of the students said they would do science at home related to electricity following the Roadshows. Following the show, 73% (8/11) of the students said they would do more science at home because of the Roadshows. Of the interviewed students, 45% (5/11) said they would do some different science following the show.

Table 7 (Appendix 3) shows a comparison of the types of Science Fair projects that the students completed before the Roadshows with project ideas they are considering for their next project. Initially there was no intention of focusing on Science Fair projects, but during the course of the interviews students talked about their projects when asked about the science they do at home. There were several students who said they would create electricity oriented Science Fair projects following the Roadshows.

Ninety-one percent (10/11) of the interviewed students chose Science Fair projects that have to do with electricity following the Roadshows. This is a change in the types of projects they completed the previous year.

The students were asked about their interest in the equipment following the show as another way to see if their interest in science had been affected by the Roadshows. Table 8 (Appendix 3) shows what the students thought about the equipment both before and following the show. Before the Roadshow, they saw the photographs of the
equipment. The students were asked if they thought the equipment was more interesting before or following the show. They were also asked if they would like to work with the equipment before the show and if they would like to work with it more following the show. The answers to these questions reveal changes in the students' ideas about the equipment used in the Roadshows. Eighty percent (8/10) of the students who were asked said that they thought the equipment looked interesting before the show. Twenty percent (2/10) students thought that the equipment either looked scary or not interesting before the show. Following the Roadshows, 100% (10/10) students said that they thought the equipment was more interesting.

Eighty-nine percent (8/9) of the students said that they wanted to work with the equipment before the show. Only 11% (1/9) of the students did not want to work with the equipment before the show. Eighty-two percent (9/11) of the students said they wanted to "work with the equipment more" following the show. Eighteen percent (2/11) students did not want to "work with the equipment more" following the show.

4.3 Students' Ideas About Science
The students thought about science in a positive way before the show. Ninety-two percent (11/12) students thought positively about science following the Roadshows. Some changes were seen in the answers students gave when asked "what comes to mind when you think about the word science?". Table 9 (Appendix 3) shows the changes over the four interviews. Eighty-three percent (10/12) of the students changed the way they thought about the word science. Many students attributed the change in their answers to their experience with the Roadshows.
4.4 Students' Ideas About Asking Science Questions

The Roadshows emphasizes that it is acceptable to make mistakes, that it is good to ask questions, and it is valuable to be curious. Table 10 (Appendix 3) shows the comparison of the students' ideas about asking questions before and following the Roadshows.

Before and following the Roadshows, the students asked questions and thought that it was acceptable to ask questions when they were curious about something. Table 10 shows that 90% (9/10) of the students before the Roadshows said that they asked questions when they were curious about something. Only student K said that she did not ask questions "very much". The students who said that they asked questions said they asked mostly how, what and why questions. They were resourceful in trying to find the answers to their questions by asking parents and other relatives and consulting books and libraries.

Eighty-eight percent (7/8) of students said they would ask more questions following the Roadshows. Student G said she would not ask more questions following the Roadshows. Somewhat contradictorily, she agreed with student H that if you know more you will ask more questions. Some students thought that if you did not ask questions you would not learn anything. They thought that it was acceptable to "make mistakes so you learn". Several of the students also said that many of their questions were answered by the Roadshows.

All the students (11/11) said they were more curious "about things" following the show. They were curious about electricity and specific pieces of equipment from the Roadshows. They asked the researcher questions during the interviews about these things. This new interest appears to be directly linked to the content of the Roadshows.
4.5 Discussions Stimulated by the Roadshows

The findings indicate that there was discussion and thought about the Roadshows following the presentations. All of the students (11/11) who saw the Roadshows and were interviewed talked to relatives about the Roadshows at some time during the five week interview period. All these same students also talked about the show to people outside their families, including friends. Tables 11 and 12 (Appendix 3) show what was discussed between the students and their families and between the students and their friends.

The students were asked over the three post-Roadshows interviews "did you talk about the Roadshows following the show?" and 78% (18/23) of the students said yes. Three out of four interviews, the students said that their parents or relatives had a comment about the Roadshows. During each interview, 75% (6/8) of the students said that they talked to their relatives about the Roadshows. About half of the parents had a comment to make every week their child was interviewed. About half of the families discussed the Roadshows every week their child was interviewed, according to the students.

Table 12 (Appendix 3) presents comments on conversations between the interviewees and their friends. Students B and E each said they had two separate and distinct conversations with their friends about the Roadshows. The rest of the students noted they had only one conversation. Most of the students said they talked to one or two friends about the Roadshows.

The Grade 5 teacher asked the students to keep a record of whom they talked to about the Roadshows. This was not requested by the researcher, but revealed some
interesting information. The students made this record on April 13, 1994, the day before the last interviews. The data are presented in Table 13 (Appendix 3). Eighty-five percent (17/20) of the students who recorded their answers in class had conversations about the Roadshows. Only 15% (3/20) said they did not talk about the Roadshows. Some 50% (10/20) of the students identified their records by writing their names on the paper. These data provide confirmation of conversations taking place between non-interviewed students and their families.

Additionally, school staff talked about the program with a variety of people. Some comments were overheard by the researcher in the staff room, some were heard and reported by students, and some comments were made directly to the researcher. Some data was revealed from the questionnaires the teachers completed (Appendix 2.6).

According to one student, Mr. H., the principal, said the Roadshows were good. Mr. H. was standing in the doorway to the gym when this comment was heard. The principal also filled out a questionnaire following the Arcs and Sparks show and indicated he thought the show was excellent. He liked the student participation and the underlying message - "not to play with electrical things and to respect its power". He said he talked to parents, teachers, students and that they all agreed the Roadshows program was an excellent presentation. When asked about the effect on him he said "I've seen the show 2-3 times previously". He has heard other staff say the program was excellent as well. He also said "certainly in the school we look forward to a return performance next year". He believed that the Roadshows "will have a lasting impression on people" and he also said he thought that "the students gained an increased understanding and appreciation of electricity". He believed that the impression will be longer than 3 weeks.
Ms. G, the Grade 2/3 teacher, attended the "primary oriented one" (Science Carnival show) and thought it was excellent. She liked the hands-on aspect of the show and thought it held the students' attention. She said she talked to students, other staff members and family about the Roadshows. Other teachers talked about the students' reactions and comments. She reported that colleagues heard students' reactions. Some of these reactions revolved around content including the water "trick". She told her own family about the content of the Roadshows including some of the experiments presented. She says that it is unlikely that the Roadshows will have a lasting impression on the students. She thinks that "children have so many stimuli presented to them in a day and over the course of a week. Their attention spans are short. They really enjoyed the presentation but for it to have any lasting effect there would have to be repetitions and follow-up".

Comments from the Grade 3 teacher came from both informal discussion with the researcher and from the questionnaire. Of all the teachers Mrs. H.'s comments were the most abundant and the most positive about the Roadshows experience for her students, her daughter (student E) and herself. Mrs. H. saw one of the Science Carnival shows with her Grade 3 class. She thought the program was "Wonderful! Stimulating! Exciting!". She liked all of the demonstrations where a scientific explanation was given (this accounts for a large proportion of the demonstrations except the last one with the water disappearing, see Footnote 1). She liked the demonstration with the cups (see Footnote 1) the least because no explanation was given and she "couldn't duplicate the results and because [she] could offer nothing to [her] students in ways of hints, tips or explanations". She asked for the explanation.

1 This water trick is a version of the shell game, but instead of the pea disappearing, water disappears.
She talked to many different people including students, other staff, family and parents of students. She talked about the Roadshows and "how it caught the student's interest and enthusiasm, how all students in class wanted their own 'hands-on' experiences and a chance to make their own observations and hypotheses based on their own experiences, how it was very good value for the money spent, how valuable it was for students who may otherwise never have opportunity to visit SCIENCE WORLD".

She thought that the program had an effect on her. She thought that it "rekindled [her] excitement and enthusiasm for science, reaffirmed how basic science principles can be demonstrated simply and inexpensively, for the most part". When asked if she would do more science, she said she already does a lot, but would like to "refocus so there is more hands-on experience for each student".

When asked if she heard the students talk about the program, she was uncertain "because we were so busy moving out of our classroom and preparing it to be painted, then Easter Break arrived". She did say, however that she heard the staff talking about the program. She said they were "all very excited about what they'd seen, some thought they understood better the science principles that they had learned in school".

Mrs. H. also noticed some increase in student interest in science. She noticed this even more in her daughter (student E). In addition, she noticed an increase in the number of questions that her students asked about science. She said that "some students have come to see that being a 'scientist' is not knowing lots about science, but is being curious about science and wanting to find out the why and how".

This teacher was not sure if there has been an influence on the school due to the presentation. She "certainly hope[s]" that there will be a lasting impression on people
due to the program. She said that the science fair was a great success and she thinks that "following experiencing the Roadshow, students will be more excited, prepared and confident for next year's science fair".

The Grade 4/5 teacher's comments are taken from the questionnaire. Ms. W. saw the Arcs and Sparks show and thought it was excellent. She liked the demonstration of how current passes from one person to another the best because it was "impressive and a valuable lesson". She said she talked to students and other staff about the program. The staff talked about the fact that "it was good to have it [the Roadshows] come to school, so all can see it. [It] would not be possible to take all children to Science World with present budget constraints".

Mrs. W. said the Roadshows had an effect on her because the program was a reminder of how to keep safe around electricity and it gave her more understanding. She did not hear the student talk about the SCIENCE WORLD program, but she has heard the staff talking about them. She thought that the influence on the school has been the "intent to use the program again". She believes that the Roadshows will have a lasting impression on people and she also believes that this will be longer than 3 weeks.

The Grade 5 teacher did not attend the Roadshows, but he talked to his students before the show. He told them to behave, told them that some students would be interviewed, told them that he had seen the Roadshows in the past and that the program was good. He wrote report cards while the show was on. Following the Roadshows presentation he asked the students how it was, asked them to make drawings and asked them to record their comments. In response to the questionnaire that was given to him to fill out, he said "unfortunately, I didn't see the show. I hope you don't get the idea that I wasn't interested. I have seen them in the past and the
students are generally 'wowed' by the demonstration". In response to specific questions about the Roadshows he used the students comments (Table 13, Appendix 3). In response to other questions he said "I am certain if we were to discuss the activities presented [in the Roadshows] and follow-up with the lessons, there would be much more of a lasting impact on teachers and students. Unfortunately, there have been so many other distractions and priorities that have prevented us from building on the presentation (i.e. skating, holidays, upcoming fun fair)". According to a student "Mr. B. asked if it was good because he wasn't there so he wanted to know what it was about. He said he should have been there but he couldn't". Students E and F said they talked to their teacher about the banana and what happened with that demonstration.

The SCIENCE WORLD evaluation form given out to each school was completed by the Grade 6/7 teacher (Appendix 4.1). One question asks about special needs students. The Grade 6/7 teacher wrote that these students' needs were being met during the program, "the program had lots of visuals for the deaf student". He said he would recommend the program to another teacher and would book the program again. The educational content was rated at a 9/10, the suitable questions category was given a 9/10, the question on variety of materials was given a 10/10, the amount of student interaction was rated a 10/10.

The Grade 7 teacher filled out the researcher's questionnaire. This teacher saw half of the Arcs and Sparks show and thought it was good. He said he talked to students. He did not notice any change in the students due to the program.

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2 The banana was used with liquid nitrogen to show what happens to cells when they are frozen.
Eighty-three percent (10/12) of the parents had something positive to say about the Roadshows program. Two parents were unable to comment.

The librarians also had conversations with students about the science in the Roadshows. These conversations and the number of books taken out of the libraries were used as other indicators of the Roadshows' effect within the community. They were also used as an indicator of the students' thinking about the Roadshows.

It was a challenge to try to discern if more books were taken out of local libraries in the area because of the Roadshows. The school library was closed for painting and the school librarian was on holidays, so the school library did not offer resources for the students during the study. Many of the students talked about using the local public libraries, however.

Most of the students said they did not take any books from the library on topics from the Roadshows. One student said it was because the library at the school was not very good, another student related the story about her sister in Grade 4 who took a science book out of the library. "I forget the name of it. It had a bunch of science stuff in it and it tells about what they do and stuff" (student I). She seemed to think that perhaps her sister took this book out because of the Roadshows. The older sister, student I, looked at the book as well.

Student E said she wanted to take a book out (on electricity) but did not. Student F said that he had no time, but that he became more interested in electricity following the Roadshows. Students C and D said they "sort of" wanted to take books out on electricity. Student A said that he looked at his own books as did student B. She has two books that she looked at and she looked up liquid nitrogen, Plasma Ball and
Jacob's Ladder. Jacob's Ladder was not in the book. She said that the book talked about what would happen if you put your hand in liquid nitrogen. Student A said that he "did not really look anything up" but he did some "science stuff" including an experiment he performed previously on volcanoes. This boy also said that he was going to take a book out of the library, but he was too busy the night of the show because it was his birthday. He wanted to take a book out about who invented "those things".

More students said they would take books out than actually followed through with the idea. If the school library had been open, perhaps more books on Roadshows topics may have been taken out. When the librarian came back from holidays, she said she did not notice any increase in requests about books on electricity, but this was three weeks following the Roadshows when she returned.

The community Librarians were asked to record the number of books and conversations about SCIENCE WORLD, electricity and other related topics to the Arcs and Sparks show, that occurred during the study period. The head librarian sent a memo to the staff in the community libraries part way through the study to ask them to record this information. At the Daisy Library, over the final 2 week period of the study, (March 31st to April 14th), there were 4 inquires and 4 books on electricity and magnetism taken out. At the Clover library, slightly closer to the school, there were 10 inquiries and 10 books on electricity and magnetism taken out. The Daisy Library reported that from all the libraries in the area, 19 students in the Kindergarten to Grade 7 range asked about electricity books and projects between March 28th and April 14th. Student B said she talked to a librarian and asked if the library had any books on liquid nitrogen. This was at the Nelly Library.
Of the libraries which participated in the study, the closest one had the highest number of requests recorded for science books in comparison to the other libraries, but it is possible that there were more inquiries and books taken out earlier in the study period and the librarians did not catch the information at that time. There is no system in place at the libraries to record the number of science books taken out in a week. The head librarian said that the most popular books for students in Kindergarten to Grade 7 are the dinosaur books and ones on animals, especially cats. The week of March 25th, planets seemed to be popular. There was no obvious increase in the lending of books on electricity.

Another indication of students' conversations about the Roadshows was provided by toy store clerks. It was expected that some of the students would talk with shop keepers about buying materials they saw in the Roadshows. Of the shops in the area around the school related to science materials, the Science and Nature store in the Public Market was mentioned the most by the students. This was also the store that seemed to have had the most number of inquiries from the students about a piece of equipment found in the Roadshows. Whether the number of inquiries about the Plasma Ball in this store was more than usual, the clerk could not say.

Two other stores, the Hans Christian Toy store and the Science and Nature Store in the Shopping Mall both had questions from a student that may have related to materials used in the Roadshows, but the clerks were not sure. Student B said she went to a store and "I asked him if he had any books on like the Plasma Ball".

Eighty-two percent (9/11) of the students said they wanted to buy a Plasma Ball and 7% (1/11) of students said they also wanted to buy the static electricity ball (Van der Graaf Generator). Eighteen percent (2/11) of the students said they did not want to
buy anything. It is doubtful that any of the students will ever buy Plasma Balls due to the expense. They also commented that it was expensive for them.

Students were also asked to phone the researcher if they had any comments or questions. According to Mrs. H., the students in the older grades should have had "no trouble picking up the phone and calling" as phones are a part of their lives at an early age. However, only 17% (2/12) of the interviewed students said they tried to phone the researcher (students B and E). Student B said, she called and the line was busy. She wanted to ask when the pictures of the equipment were taken and where they were from. During another interview she said she wanted to phone to ask if the researcher had ever tried experiments with the equipment such as the Plasma Ball. Student E said that her friend tried phoning again, but the answering machine was on. She wanted to ask something about the bucket of nitrogen. One other call recorded on the researchers' answering machine could have been student E, but no message was left, only giggles. Potentially as many as five different calls could have been made by the interviewed students and their friends. In the interviews, students said they tried to call the researcher. Because no other calls were received, it safe to assume that this method of initiating conversations was not successful. It is true, however, that some of the conversations about the Roadshows between students who participated in the Roadshows and their relatives did take place over the telephone.

4.6 Students' Thoughts About the Roadshows

The students were asked to record what they thought of the Roadshows: (liked, disliked, not decided) on the provided questionnaire (Appendix 2.3). Table 14 (Appendix 3) shows the results from the questionnaires handed out to the students. They were asked to indicate their judgment of the Roadshows program by circling one of three faces - a happy face, a neutral face or a sad face. One hundred and seventy-
five of the questionnaires were returned from a possible maximum of 280 participants. Not all teachers gave the questionnaires to their students, and some students were absent. Eighty-seven percent (153/175) of the students (Kindergarten to Grade 7) chose the happy face on the questionnaire to indicate their judgment of the Roadshows. Eleven percent (20/175) of these students circled the neutral face. Less than one percent of the students (1/175) circled both a neutral face and a happy face. This was counted as a neutral face.

To check to see that the students had interpreted the meaning of the faces correctly, the interviewed students were asked why they circled the happy faces on their sheets. Students C and D said they liked the show and this was their reason for circling the happy face. Students A and B said "I felt good" following the show. Student F said "because it was quite good and it was fun" and E said "it taught us quite a bit". H said "cause it was a good show and it was funny and I learned a lot" and G also said "I learned a lot". Student J said he circled the happy face because "cause I liked it" and student I said "cause some of it was pretty funny. When some people had to stand in the box and shake their hair I thought that was funny. I liked the show". Student K also said she liked the show. When asked what they thought when they left the show, student E said "I didn't really want to leave" and student F said "yeah I didn't want to leave. I wanted to try everything out like all the stuff that they showed". Student K said she was sad that the show was over. The students also said the show was "really good". For the Grade 5 students, the show was a positive experience. Their meanings for the happy faces were all slightly different, however.

The student were also asked to rate the show on a scale of 10 (1, worst to 10, best). This was used as an additional measure of student judgment of the Roadshows.
Eighty-two percent (9/11) of the students gave the Arcs and Sparks Roadshow a top 'mark' of 10. Eighteen percent (2/11) of the students rated the show 9/10. These scores of 9 were reported as "9.75" and "9.99" and were chosen by the students themselves. Students H and B gave these responses. These answers were consistent over the 4 week interview period. Students explained why they gave these marks by saying "because it was good" (student B), "because it was good, fun educational and I learned a lot" (student A).

4.7 Students' Memories of the Roadshows
This section examines interviewees' recognition of equipment from the Roadshows as well as what they remembered and learned. A comparison will be made between what students recognized before the Roadshows and what they recognized following the Roadshows. In addition, what they said about the pieces of equipment before and following the show is also tabulated.

Table 15 (Appendix 3) shows what the students recognized before the Roadshows. Before the shows, all the students who were interviewed (6/6) said they had seen the Plasma Ball previously. They were not always sure where they had seen the equipment, but SCIENCE WORLD was given as the location as well as the Science and Nature Store.

Thirty-three percent (2/6) of the students said that they thought they had seen a Tesla Coil before the show. It is likely that the only place that the two students could have seen a Tesla Coil was at SCIENCE WORLD. Thirty-three percent (2/6) of the students thought they had seen a Jacob's Ladder before the Roadshows, but they misidentified it as a bubble maker (students E and F in Table 15, Appendix 3). It is possible that the bubble maker in the Main Gallery at SCIENCE WORLD looks like a
Jacob's Ladder, explaining the incorrect identification of this piece of equipment. Some of the students said that in the past they thought they might have seen a Jacob's Ladder in a movie (Table 17c, Appendix 3). None of the students thought they had seen the Van der Graaf Generator before the Roadshows (Table 15).

Table 15 shows the recognition of the Roadshows equipment by the students following the Roadshows. One hundred percent (11/11) of the students who saw the show and were interviewed said that they recognized the Plasma Ball. This percentage is the same as before the Roadshows. Students C and D recognized the Plasma Ball from SCIENCE WORLD visits before they had seen the Roadshows. After the Roadshows they attributed their recognition to seeing the Roadshow.

Ninety-one percent (10/11) of the students recognized the Tesla Coil following the Roadshows. This is an increase in recognition from 33% before the show. There is very little chance that the students saw a Tesla Coil any other place other than at the Roadshows or at SCIENCE WORLD. This indicates that the Roadshows was responsible for the change in the number of student who recognized the Tesla Coil. Table 16 (Appendix 3) shows the recognition of equipment following the Roadshows for all four pieces of equipment.

Ninety-one percent (10/11) of the students also recognized the Jacob's Ladder following the show, whereas no students correctly identified it before the show. One student said that he thought he saw a Jacob's Ladder where his father works at BC Hydro. This is entirely possible, as BC Hydro builds equipment such as this for demonstrations.
The Van der Graaf Generator was also remembered by 91% (10/11) of the students, but by different students who remembered some of the other equipment.

A set of 24 tables (Tables 17a to 22d, Appendix 3) delineates the comments the students made about each of the four pieces of equipment over the five week interview period. A table is presented for each student for each piece of equipment used in the Roadshows. This representation allows for a comparison between what the students said before and following the Roadshows. Not every student had something to say about each piece of equipment during each interview. The results for equipment recognition from the students who participated in only one interview are tabulated in Tables 23, 24 and 25 (Appendix 3).

Table 26 (Appendix 3) shows the responses from the students for the questions "Did you think about the show after you had seen it or not?" and "What did you think about?". This table shows that 100% (11/11) of the students did think about the Roadshows after seeing the program. They thought about a variety of things all of which were positive responses to the show.

The students' drawings showed what they remembered and thought about the Roadshows. Tables 27, 28 (Appendix 3) show the types of drawings the Grade 4 to Grade 7 students made following the Arcs and Sparks Roadshows. The total number of drawings are divided by grade in the tables and by the pieces of equipment drawn most frequently. The tables show the percentage of students who chose to draw each piece of equipment. These tables reveal information about which demonstrations were the most popular. Many students drew more than one demonstration. Students' reasons for their choices of drawings were found on some drawings and were elicited
through the interviews. The major demonstrations presented in the shows are listed in Appendix 4.2.

Table 28 (Appendix 3) shows the percentage of interviewees who drew each demonstration. Ninety two percent (11/12) of the interviewees drew the Plasma Ball. In contrast, 25% (3/12) drew the Van der Graaf Generator, 17% (2/12) drew the Liquid Nitrogen, and 17% (2/12) drew the Tesla Coil. These numbers are similar to the group of Grade 4, 5, 6 and 7 students (Table 27, Appendix 3) except for the Plasma Ball. The percentage of Plasma Ball drawings for the Grade 4, 5, 6 and 7 students together is only 54% (46/85) in comparison to the 92% (11/12) of the interviewees. In the younger grades, Kindergarten to Grade 3, the Plasma Ball was common in their drawings. An average of 79% (53/67) of the students drew the Plasma Ball. Samples of the drawings by the Grade 5 students are presented in Appendix 5 as Figures 5-9.

Table 29 (Appendix 3) shows what the student said they learned or remembered from the Roadshows presentation. The students remembered details from the Roadshows. Table 30 (Appendix 3) shows the items the students saw at home which reminded them of the Roadshows. These items included lamps and lightening.
Chapter 5 Discussion

Many of the results from this study speak for themselves, however some need interpretation, explanation and details added to them to make their meaning more evident. This discussion will address the six questions under investigation for this study (Chapter 1, page 8) and will follow the order of the results as they have been presented in Chapter 4. Reference will be made to the tables in Appendix 3 where necessary. Comparisons to the literature will be made throughout the discussion.

Following the discussion of the study questions, the impact of the Roadshows on each child will be delineated. At the end of the chapter, the methodology and study assumptions will be discussed.

5.1 Students' Previous Experience with Science

Before each study question can be examined, the students' previous experience with science needs to be understood. This understanding provides the framework for comparison of the students' reactions to science after the Roadshows.

The students were relatively unfamiliar with the name Roadshows at the beginning of the study. By the end of the study, however, the students used the term and answered questions about the Roadshows without hesitation. In the interviews, there was an assumption about using the word. It was assumed that the students were familiar with it. The questions repeatedly used the word Roadshows. Questions like "what do you remember about the Roadshows?" were asked and the students had no trouble responding. Following 4 weeks of interviews following the Roadshows, many of the students would have heard the term Roadshows many times. There was a change in the students' familiarity and usage of the word Roadshows following the Roadshows. This was obvious because of their lack of familiarity with the name before the show.
Although many of the students had not experienced a Roadshows presentation, many of them had other science experiences through visits to museums, science stores and science-related venues. The students were not always specific about the science place that they had been to, for instance "museums with artifacts" (student G Table 3 in Appendix 3), but some of the students remembered the name Science and Nature Store or the Art Museum. The students did not distinguish between a natural history museum and an art museum which may indicate a very loose definition in their minds about what a science oriented place would be about.

The reasons that some students said they had not been to any science oriented places could include that they may not have understood the question, may not have remembered going, may not have had any field trips or trips with their families to these types of places. It is the researcher's impression, that the 4 students in Table 3 who said they had not been to any science oriented places have been to some of the places mentioned by the other students, but did not think of them during the interview. The term "science oriented place" may not have meant anything to them. Although 4 students did not identify a science oriented place that they had been to, 8 other students said they had been to a science oriented place such as SCIENCE WORLD.

It was surprising that the Science and Nature Store was mentioned several times as a place the students visited which related to science. The researcher did not consider this store to be a science oriented destination, but obviously some students did.

Several students experimented with science at home before the Roadshows. In addition to a well rounded exposure to science outside the classroom, these students also talked about science experiences in the classroom or for school. Many of them talked about Science Fair projects.
5.2 Students' Interest in Science

To find out if the students were more interested in science following the Roadshows, information was collected on their thoughts about science and curiosity before the show. Tables 4-7 (Appendix 3) show that the students were curious about science before the Roadshows, but these tables also show that there was an increase in the students' interest in science. This was particularly evident in student K's case. She did not like science before the show, but liked it following the show. She attributed this change to her experience with the Roadshows. It made her "more interested [in science]". Even her mother commented on her daughter's change in attitude and thought her daughter's change was due to the Roadshows. All the other students interviewed said that they liked science more following the Roadshows. They were asked this question several times over the course of 4 weeks and their answers were consistent. Table 5 shows the comments the students made about liking science before and following the show.

The general consensus from the students was that they perceived science to be more fun following the Roadshows. Some of them thought science was boring before they saw the Roadshows. They expected the Roadshows to be fairly boring, but were surprised to find out that the shows were not. Student B imitated what boring science was like, by drawing out words a scientist might use (Table 5). When asked what she thought about science following the show she said "fun science". Many of the students also said that they thought they understood more, knew more and learned some things about science because of the Roadshows.

The science the students worked on at home also gave an indication about their interest in science before and following the Roadshows. Many students read and
experimented at home. The 45% increase in experiments on electricity following the show could indicate a significant rise in students' interest in electricity. However, the students were not asked explicitly if they ever experimented at home with electricity. In hind sight, this question would have assisted in the interpretation of the results and the conclusion drawn here could be made with more certainty. It is clear, however, that there was some increase in interest shown by the students about doing experiments on electricity at home.

The results also show that 73% (8/11) of the students said they would do more science at home because of the Roadshows, but it is optimistic to believe that all of these students would follow-through with their intentions. It is unlikely that they would all do more science at home, but there may be a few of them that will follow through. Student E, who experimented with static electricity several times during the 5 week interview period, is a likely candidate. Students B, F and I all seemed to follow-through with experimental ideas over the interview period as well. During the interviews they said that their experiments were somewhat related to the Roadshows. Sometimes they attributed their experimentation partially to the show. For these students, the show might have motivated them to participate in more and different science activities at home.

Both students K and G said they would not do more science at home. Student G's reason was that "no I'd rather not do science". Student G in particular was quite firm in her answer, yet earlier had not shown such disdain for science. The results show that 27% (3/11) of the students would not participate in more science activities at home because of the Roadshows. This is perhaps a good indication of the percentage of students who were not turned onto science by the Roadshows. This may have been
because they already had a negative feeling about doing science before they saw the show.

Many of those students who said they would do more science at home also said they would do "different science" (45% (5/11), Table 6, Appendix 3). Student E following the show said "well I wanted to take that booklet out and try some other things from it". Student A said "it'll be really different. More electricity and I'll do more experiments with it and this time I'll try to do different things with it and add more things". These students intentions to do different science at home are convincing. Student A is one of the students that will probably follow-through with his ideas because of how keen he was in the interview. He always wanted to know answers to questions during the interviews. These students appear to have been influenced by the Roadshows to engage in more science at home.

Student J said he would do the same kind of science at home as he did before the Roadshows. For some of the students it is evident that the Roadshows did not give them ideas about how they could participate in different types of science at home. Student I initially said she would not engage in any different science at home because of seeing the Roadshows. Later she said she got the "electricity part" of an experiment idea she did at home from the Roadshows. It is possible in some of these cases that the students themselves did not know how they have been affected by the Roadshows. Indeed, it is possible that they may never know why they have a new interest in electricity and may never attribute it to the Roadshows at all. This possibility only makes the interpretation of these results more complex. This study must depend on the students' ideas in order to determine the impact the show has on them. There are, however, other indications of the impact the show has had on the students. There are data provided by the study which point to an impact from the Roadshows without a
conscious effort from the students. Such is the case with the students' choices of Science Fair projects.

The students easily spoke about their Science Fair projects before the Roadshows. Before the show, the students said that they talked about their Science Fair projects a lot to their friends. Following the Roadshows, 91% (10/11) of the students chose new Science Fair projects that related to electricity following the Roadshows. None of the students had performed experiments on electricity in the previous year. This change in topics suggests a large impact on students' interest due to the Roadshows.

While initially, these results appear excellent, there is always another way to look at the answers from students. These results could also be due to the way the question was asked about Science Fair projects. By asking the students if they thought of Science Fair project ideas from the Roadshows, there may have been too much leading. The students may have thought a need to please the researcher and therefore, needed to decide on a project that related to electricity and the Roadshows. This could be the case with student K especially. By mentioning the show, the students may have been given an idea about what to answer or what the researcher was looking for. The question should have been more neutral, such as "what do you think you will do for your Science Fair project next year?". This implicit questioning technique would have been a better test of student K's and the other students' plans. Fewer students may have chosen projects on electricity with different questioning.

The students agreed that they may not be able to follow up on their ideas for their Science Fair projects. Student E mentioned that she might not be able to find the materials she learned about in the Roadshows for her Science Fair idea. Students also said that some of the equipment they wanted to use for their project was dangerous
and so this might stop them from doing projects on topics related to the Roadshows. This probably means that at least two or three fewer students will be able to plan a project on electricity next year.

Two specific students, C and F, are likely to carry out their plans for a science fair project next year on electricity. These students worked together last year on a project. At the time of this study, they were both interested in doing a project next year on electricity. It is apparent from their comments that they were thinking a lot about their project ideas before the topic came up in the interviews. It was obvious because they lacked any hesitation when asked the question about their next year's project ideas during the interviews. It seemed that they already had ideas formulated in their heads before the question was posed. The Roadshows may have made them think about their plans for next year. The timing of the Roadshows, just following the Science Fair, may have played a role here. The new information in the Roadshows may have made them think about projects. The interviews and listening to their classmates talking about their projects may also have influenced the students' thinking about projects for next year.

Another indication of the students' interest in science following the Roadshows was their interest in the equipment used in the show. Table 8 (Appendix 3) shows that there is an increase in the student's interest in the equipment used in the Roadshows following the show. The answers the students gave to questions about the equipment revealed changes in their ideas. They were more interested in the equipment and wanted to work with all the pieces more following the show. Student A thought differently about the equipment following the show because "well I know more about it now and I know what it does". He agreed with student B that he understood the equipment more and said "I'd like to do experiments with it". Student B said "I know
more about it, I like it, I understand it more" and she thought differently about the equipment following the show. Student C said he knew how dangerous the Tesla Coil could be. Student D said she knew what the equipment pieces could do and that was why she thought differently about them. Student E said "before she really didn't know how they worked, but now... " She knew more about the equipment following the show because she saw the show and the show talked quite a bit about it. Student F thought that the show taught the students a lot about how the equipment worked and he learned "quite a bit about them". None of the students said the equipment looked uninteresting or scary following the show as they had before the show. Their comments indicate an increased interest in the equipment following the show.

The comparison of answers before the Roadshows with answers following the Roadshows provides evidence which points to an over all increase in the students' interest in science due to the Roadshows. Their increased interest in the equipment, their electricity Science Fair project ideas and their other answers about their interest in science have provided this evidence.

5.3 Students' Ideas About Science
The second question in this study relates to the students' ideas about science. Did they change their idea about what science is due to the Roadshows? According to Table 9 (Appendix 3), 82% (9/11) of the students changed their ideas about science. Some students did not realize that their ideas had changed, but in comparing their answers before and following the show, there was evidence of a change.

In probing for more information about the way that the students thought about science, they were asked what came to mind when they thought about the word science and if that was a positive or negative thought. Two students gave answers that
revealed a complex understanding of science. One answer was given before the Roadshows (student F) and the other following the Roadshow (student A). Students F and A were the only two students who said that thinking about science could be good or bad. Science was a good or bad thing depending upon what it was that science had done according to student F. He gave the example of someone who broke into the atom and "that wasn't good because it has made all these bombs and stuff". Student A said when he thought about science he thought it could be dangerous and it could also be good for you. Only student A's comments could have been influenced by the Roadshows because his answer was given following the show. It is not clear, however, if the Roadshows influenced his thinking on the duality of science or not. He was certainly exposed to both the dangers and the fun of science during the show, so a potential exists for an impact on him in this regard.

When the other students were asked about their answers changing in relation to the word science, the students gave interesting answers. Students E and F agreed that "I guess it [the Roadshows] changed our minds a bit of what science really is". Student E changed her mind about what she thought about science because the Roadshows were "kind of mostly on electricity, and cause I saw the show". Student A said he changed his answer because "well we are learning more, yeah the more you think about it, from the Roadshow like we just think more about it". Student G changed opinions about science because "she [the Roadshows teacher] explained it, how it works" and H also said "we know how it works now, so we can do other stuff with it". Student A before the show said that thinking about science had no effect on him, but following he said "now it has an effect on me, well now it makes me think about it and think about experiments and would it work and keep on asking questions now". Student B said before the show thinking about science made her feel "soso" which meant "some good
and some bad". Following the show, however, thinking about the word science made her "feel good".

The students thought differently about science following the show. According to student A, "we hadn't seen it and didn't know that much about it and now we know more, because I think mostly because it looks more fun than before". The students generally thought that science was more about electricity and more about experiments following the show. Not only had their ideas about the word science changed, but their attitudes had changed. They thought that science was more fun following the show. From this information it is evident that the student's ideas about science were influenced by the Roadshows.

5.4 Students' Science Questions
The third question asked in this study is "does the Roadshows stimulate more science questions?". According to their answers (Table 10 Appendix 3), 88% (7/8) of the students said that they would ask more questions following the Roadshows. These students had also said that they would ask questions before the Roadshows. Because the number of questions the students asked in the classroom was not quantified before and following the shows, the students' answers to this interview question must suffice.

Following the students' exposure to new information, it is highly probable that they would be curious about more things and would, therefore, ask more questions. It is somewhat doubtful, however, if this increase in questioning would be long term. More study needs to be performed on this topic. The new curiosity that the students had about electricity, did however, seem to be directly linked to the content o the Roadshows.
5.5 Communication About the Roadshows

The fourth question asked in this study is "what conversations and discussions were stimulated by the Roadshows?". This section focuses on the methods of communication about the Roadshows and what was communicated about the Roadshows. It examines who said what to whom. By studying the communication stimulated by the Roadshows it is possible to find out what information travelled into the community. It is also possible to suggest the importance of the communication between the students and others in the community.

A major portion of this study revolves around students' communication about the Roadshows because of the plethora of communication that took place following the show. In addition, communication about the students experience has a large potential significance to the study. It will assist in evaluating the impact of the program on the participants and community.

Communication is a social activity and in this study communication happened in many places including the school, students' homes and local businesses. According to Falk and Dierking (1992), learning "is almost always socially mediated" (p. 100). "People learn while talking to, listening to, and watching other people. They incorporate other people's ideas in their own; even feelings and physical actions are amalgamations forged during social contacts" (p. 100). The wide range of communications which took place as a result of the Roadshows both stimulated learning and are evidence of "socially mediated" learning.

All the students involved in the Roadshows had the opportunity to listen to, talk to and watch other students during the shows. Following the shows they all had more opportunities to talk to other people about their experiences. During the Roadshows
students were provided with the opportunity to participate in a social activity with others.

The interviews offered the opportunity for the students to participate in another socially mediated situation. The interviews provided the chance for the researcher to observe and hear the students' conversations as well. During the interviews the researcher observed the students adopting their interview partners' ideas and incorporating them into their own ideas. It was especially evident that student D incorporated her partner's ideas. Student D used the ideas and opinions of her interview partner, student C to answer interview questions. Student B also learned things about the machinery in the show from her interview partner student A and from discussions with other students. This was particularly obvious because she missed a portion of the show and still in later interviews had information about the demonstration she missed. During the interviews, the researcher also heard about many discussions that took place between the students and their peers, families, teachers and others in the community. These discussions are thought to offer learning opportunities for those involved in the discussions.

Over the 5 week period of the study, there were several different ways that information about the Roadshows travelled into the community including these discussions the students had. But, even before the study began, there were mechanisms for communication in the school which were used to keep people informed about the Roadshows. The booking had to be made by a teacher, then the Parent's Advisory Committee (PAC) had to be informed. The parents' group was in support of the event and printed a newsletter telling the other parents about the Roadshows coming to the school. The school posted a bulletin reminding the teachers about the program that
would be at the school on March 17th, 1994. All of these communication methods were used by the school without any suggestion from SCIENCE WORLD.

There were also some ways that the study influenced the way communication about the Roadshows travelled into the community. The study protocol for communication with the school is detailed in the Methods (Chapter 3). To summarize, the communication included discussion of the study with the School Board and the School Board's discussion with the principal. Then letters of explanation and a request to participate in the study were also received by the study school before phone contact was made. The principal then contacted the researcher and he, in turn, talked with the staff and the staff talked to the students. Some students were then selected by the Grade 5 teacher and more discussion took place about what these students would be doing for the study. Then letters went to the parents about the interviews and permission forms were attached. Students were asked by their Grade 5 teacher to return the permission forms.

There was also a meeting between the teachers and the researcher to inform them about their role in the study. Throughout the 5 weeks, the researcher regularly spoke with the teachers, secretary and principal. The researcher also spoke with the parents of the students who were interviewed. In all these discussions, information about the Roadshows was exchanged. Further exchange may have been encouraged by these conversations, in particular between parents and their children.

It was suspected before the study started that the students would talk about the program to their friends and family. It was also hoped that the discussion went further into the community, into the stores and libraries because of the Roadshows visiting the
school. This was shown to be true. There is also, no doubt, however that the research itself increased the information going into the community.

There was a large amount of communication that took place about the Roadshows, which started with the students. All the students who were interviewed talked about the Roadshows to someone. The students talked to their relatives, to their friends, to librarians and shop keepers. They talked to their teachers and were asked by one teacher to record their thoughts about the Roadshows. Teachers and parents also made comments about the Roadshows as part of conversations with the students. These adults also commented to their peers or to the interviewer.

Tables 11 and 12 (Appendix 3) show that there were many conversations that were stimulated by the Roadshows. The data indicate that, not only did the students tell their relatives about the Roadshows program, but also the families were having new conversations because of the Roadshows.

The interviews with study participants (students and parents) stimulated even more conversations. Conversations between the students and their family members seemed to be influenced by interviews. This was illustrated by students comments about new conversations they had each week with their families after their interviews. In addition, according to student A, following the researcher's discussion with student A's mother, she and her son talked about the Roadshows. The mother seemed to be unhappy that her son had not talked to her about the Roadshows, so she initiated the conversation according to her son.

If each of the 11 students who were interviewed talked to one other student, then at least 22 students had conversations about the Roadshows following the shows. Most
likely, this can be extrapolated to the other students who experienced the Roadshows, but the interviews could not confirm this. Most of the discussion between the students and their friends at school would have taken place the day of the Roadshows and the day following the shows. This is due to Spring Break occurring immediately following the first interview and only one day following the Roadshows. The students were then away from school for 10 days and had fewer opportunities to talk with their school friends.

The types of conversations the students had with their friends were different than those they had with their families. Due to the familiarity with the Roadshows, the students talked about the details of the show with one another. They talked about what they liked the best, what their friends liked the best and how "rad" some of the demonstrations were. They talked to students who were unable to attend the shows as well. When asked if they talked to their friends about different things following the show than before the show, student A said "yeah we asked each other have you seen something else that has to do with electricity. Maybe that nobody else has seen and he explains it". Following the Roadshows presentation, the researcher also heard a group of girls discussing a story they had heard about lightening, then they all exchanged ideas about what had happened in the story and about other things they had heard about lightening. Lightening was discussed in the Arcs and Sparks show. From these conversations it is evident that the Roadshows stimulated conversations between students.

There is more data to add to this evidence of communication due to the Roadshows. Table 13 (Appendix 3) presents the written answers to the question "have you talked about the Roadshows?". These results confirm what the interviews found. The students talked to their families about their experience with the Roadshows. Student G
was the only interviewed student who did not remember that she had talked about the program. Comparisons with the interview information confirmed that the students' written answers were fairly consistent with those found in the interview. It was interesting to note that only two students in this class listed the researcher as a person they talked to about the Roadshows.

Some additional details were revealed through the written information as well. Student L (one who did not attend the interview, but who saw the show) also talked to his parents about the Roadshows. The written details indicated that the interviewed students were not the only students to talk to a variety of people about the Roadshows. In addition, some of these students talked about the Roadshows more than once. This was indicated by statements such as "I talked about it lots" and "sometimes with my parents at dinner". Some students just listed off all the people they talked to which was as many as seven different people.

According to the results, 15% of the students in the Grade 5 class did not remember talking to people about the Roadshows. All interviewed students remembered talking to someone about the Roadshows. The 15% may be more representative of the larger population of Grade 4-7 students who saw the Arcs and Sparks show. There is a possibility, however, that the students did not remember talking to anyone about the Roadshows because the written information was collected almost 4 weeks following the Roadshows. Even if 15% of the student population said they did not talk to anyone about the shows, 85% of the students remain who could have talked about the show. This extrapolates to potentially 176 students in the school who talked about their experience with the Roadshows. These numbers suggest that information about the Roadshows could travel both easily and quickly to other people in the community. These numbers cannot be substantiated by this study, but, it is known that 17 students
in the Grade 5 class talked with others about the program, spreading information about the Roadshows into the community.

The teachers talked about the Roadshows as well. Their discussions furthered the communication of information about the program into the community. The teachers made conclusions about the Roadshows and the program's impacts on the students. These conclusions were communicated to the researcher by the questionnaire and informal conversations.

Most of the teachers said they did not hear a lot of communication about the program and hence did not think the Roadshows had an influence on their students. They also said the program did not have an effect on them personally. While this is a fair assessment for themselves in the short term, it may not be a good assessment for the students. The 9 day interruption in their contact with the students over the Spring Break undoubtedly resulted in the teachers hearing fewer discussions about the Roadshows. The conversations reported by the students are likely more representative of their communication about the program.

In addition, it is also possible that, while the students were in school, the teachers did not pay attention to the students interacting outside the classroom. The researcher heard many students talking about the Roadshows in the school yard and in the hall during classroom breaks. Recess, lunch and following school tended to be the time the teachers were not with the students, so their assessment of discussion about the Roadshows may only apply to within the classroom setting.

Teachers talked with students about the Roadshows during class time. The teachers also talked to each other in between classes about what they experienced with the
Roadshows. Most of the staff were excited about the show and said the students enjoyed the program. One of the teachers in particular thought that the program had a positive effect on her, stimulating her to do more hands-on science in the classroom.

When the researcher talked with the parents, it was evident that they had conversations with their children about the Roadshows program. The conversations shaped their opinions about the Roadshows program and in some instances had stimulated the parents to participate more fully in the science experiences of their children.

The parents in this study had positive comments about the Roadshows and SCIENCE WORLD. Even though they did not attend the show, most of them thought the program was worthwhile. Comments about the Roadshows from the parents included student A's mother talking about her son. She said "the program must be good because he learned something". Student D's father said that his daughter was quite interested in the SCIENCE WORLD program, it kept her interested and she was now more interested in science. Mrs. H., student E's mother, could not separate her reaction as a parent and teacher. She was very enthusiastic about the program and said it was wonderful, providing a lot of involvement for the students. Student F's father was "glad the Roadshows program is offered and reaches out into the communities where the students are". "Affording going to SCIENCE WORLD might be a problem otherwise" he said. Student H's father said the program "gets the kids in touch with science" and the fact that it travelled to the school "shows that it really is for the whole province". Parents attributed the Roadshows to changes in their children such as enhancing self-esteem, changing attitudes about science, and stimulating experiments with electricity. The interviewed student's parents said that the Roadshows provided positive experiences for their children.
The positive impact of the Roadshows program on the students was evident from their parent's comments. The teachers, however, did not agree with some of the parents, that the show made an impact on the students. It is the researcher's opinion, however, that the parents had a better idea about the impact the Roadshows had on their children than the teachers. The teachers may not have a mechanism in the classroom to observe and evaluate the changes that had taken place in the children due to the Roadshows. At home, the children could talk more freely giving parents an opportunity to observe changes.

Falk and Dierking (1992) say that there is support for the idea that "families, and children in school groups, use museums as socially mediated learning environments. Parents ask children questions; children ask parents questions" (p. 110). Some discussion takes place about "abstract ideas and feelings" and "ideas are transmitted" (p. 110). It "can be inferred that learning occurs" (p. 110). There is no doubt that the students and their parents in this study asked questions about Roadshows. It is reasonable to extrapolate that the conversations at museums referred to by Falk and Dierking (1992) parallel the discussions the students had with their families and their peers following the Roadshows. The students who saw the Roadshows wanted to share their experiences, ask questions and get answers from their parents even though their parents did not see the program with them. According to the data, the conversations which took place as a consequence of the Roadshows were not just an exchange of information. They appeared to be social learning situations where discussions took place. Discussions over the dinner table are concrete examples of this situation. According to Falk and Dierking (1992), learning takes place in situations where students interact with their parents in this way.
Not only could learning be taking place after the Roadshows due to conversations, but the family dynamics may also play a role in stimulating learning after the Roadshows. "There is some evidence that families have different social learning styles" (p. 110) and that teaching and learning can take place within a family because of a certain learning style. One learning style described by Falk and Dierking (1992) is an independent-learning family where the children and adults experience things separately then "check back with each other occasionally to share what they have seen" (p. 111). This can parallel the situation with the Roadshows where the students had the experience at school and the parents learned about the experience through their children. One parent-child pair also learned about the Roadshows separately and then discussed their experiences together after the Roadshows. Student E and her mother, Mrs. H., had independent experiences with the Roadshows. Student E was with her class in the Arcs and Sparks show and Mrs. H. was the teacher of her Grade 3 class and saw the Science Carnival show. Later, their family was involved in experiments and discussions at home discussing the two programs. According to Falk and Dierking (1992) this independent experience, then group discussion can stimulate learning. Learning appeared to have taken place in this home because of the detailed discussion which took place following the Roadshows. In these situations parents could be learning not only about the content of the program, but also that the program is a positive experience for their children. Falk and Dierking (1992) said that both content and attitudes were learned by family members with the independent-learning families.

Communication also took place between the students and other adults in the community. The librarians were asked a few questions by students. Students also took science oriented books out of the library. The subjects that the librarians found to be the most popular were dinosaurs and present day animals such as cats. It is also interesting that in Falk and Dierking's studies (1992), the personal interests of their
subjects were very similar to those of this study. Dinosaurs, animals in general and buying things were three common areas of interest. Perhaps these are universal interests for children and are not really relevant, but it is strange how these personal interests stood out in both studies. The librarians assisted students in finding books on these topics.

There is no indication that there was a large impact on the librarian or the library due to the Roadshows. There is no indication that the Roadshows stimulated an increase in books being taken out of the library.

The timing of Spring Break was one of the factors that the librarians thought influenced the number of books taken out. They thought that the number of books taken out would be lower during the break. In addition, they thought that the books were still returning from the Science Fair recently held in the area. The projects were judged just prior to the Roadshows. According to the librarian at one library, during the Science Fair, there were no science books left. In addition, during a previous rental of one of SCIENCE WORLD's other programs at the library (the Travelling Discovery Boxes\textsuperscript{3}), there was also an increased interest in books on science. Over the time period of the Roadshows study, however, the librarians did not notice an increase in circulation of science books. If the school library had been open and had a good selection of science books available to the students, there may have been more positive results with this method of information gathering. It was hoped that more books would have been taken out due to the Roadshows and that conversations with the librarians would have been stimulated by the Roadshows. This was not found.

\textsuperscript{3} The Travelling Discovery Boxes are a set of hands-on kits which travel to libraries and other venues. The boxes have books in them and activities for students to do on environmental topics.
Conversations took place between shop keepers and students. Students found out the prices of Plasma Balls after visiting stores carrying them. Some of these students talked with the researcher about going to the stores to look at Plasma Balls and finding two different sizes and two different prices. The students said they also realized that the Plasma Balls were too expensive for them to buy. Some of these students talked about buying the Plasma Ball on several occasions. The shop keepers also remembered inquiries from students, but, this method for collecting information resulted in few numbers of conversations that could be directly linked to the Roadshows.

Many different conversations took place about the Roadshows. Many different people discussed the Roadshows. Several different topics were discussed by the students in their conversations about the Roadshows. These topics included visiting SCIENCE WORLD, hair standing on end with the Van der Graaf Generator, static electricity, the interviews, getting shocks, being a volunteer, buying Plasma Balls, liquid nitrogen, the Arcs and Sparks show, the Science Carnival show, the Roadshows experience and what people liked from the Roadshows.

5.6 Students' Thoughts About the Roadshows

The fifth question in the study revolved around the students' thoughts about the Roadshows. The thoughts that students had about the Roadshows are believed to provide insight into students' opinions of the Roadshows.

One of the ways the researcher collected information about the students' thoughts on the Roadshows was their responses to the questionnaire. They circled one of three faces on a paper they were given. Because most of the students chose the happy face, it was assumed that they liked the show. From the interviews, it was also evident that
the happy face had other meanings for the students including "I felt good" and "I learned a lot". When the children circled the happy face, they had positive thoughts about the Roadshows and their experience with it.

Some children chose neutral faces. The students were told that a neutral face was to indicate that they "had not decided what they thought about the show". Some of the neutral face choices were put into perspective, however, by the students saying that they were sad at the end of the program because they had to leave the show and wanted to "try everything out" (student F). The students who were interviewed said that they were sad that they had to go back to class at the end of the show, they did not want to leave the Roadshows, they wanted to have more of the Roadshows. These thoughts the children had indicate that they may have used the Likert scale more as an indication of their emotional state at the conclusion of the program, rather than an evaluation of the program itself. The students who chose the neutral faces on the questionnaire also drew happy faces in their drawings suggesting the Roadshows was a positive experience which they felt ambivalent about leaving.

The Grade 3 teacher was quite concerned that the students had not chosen happy faces on their questionnaires. She made a point of telling the researcher that she did not think the neutral faces were chosen because the students did not like the show. She thought the reason the students chose the neutral faces was that they did not know the answer to the last "trick" demonstrated in the Roadshows (see Footnote 1). There was a great deal of discussion in her class about this last trick and how it worked and whether or not the researcher would give the answer to the "trick". Her insight into the way her students reacted to the Roadshows also indicates that the questionnaire was interpreted by the students as a measure of their feelings at the conclusion of the Roadshows and not their liking or disliking of the show itself.
One sad face was chosen by a student in Grade 3. The children were told that the sad face was to represent dislike of the Roadshows. However, this same child also drew a picture of people in the Roadshows who were smiling. Again, there may have been ambivalent feelings by this child about leaving the Roadshows after having a positive experience.

The Likert scale has been used by many researchers to explore children's thoughts. The three point Likert scale in this study was chosen because of its good reputation for reliability. The study performed on the Ontario Science Centre's Science Circus used five faces. Their five point scale ranged from a happy face to a very unhappy face. It was also used to find out how well the students enjoyed the program and was a way to collect the students' opinions. The percentage of students who chose the happy face in the Ontario Science Centre study was 72%. The "quite liked" category was chosen by about 23%. This gives a total of 95% for the positive categories on the Likert scale for the Ontario Science Centre's program. Those who chose a neutral face was 2%. Those who chose the "didn't like much" category was 1% and the unhappy face was 2% (Gillies, 1981, p. 8). The total for the negative categories on the Likert scale was about 3%. In comparison to the present study, the results show 87% of the students chose the happy face, 11% chose the neutral face and less than 1% chose the sad face. One percent chose no category. The comparison between the two studies is not a perfect one, but it shows a similarity in the way that students responded to the Likert scale and to the informal science education presentations. Most children in both studies chose a positive category on the Likert scale indicating some type of positive experience for them.
In the present study, most of the questionnaires were filled out the day of the program which eliminates the possibility of memory interfering with the results. The results are not always easy to interpret, however. The students may have interpreted the Likert scale to represent something different from what they were told. It is recognized that Likert scales and other scaled measures are not 100% accurate, especially when used with young students. They rely on self-reporting which is difficult to interpret. However, they do provide a measure of reaction from the students on what they thought about their experiences with the Roadshows.

The results suggest that the students enjoyed their Roadshows experience. Another interpretation, however, is that the students may have wanted to please their teacher, the researcher, the Roadshows teacher or SCIENCE WORLD. They may also have chosen the happy face on the questionnaire because it was the face that their friends chose. The most logical conclusion, however is still that their reactions to the Roadshows were positive.

5.7 Students' Memories and Learning

The sixth question in this study asks what the students remembered about the Roadshows. The data on what the students remembered also provide information on content learned by the students. The students remembered the equipment used in the show as well as details about how the demonstrations were performed and information that accompanied the demonstrations.

Each student remembered different information about each piece of equipment. Many of the students changed their minds about what the equipment was used for and how it operated following the Roadshows. Many of the students wanted to work with the
equipment following the show. Below is a sampling of changes in the students answers about the equipment used in the Roadshows over the 5 week interview period.

Student A's knowledge about the Plasma Ball over the 5 week interview period is presented in Table 17a (Appendix 3). Before the Roadshows he believed that the Plasma Ball shocked people. Following the Roadshows he did not change his view. It is possible to receive a slight shock from this machine. The information student A volunteered during the interviews following the Roadshows mostly revolved around the rules of electricity discussed in the show such as "you cannot see or hear electricity". Student A also discussed glass as an insulator. This was information provided during the demonstrations in the Roadshows. On March 28th, student A corrected himself about seeing electricity. He seemed to make a conscious effort to give the correct information about not seeing the electricity, but rather seeing the effects of the electricity. This occurred 10 days following the show. This information indicates both memory of the Roadshows event and content learned about electricity.

Table 17b (Appendix 3) presents student A's knowledge about the Tesla Coil. This student knew nothing about this piece of equipment before the show, but following the show realized its danger. Several other messages were persistent for this student. He remembered up to 4 weeks following the Roadshows that the Tesla Coil was not a good method to provide electricity to homes and remembered that it was able to generate power to light up objects at a distance. He learned this information from the Roadshows presentation.

These pieces of information were key components to the Roadshows presentation on the Tesla Coil. This student not only was able to remember content details accurately, he also remembered the safety aspects and everyday application details as well. This
detailed memory suggests that an impact has been made on this student from the Roadshows presentation.

Table 21c (Appendix 3) presents student E's knowledge of the Jacob's Ladder. The Jacob's Ladder was used to introduce many of the properties of electricity to the students. The results indicate a difference in the amount of information that student E knows following the Roadshows in comparison to before the Roadshows. She was able to provide more information about electricity following the Roadshows. Student E commented that the spark and the electricity were not the same thing and that hot air rises.

Student E also talked about electricity in relation to what her classmates learned from the Roadshows. She said "cause at first people thought you could see it [electricity] and stuff, but then the last question ... asked was could you see it and nobody put up their hand". She compared the responses by the students at the beginning of the show where the presenter asked if the students could see electricity with the Jacob's Ladder. Many students put up their hands, but then at the end of the show, when the same question was asked again, very few student put their hands up. Student E noticed this and commented that she and her classmates had learned something. It is remarkable that student E noticed the changes in other students' answers about the electricity. Student E was also aware that she had changed the way she thought about electricity during the one hour Roadshows presentation. The Roadshows was responsible changing her ideas about electricity. She learned about electricity from the Roadshows as did her classmates.

Table 22d (Appendix 3) presents student F's knowledge about the Van der Graaf Generator. This student's explanation about negative charges repelling changed over
the 4 weeks of the post-Roadshows interviews. He had some of the basic ideas correct after the Roadshows, but still sounded a little confused. This student is one of the few who articulated his ideas about why the demonstration worked the way it did and he was also one of the few who had ideas that were correct. By April 14th, it appeared that this student had wrestled with the idea of negative charges repelling and come up with an explanation with which he appeared to be more comfortable. His continual thought about the concepts in the Roadshows demonstrated the potential continuance of learning up to 4 weeks after the Roadshows.

Student M did not attend the show, however he still had comments to make about what was seen in the Arcs and Sparks show. He said his friends talked to him about the Plasma Ball and told him that he "should have seen it". He learned about the pieces of equipment in the Roadshows from his friends. This indicates an impact from the Roadshows on children who did not attend the shows as well as those who attended.

From Table 26 (Appendix 3), it can be seen that all interviewed students who saw the Roadshows remembered details about the Arcs and Sparks show and thought about the show at some time. All the students said that thinking about the show was a positive experience for them. These results are similar to studies performed by Falk and Dierking (1992).

Falk and Dierking (1992) interviewed people one year after having 90 minute experiences to gain insight into recall. A few of these results are relevant to the Roadshows interviews and the recollections in this study. The 90 minute experience was similar to the 60 minute Roadshows experience. Following more than 200 interviews, Falk and Dierking (1992) found that most of their interviewees could recall specific details about their experiences a year after their experience, but no one
remembered everything seen. Almost everyone remembered how they "felt" at the time because their mental state was part of their recollection. They could remember who they were with and where they were as well. The Roadshows findings are similar over a 4 week period. The students remembered details of specific things, but did not remember all details about all demonstrations. The students easily recalled their mental state when they left the gymnasium. Some of these were negative thoughts, sad the show was over, but most of them were very positive thoughts about their experience. They remembered the location of the program in the gymnasium as well. Given that "learning and memory are ... contextually influenced" (Falk and Dierking, 1992, p. 112), it appears that the social and physical contexts for the Roadshows were facilitating remembering for these students.

The students in the Roadshows study also demonstrated what they remembered through their drawings. Tables 27 and 28 (Appendix 3) indicate that the Plasma Ball was the most drawn piece of equipment from the Roadshows. In addition, before the study began a high number of unsolicited drawings were received by SCIENCE WORLD from schools who saw the Roadshows and many of these drawings were of Plasma Balls. The Plasma Ball was remembered by students who saw the Roadshows for this study and by students in other schools who have seen the Roadshows in the past.

Reasons given by the interviewed students for choosing to draw the Plasma Ball included "I like it, it was my favourite" (student F). Other reasons given by students were that the Plasma Ball was easy to draw. Student A said "it is not that hard". Some other students said they had seen the Plasma Ball before. Some had seen it at SCIENCE WORLD. Student A thought people drew the Plasma Ball because it was "pretty common, because most people have used it before". Student B said a friend
had one at home. Some students said that they drew it because other people were drawing it. Student B noticed that everyone in her class was drawing the Plasma Ball, but when asked if she was able to see everyone else's drawings both students A and B said she was not able to see them. Student C also said he drew the Plasma Ball because everyone else was drawing it. Whether they were all drawing it because they all liked it or because their neighbours liked it and chose to draw it is unknown. Most likely all of these factors influenced the students to choose the Plasma Ball to draw. This information suggests that the level of difficulty of drawing the Plasma Ball and student preference of the demonstration both highly influenced what the students drew. They drew the Plasma Ball as well because they were able to remember it from the Roadshows.

Student G drew the Plasma ball with a caption "you touch the ball and the electricity attracts to your hand". Student I drew the Plasma Ball with a friend touching it. Another reason that the Plasma Ball may have been drawn by 92% of the interviewed students may be because their class had several volunteers involved in the demonstration including students A and F. Having a friend involved or being personally involved with the piece of equipment would make it more memorable for the students.

When the students were asked about their favourite parts of the show, the Liquid Nitrogen was liked the best. It was thought that the Liquid Nitrogen was hard for the students to draw and this was the reason it was not drawn often. Students liked the Plasma Ball second best and liked it more than the Tesla Coil, the Van der Graaf and the Jacob's Ladder.
The detailed remembrances of the Roadshows exhibited in drawings and through interviews may indicate more than just a memory of the Roadshows experience. Falk and Dierking (1992) assert that the "recollections reflected in [their] interviews are not only what people remember but what they learned from their museum experience" (p. 123). Therefore learning and remembering are very closely tied together.

The students not only learned very specific content items about the equipment, but they also learned details about electricity. From a safety perspective, it was positive to discover that some of the students remembered the rules about electricity. They learned that you cannot see or hear electricity, it takes the easiest path to the ground, that electricity is dangerous and that too much electricity can kill you. Eighty-two percent (9/11) of the students mentioned that they learned something about electricity and its properties. Ninety-one percent (10/11) of the students said that they knew more about electricity following the Roadshows. The students themselves said they learned information from the Roadshows.

Individually, each student learned something different from the content of the show. This will be discussed in detail below, but what student G learned is significant because she only attended one interview. She could list the dangers of electricity that were mentioned in the show. Her knowledge of electricity suggests that the show taught her these details, she did not learn content from the interviews. It is also possible that the other students did not learn their information about the Roadshows from the interviews either. This suggests that the Roadshows were able to transmit a large volume of information to the students in a way they could understand and remember.
It is apparent that content was learned by the 11 interviewed students because of what they recalled in the interviews. Another indication of what the students learned from the show was in how they reacted to everyday items in their homes. One teacher, Mr. B., asked the students to write down if they had seen anything that reminded them of the Roadshows. This was a good question to ask the students and was not thought of by the researcher. Some of the answers were a surprise. Table 30 (Appendix 3) presents these results.

The students related everyday items such as bananas, lightning and lamps to their experience with the Roadshows. The conversation the researcher heard after the show with some students about lightning indicates that the students were not just learning content, but they were also learning about connections to the "real world". They learned that some of the items used in the Roadshows related to their everyday lives. The Roadshows changed the way they thought about some objects at home. It has always been a priority of the Roadshows to try to make the show information relevant to the students' everyday lives. It is therefore, valuable to know that the effort to maintain relevance in the show has been worthwhile. The students are learning new connections between science and the objects in their lives because of the Roadshows.

Another way to understand the findings of this study is to relate them to learning theory. It is valuable to make this comparison because of the claim that learning is taking place in the Roadshows. By examining learning theory, it may provide more credence to the idea that the Roadshows provide learning opportunities to students.

Learning theory is often examined through models. A relevant learning model described by Falk and Dierking (1992) is the Bernice McCarthy's 4MAT System. It examines four learning preferences including feeling, watching, thinking and doing.
These terms are used to describe types of learners. This model assumes that each different type of learner asks different types of questions. For instance, the person who feels a concrete experience may ask and answer the question 'why?', the person who is a reflective watcher may answer the question 'what?', the person who thinks about situations answers the question 'how does this work?' and the person who combines experience with actions answers the question 'what can this become?'. These questions are relevant to this study because they also reflect many of the questions the students asked the researcher at the end of the interviews. Blum (1970) said that it is common for valuable information to be uncovered by casual discussion at the end of an interview. These questions can be seen as an indication of the type of learning in which the students are engaging. According to McCarthy's system, their questions also indicate what types of learners they are.

When the interviewed students' questions were examined using the McCarthy model, it was found that student A asked "who", "how", "what", "how long", "how many" and "how are" questions. This student did not ask why questions associated with concrete learners. His questions suggest that he is a reflective watcher who studies situations in order to learn. Student B asked "how many" questions. How questions are associated with learners who look at situations to learn according to the McCarthy model (Falk and Dierking, 1992). Student C asked "why" questions which are related to concrete experiences. This student may learn by asking why questions during concrete experiences according to the model. Student E asked about the balloon experiment\(^4\) with a "how long" question. This type of question is associated with a situation or in this case an experiment. She appears to learn by asking specific questions related

\(^4\) The balloon experiment is when a balloon is rubbed on hair and sticks to a wall. This student took the experiment one step further and timed how long the balloon could stay on the wall.
to a given situation. Student F asked "do", "what", questions about the researcher's work. This indicates a reflective learner. Student I also asked "how long" questions, related to situational learners. Student L asked "what" questions of a reflective learner and student K asked "did you" questions which do not relate to the model, but appear to be situational as well.

The fact that these students asked questions about the program or interview suggests that they were thinking about the program and learning about it. (Falk and Dierking, 1992). The variety of the questions also suggests that either the Roadshows or the questions in the interviews stimulated a variety of learning preferences. It also confirms the variety of learning styles the students have and that the Roadshows encouraged a variety of learners to ask questions.

If the Roadshows do in fact stimulate a variety of learning preferences in students, then the format of the Roadshows may be useful to other educators. Using the different learning styles as a guide, exhibits and programs can be designed so that all learning styles can be accommodated (Falk and Dierking, 1992).

From this study, the students claim themselves that they learned information from the Roadshows. They learned about electricity, electrical safety, specific pieces of equipment used in the show and about Liquid Nitrogen. It is unknown, however, the longevity of this learning. Four weeks is the extent to which this study claims that learning was maintained.

According to Falk and Dierking (1992), to understand "the long-term effects of the
museum experience" of which the Roadshows are an extension, one needs to understand "museum 'learning'" (p. 97). Falk and Dierking (1992) point out, however, that learning is hard to define in itself. "Despite a great deal of research and theorizing about learning, science has yet to devise a consistent, functional description of what learning is or how it functions" (p. 98). Theorists tend to focus on cognitive learning as the way learning should be defined. Falk and Dierking (1992) believe, however, that learning is "strongly influenced by what we know and feel as well as by associated visual and tactile information" (p. 99). They also believe that "learning is rarely so pure as not to represent an amalgamation of all three components" (p. 99), that is cognitive, affective and psychomotor learning. This view of learning is shared by SCIENCE WORLD and is used by the Roadshows in program design.

To go one step beyond, Falk and Dierking (1992) stress that "for the purposes of evaluating learning in the museum setting, we need a broad definition of the term, encompassing the richness of experience occurring within museums and emphasizing long-lasting memories and relationships" (p. 99). They believe that the definition should embrace "certain elements of mainstream learning theories, but that prescribes a much stronger role for the variables of motivation, beliefs, and attitudes of the personal context and for the influences of social and physical contexts" (Falk and Dierking, 1992, p. 99).

Therefore, there is no one working definition of learning which can be applied in this situation. Many variables must be taken into account when studying learning. In addition, Falk and Dierking question if the museum experience is a learning experience or not and say that there are "decades of museum learning research, which suggests that there is little or no direct evidence of learning in museums" (p. 97). On the other hand they say that there are "a few studies [that] do, in fact demonstrate visitor
learning of facts and concepts during museum visits" (p. 97). So the question then becomes, is this learning research in the museum context relevant to this study? The Roadshows context more closely resembles the museum context than the classroom context due to the presentation methods. Therefore, museums' research is some of the only relevant learning research which relates to the Roadshows.

The informal presentation methods and the informal learning context of the Roadshows distance the situation from both the classroom and the theoretical learning lab where learning theory is studied. Learning research is usually "conducted under controlled laboratory conditions, with little connection to real-world learning and motivation" Falk and Dierking (1992, p. 98). Therefore comparison to the learning labs is not useful here.

Comparison of the Roadshows to the classroom is also difficult. There is a "distinction made between formal and informal learning. Classrooms are considered formal learning settings, museums are considered informal learning settings" (Falk and Dierking, 1992, p. 99). Whether this distinction is useful or not is questionable, because learning takes place in every context imaginable and the "terms 'formal' and 'informal' have little predictive value in relation to learning" (Falk and Dierking, 1992, p. 99). Yet this distinction often results in credibility for the classroom learning situation and research within the formal setting. The term formal learning context implies, to the general population, success in the promotion of learning. By contrast, informal learning contexts are assumed to put less emphasis on learning. This may be because the learning takes place by less structured means and fewer tools exist to measure the learning. This distinction may limit the informal learning institutions in promoting themselves as places of learning. However, the increasing criticism of the formal learning context has turned people to look elsewhere at learning.
The distinction between informal and formal learning contexts also limits the relevance of extrapolating from formal learning studies to informal learning studies. This means that there are few studies with which to compare this study and that more studies need to be performed on informal learning settings. Then comparisons can be made more easily within the museum field. These studies will also lend credibility to the informal learning context as viable learning experiences. It is hoped that this study will provide some assistance in this matter. It is also hoped that this study will provide new insight into the learning which takes place in an informal setting.

Museums are what Falk and Dierking (1992) describe as "excellent environments for meaningful learning because they offer rich, multi-sensory experiences. The proper presentation of ideas through tangible objects, particularly if they are interactive, is a powerful device for sense-making and, thus, understanding" (p. 114). The interactive, multi-sensory nature of the Roadshows program fits this description and therefore has the potential for being a vehicle for meaningful learning.

Not only do museums provide good learning environments, but perceptions about time at a museum in Falk and Dierking's (1992) studies were thought to influence learning in museums. These perceptions about time were thought to be personal. It was implied that those who did not have enough time to participate in everything they wanted to, thought that time went quickly and their learning may have been more meaningful. Several students in the Roadshows study mentioned they were sorry the show ended, wanted to stay and play with all the equipment and did not want to go back to class. Perhaps these yearnings, too, indicate that time went fast and their learning may have been more meaningful (Falk and Dierking, 1992).
"Within a museum context, meaningful learning might involve ... talking with friends and family and, in doing so, accommodating new ideas" (Falk and Dierking, 1992, p. 114). The discussions which took place between students, staff, family and friends following the Roadshows program in various locations outside the gymnasium might then be situations in which new ideas were thought out and added to existing understandings. "The information [may become a] part of the ... permanent store of knowledge, available for use long after" the experience (Falk and Dierking, 1992, p. 114). Therefore, the many discussions about the Roadshows would actually make the information more available for retrieval in the future by the participants in the program. The Roadshows information may have become part of that "permanent store of knowledge" as suggested by Falk and Dierking in 1992 (p. 114). The data suggests that the conversations at home helped the students think more about the ideas presented in the Roadshows. In addition, it also appeared that discussion in the interviews encouraged more discussion at home and in some cases lead to experimentation and more learning. To know the permanency of the information from the Roadshows, however, interviews with the students would need to be arranged in a longitudinal study over many months or years. It would be ideal to return to this school a year following the Roadshows presentation and interview some of the same students to find out what they remember about the show.

5.8 Summary of Impact on Each Student
This section summarizes the impact the Roadshows has had on each student. The information has been synthesized from their conversations with the researcher in the interviews and from the interviews with their parents. The Roadshows experience was different for each student. Some students were volunteers, some were not, some students had friends who were volunteers, some students asked questions, some had
those questions answered during the show. Depending upon these variables and 
others, each child came away with a slightly different experience. The question then 
arises, did the Roadshows experience have an impact on each of the interviewed 
children?

Student A

Student A talked about the Roadshows program following his experience. His 
communication about the show with his mother increased following his mother's 
interview with the researcher over the telephone. She had asked him questions about 
the program and may have chastised him for not telling her about the Roadshows. He 
said he had forgotten to tell her and thought that he had told her about the 
Roadshows. Perhaps the telephone call from the researcher to this parent embarrassed 
the mother, resulting in her challenging her son. The telephone interview with this 
parent may have been a negative impact on student A.

Student A's mother said that her son's attitude had changed because of the 
Roadshows. She thought his attitude was more positive about science. Student A 
agreed with his mother's answers. He believed he had changed because of the 
Roadshows.

The interviews revealed that this student changed his behavior following the 
Roadshows. He talked more about science. He said he was more interested in science 
and knew more science because of the Roadshows. He was planning a Science Fair 
project for next year on electricity. This student also said he learned some things from 
the Roadshows and wanted to buy a Plasma Ball after seeing it in the Roadshows.
Some of the equipment in the Arcs and Sparks show had more of an impact on this student than others. The Plasma Ball was one of those pieces he talked about at length. He made a conscious effort to correctly explain what he had seen inside the Plasma Ball. He made this effort 10 days following the Roadshows.

This student knew nothing about the Tesla Coil before the show, but following the show realized its danger. The message about the danger was obviously a strong one because even up to 4 weeks following the show, he was thinking about the danger of this piece of equipment. The Roadshows had a strong impression on this student in relation to the Tesla Coil.

The Van der Graaf Generator demonstration had impact on this student because of the sound. It appears that the dramatic sounds of this experiment may have overshadowed the messages attached to the demonstration for this student.

Student A learned about how an experiment was done with the Plasma Ball and hypothesized about the results of the experiment. His hypothesis was right and it showed that he understood the fact that the plastic prevents electricity from travelling to the ground. He understood the concepts of insulation and electricity travelling. It appears that this understanding was gleaned from his Roadshows experience.

5 The demonstration was showing electricity passing through the student to light up a fluorescent tube. This was a very safe demonstration and during this show, about 15 volunteers were used to demonstrate how far the electricity could travel. At each person in the line, the electricity left through their feet on the way to the ground. Student A was a participant in this demonstration and suggested that if all the people in the line stood in an insulating bucket, the electricity may have been able to travel further.
Student A volunteered in the Arcs and Sparks show. Volunteering contributed to the impact the Roadshows had on this student. He talked excitedly about being a volunteer. He was also excited about the program and what he drew. These reactions along with his mother's suggestion that her son's attitude had changed suggest at least a short term impact of 4 weeks on this student due to the Roadshows. He was more excited about science following the Roadshows.

Student B
This student liked science before the Roadshows and liked it more following the Arcs and Sparks show. She said she was more interested in science because of the show, thought that she knew more and would probably take part in more science activities because of the Roadshows.

She talked about the Roadshows program with several people. Her mother remembers hearing something about the program from her daughter. Student B's answers on paper, in the interview and from her mother were consistent showing that she talked about the program. The banana and the liquid nitrogen (see Footnote 2) were favourite topics of hers and were mentioned several times in the interviews. She said she joked with her dad about them.

This student seemed more positive and more curious about science following the Roadshows. She said she wanted to be a scientist with animals after the Roadshows. It appeared that she thought about working with animals before the Roadshows and after the show she realized that working with animals was considered to be a type of scientist.
Student B said that she got some ideas from the show for science activities at home. She experimented with her motor bike following the Roadshows. It is unclear if this experiment was related to the Roadshows. From her own comments, the program appeared to have an impact on her, but her mother did not think that there was any impact on her daughter. Her mother said, however, that with a new baby in the house, she was so busy that it was hard to tell if there had been a change in her daughter.

The Roadshows stimulated a new interest in Liquid Nitrogen for student B. Her interest in horses and biology may have lead her to choose the demonstration with the Liquid Nitrogen and the banana (see Footnote 2) to be her favourite. She remembered intimate details about the demonstration and talked about it repeatedly over the 4 weeks of the post-Roadshows interviews. She understood that something at room temperature, such as the banana could seem warm in comparison to the Liquid Nitrogen which was very cold. This was difficult for most other students to understand.

She also became interested in knowing how dangerous the Tesla Coil was. She asked questions during the interviews about the Tesla Coil. The interviewer used her questions to further her understanding of the danger of the Tesla Coil. This information should not have been provided by the interviewer because it gave the opportunity for student B to learn new information in the interview. However, from a safety and educational stand-point, this type of question could not be overlooked by the researcher. Her natural curiosity about the Tesla coil was difficult to ignore.

This student showed interest in the Van der Graaf Generator as well. She talked about the fact that it attracted her attention even though she did not see most of the demonstration. It is thought that her friends gave her information about the portion of
the demonstration she did not see. This suggests that the demonstration stimulated conversation between the students.

This student developed interests in the equipment used in the Roadshows from the seeing the program. Because of her new found curiosity and discussions about the program it is thought that there was a short term impact on this student due to the Roadshows.

Student C
This child had a very positive Science Fair experience before the Roadshows. He talked about this experience repeatedly indicating that the experience had a positive impact on him. Student C said that he might choose a project for the Science Fair next year on electricity. This indicates a high interest in electricity which can partially be attributed to the Roadshows. There is no way of knowing how interested he was about electricity before the show. Unfortunately this was not a question asked during the pre-Roadshows interview. He said he liked science "a lot" before the show.

Student C said that he was more interested in science because of the Roadshows. He said he "knows more" about science and "will do more science" because of the Roadshows.

He talked about the Roadshows, but his mother did not remember hearing anything about the program. During the interviews he said he told his mom about the Nitrogen and the Plasma Ball. He also said his mom said the Roadshows program sounded interesting. He "always talks about science and already had a positive attitude about science" according to his mom. Perhaps this was why she did not notice his discussion about the Roadshows program. She said, however, that she thought the program may
have helped his self esteem. How the program helped his self esteem is unknown. Perhaps being chosen for the interviews had this effect. Other students (B and F) indicated they felt special because they were chosen for the interviews, so it is possible that the interview had an "ego boosting" experience for this student as well.

Student C used a battery analogy to explain his understanding of the Plasma Ball. His knowledge of this equipment following the show was markedly different from before the show. He remembered information for up to 4 weeks following the show indicating a large impact on him due to this piece of equipment. It was surprising that he was still trying to make the distinction between the effects of the electricity and the electricity itself 4 weeks following the show.

This student was somewhat puzzled about what was happening with the Jacob's Ladder. His puzzlement may stimulate him to learn more. This idea is untested, however. The Van der Graaf Generator created an impact on this student because of the visual nature of this equipment. For several weeks he talked about the equipment, but did not mention the fact that a student had his hair raised by this equipment. It has always been thought by SCIENCE WORLD that the "hair raising experience" of the Van der Graaf Generator was something that students would talk about. To this student, perhaps the machinery itself was more interesting than the demonstration and therefore his memory of the machine persisted for the 4 weeks. Seeing the detail this student remembered at 4 weeks, suggests he will remember this machine for longer.

Student C said he learned several things from the Roadshows including electricity travelling through people and that it can light up a bulb even after it has travelled through someone. The Roadshows has had an impact on this student which may last longer than 4 weeks.
Student D

During the interviews, this student agreed with almost every answer student C gave. She appeared to volunteer very few opinions of her own. This student did not think that the Roadshows program had a great influence on her. This student was difficult to interview due to her monosyllabic answers in the interviews. Conclusions about the Roadshows impact on this student were difficult to make based on the interviews alone.

However, the written information student D supplied indicated that she had her own opinions about the Roadshows. The written information revealed that she was thinking about the program and had a well thought out idea about how to improve the show. In addition the written information showed that a lightening storm made her think of the show. This connection between something in "her world" and the Roadshows was not evident in the interviews. The written comments indicated more thought by this student about the Roadshows than the interviews revealed.

This student's comments about the Tesla Coil shows that she remembered the sparks and the light being lit up even several weeks following the program. Considering her reserved or shy nature, this may indicate quite a large impact on her. She mentioned that she learned that electricity goes through people.

She gave very consistent answers over the 5 weeks of interviewing. Her written information, interview information and information from her father all indicated that she talked about the program. Her father said that "the way she spoke about it showed that she was keen". The researcher did not see this, but this may have been due to her shyness or discomfort with the interview. According to her father, the Roadshows
kept her interested, and she showed a lot of interest in the SCIENCE WORLD program. The program, he thought, had furthered her interest in science.

The Roadshows had an impact on this student, but her shy nature prevented the researcher from understanding this impact well. This student said that she would do more science on her own, was more interested in science and knew more about science because of the Roadshows. The impact on this student is evident, but is not as well understood as some of the other students. The information from her father, however, indicates that there was a definite impact on her.

Student E

Science was one of this student's favourite subjects in school before the Roadshows. She said that she became even more interested in science because of the show. She said she would do a little more science on her own, she would do more because of the show and also "because of the way she is" as a person. She thought that she knew more about science because of the Roadshows as well. She learned that Liquid Nitrogen was not safe for your hand and she also remembered the three rules of electricity which were taught in the show. She was interested in doing a Science Fair project on the "bucket of hot ice\(^6\), that was quite interesting, I might try that if I can find any". She also took science books out of the library because of the Roadshows. She was one of the few students who said she wanted to take books out of the library and followed through with her intention.

\(^6\) Liquid Nitrogen in a dewar, boiling, but cold.
Both student E and her mother were perceived by the researcher as very active, creative and motivated people. They appeared to have been impacted by this program both because of the "way they are" and what the program presented. Both Mrs. H. and her daughter wanted to learn more about the science in the Roadshows. They were curious about the things presented in the shows and about science in general.

This family talked about the programs they saw more than the other families. Mrs. H., who is also a teacher at the school, saw a different show than her daughter in Grade 5. Mother and daughter "talked about the kids that volunteered during the show, what happened to them, how others would look if the machine was used on them7, how far the shock could go, that it was great fun". The whole family got involved in the discussions (dad, two big brothers and grandma). The mother and father also participated in the experiment with the balloon (see Footnote 4). This experiment did not happen in any other interviewee families to the researcher's knowledge. The idea of testing static electricity with a balloon probably came from the Roadshows presentation, but later, discussions with the researcher may have also influenced these activities. The experiments performed by the whole family were the "spin-off" from one child seeing the Roadshows and are testament to the impact the Roadshows had on this family. There was also an increased discussion about science by student E, according to her mother. Her mother said that more science activities were performed by her daughter following the Roadshows. Student E's mother said "she did things on her own after. She got a balloon and rubbed it on her hair to stick it to the wall, mom and dad did it

7 The Van der Graff Generator makes people's hair stand on end.
with her. She mucked around and was creative, trying things. Whether she got the ideas from the Roadshows is hard to say for sure, but there is probably a connection. When asked as a teacher if she had noticed any increase in the students' interest in science since the Roadshows presentation, she said that the "greatest interest shown was by her daughter at home".

As a teacher E's mother also heard her Grade 3 class talking "about phoning the researcher". Interestingly enough, this teacher's daughter was also one of the few students who tried to phone the researcher with her friend. Her mother said that students at her daughter's age are not in the least intimidated to use the phone. This is obviously true in her daughter's case. Student E took the researcher's suggestion and called the researcher to ask a question.

A sample of the information that student E absorbed from the show can be seen by what she knew about the equipment. She learned detailed information about electricity from the Plasma Ball. She remembered that the Tesla Coil was dangerous because of it's power and because it could turn on many pieces of equipment at a time. Student E was captivated by the Van der Graaf demonstration.

Before the Roadshows, student E knew nothing about the Jacob's ladder. Following the Roadshows she knew that a spark and electricity were not the same thing and that the reason the spark moved up was because hot air rises. The information this student remembered was remarkably consistent over the 4 weeks. It was evident, however, that the details she could remember decreased over the 4 weeks of the post-Roadshows interviews.
When asked why students' answers in the post-Roadshows interview were different from the pre-Roadshows interviews student E said that a change in responses meant that the students had learned something about electricity. She noticed that during the show, students changed their answers about seeing electricity. She made this observation with no prompting. Not only did she think that she had learned something about electricity in the Roadshows, but she also thought the other students learned in the Roadshows as well.

Following the Roadshows, discussion about static electricity took place. Students I, J, G and E played on a trampoline and talked about static. The trampoline was mentioned in relation to static several times in the interviews with these students. The Roadshows may have influenced the discussion during their play.

In many ways, student E and her mother were ideal subjects for this study. They were eager and were open to new ideas from the Roadshows. They were curious and absorbed the information eagerly. If all the Roadshows participants became as excited, enthused and moved to action as these two were, then the impact from the Roadshow would be larger. It is thought, however, that these two people were exceptional. Their positive outlook and enthusiasm about science before the program made them react positively to the program. The program had more impact on them because of their positive attitudes.

Student F

This student worked on his earthquake Science Fair project with student C before the Roadshows visited their school. In the previous Science Fair season their project was "almost chosen" to go onto the Regional Fair. Both the students were enthusiastic about their project. Of the two boys, student F was even more interested in science
before the Roadshows. He was also very enthused about science following the Roadshows. This student's Science Fair ambitions may have been enhanced by the Roadshows experience. It appeared that he was motivated to try again next year to do well. He said that he was planning a future Science Fair project on electricity: "I thought maybe next year ... doing something on electricity. I learned quite a lot from there [the Roadshows] and I thought I could use it in a science fair project next year". He wanted to take out science books because he "became more interested on electricity following that show". The Roadshows had an impact on his interests.

Student F said he thought he knew more about science and would do a little more science on his own following the Roadshows. He said that he learned the three rules of electricity and recited them for the researcher. The three rules were some of the most important messages in the show and were repeated during the program.

This student talked about the Roadshows to his family. His mother had heard about the program, but he only recalled talking to his sister about it. His mother thought that the program had an impact on her son, but that it was not a big difference she saw in him. She noticed "differences when he came home from school because of certain knowledge that he had that he related to her", but it was hard for her to be specific. She noticed these kinds of differences in him regularly and not just after the Roadshows.

This student was a volunteer in the Arcs and Sparks show for the Plasma Ball demonstration. He thought that he was involved in the show in a different way than the other students because of being chosen as a volunteer. He talked about going up to volunteer. In addition, his drawing was of someone with his hand on the Plasma Ball.
He also said he tried to buy a Plasma Ball. His experience as a volunteer with the Plasma Ball had an impact on him.

With the other equipment used in the show, this student did not remember the same kind of detail as with the Plasma Ball. He talked about the Van der Graaf Generator and the science of the electrical charges. By the last interview, this student had wrestled with the explanation about positives and negatives several times and had come up with an explanation with which he was comfortable. Each interview following the Roadshows, his explanation was slightly different and he seemed more confident each time he explained the details. It appeared that the Roadshows stimulated his thought on this subject.

Student F talked about the Roadshows repeatedly, had questions about the program and was very keen about the science in the Roadshows. This may be his nature and the Roadshows caught his attention and enhanced his interest in electricity. It is the researcher's opinion that this show had a lasting impact on this student. The Roadshows presentation, at the very least had an impact on this student so that he was able to remember information clearly 4 weeks following the Roadshows.

Student G

The impact of the Roadshows was less evident on this student than the other students. In addition, it was even less evident following the conversation with her mother. From the discussions with her mother it appeared that the interviews were something student G talked about more than the show itself. The fact that student G's friends were interviewed before she was, bothered her. She wondered why her friends had been interviewed and she had not. Once she was interviewed, she told her mom about the interview experience.
According to her mother, student G talked a lot about science because of the Science Fair. The Science Fair appeared to have a greater effect on student G than the Roadshows. In the interviews with the researcher, however, she said that she told her mom that "the Roadshows came to school and that it was really neat and you learned about electricity and everything". So perhaps her mother did not remember this conversation about the Roadshows.

This student said that she did not think of another Science Fair project previous to being asked the question in the interview. When she considered it in the interview, she thought of starting a project on the "hair standing up" (see Footnote 7). The interview question may have been leading her to choose a topic directly from the Roadshows instead of leaving the question open to all subjects. A more open question may have indicated her personal preference instead of limiting her choice. The previous year this student had presented a project on respiration. Her switch from a biology oriented project to a physics oriented project might be a sign that the Roadshows had some effect on her. If the show had no effect on her, the researcher would have expected that she could not come up with a project related to the Roadshows at all.

Both students G and H talked about the equipment in relation to SCIENCE WORLD more than they did in relation to the Roadshows presentation at their school. It appeared from the conversation that took place with these two students that perhaps their visit to SCIENCE WORLD was a more powerful reminder of the equipment than the Roadshows. On the other hand, their only interview was one day following the Roadshows, so perhaps they had not had time to internalize their experience yet. Other students seemed to talk more about the Roadshows in the later interviews. More interviews with these students would have been helpful.
Student G also told the interviewer that she thought that she knew more science following the Roadshows. She said that she was "sort of more interested in science" following the show and that she learned about electricity and it's danger. She said she was more curious about electricity as well. She was a volunteer for the demonstration with the Plasma Ball, but said that she "did not feel different" than the other students because of her involvement in the show or because of being interviewed. On one hand, she seemed interested in science and on the other hand she did not seem particularly enthused about being involved in the show. The interview setting may account for some of the ambiguity here. This student only had one interview and so did not get a change to become familiar with the setting.

Student G said "maybe" she would ask more questions following the Roadshows. She said she had changed her opinion about science following the show, but not all of her answers collaborated with this. When asked if she would do more science on her own because of the Roadshow or not, she said she would rather not do any science. From this comment it would appear that there was little or no overall impact on this student. She may have a small amount of curiosity about electricity from the Roadshows, but this did not appear to be long lasting. The Roadshows interviews, her Science Fair Project last year and SCIENCE WORLD appeared to have more impact on this student than the Roadshows.

Student H
This student was very interested in hockey and thought that he was not good enough in school to follow-up on an academic pursuit such as science. He said that his interest in science "sort of" increased because of the Roadshows and that he knew more about science because of the show. He did not think that he would do more science on his
own, that he would rather work with a partner. He wanted to buy a Plasma Ball at the Public Market after seeing the show.

This student said he told both his parents about the Roadshows, but his father did not remember any information about a discussion. It is likely that at least one parent heard something about the program from this boy because the trend with the students in the interviews was that they talked to someone in their family if they had the chance. Student H's father admitted it was possible that his son talked to his wife. There is a possibility, however, that the students that were interviewed only once, such as this student, were not stimulated to talk to their parents about the program as much as those students who were interviewed repeatedly.

This student mentioned Science Fairs in the interview and he said he talked about science with his family. His father attributed his son's increased discussion about science to the Science Fair project he presented earlier in the Spring and not to the Roadshows. When asked directly about the impact of the Roadshows on his son, the father thought that he was "sure the Roadshows did have an impact" on his son, he just did not see anything specific and did not observe a "big difference" in his son. "He has a good attitude already" was the comment given. This father thought that the Roadshows program "gets the kids in touch with science" and that was a positive result of the program. There was probably a small impact on this student due to the Roadshows.

Student I

Student I had been to SCIENCE WORLD with brownies for a sleepover prior to seeing the Roadshows. She also mentioned going to different science-related places in Ontario. and her mother said they had seen the science centre in Toronto.
This student's mother was a microbiologist and said she enjoyed science. She was interested in "getting her kids to SCIENCE WORLD". They had not been there as a family. She said she has not been able to go to SCIENCE WORLD because she had three children and did not like to go downtown on her own with them. Student I's mother thought that it was important for the children to have exposure to science to "see where their interests lie".

Students I and J, like G and H showed more memory of their visit to SCIENCE WORLD when asked about the equipment used in the Roadshows. It appeared that visits to SCIENCE WORLD were more on their minds than the visit from the Roadshows or perhaps they could not separate the two. There was a long interruption during the interview with students I and J and they were only interviewed once, so it will never be known if the Roadshows was more on their mind than their visit to SCIENCE WORLD or if they used the name SCIENCE WORLD to refer to their experience with the Roadshows at their school. Information on the equipment used in the Roadshows was very limited from students I and J in the interviews. The Van der Graaf Generator made the biggest impression on them of all the pieces of equipment used in the show.

Student I was one of the students who said that she had always liked science, but said that she liked science more following the Roadshows. She said that she thought of science as "fun and experiments" both before and following the show. Her Science Fair project had an influence on her thoughts about science. She developed an idea for a new Science Fair project from the Roadshows. She said she was interested in researching a project on electricity. Her interest in pursuing electricity for a Science Fair project suggests an impact on this student due to the Roadshows.
She also said that she knew more about science, in particular, more about electricity because of the Roadshows. She thought that she would do more science because of the show. Following the program she had "sort of" changed her mind about becoming a scientist because the Roadshows explained some of the questions she had. Her career interest was working with animals. However, she also liked the idea of working in a job like the Roadshows teacher because the teacher got to "work with younger people and the different stuff". This suggests that the Roadshows teacher was a positive role model for this student.

Student I talked repeatedly about the program to her family. She talked with her bother in Grade 2 who saw the Science Carnival show, with her sister in Grade 4 who saw the same Arcs and Sparks show as she did, and with her mother and father. The three students brought home information to share with their parents. With three students having seen the programs, a large impact on this family was possible.

In addition, these students' mother was aware of the program because she was a member of the Parent Advisory Committee (PAC). The PAC helped support the Roadshows visit and wrote the newsletter to the other parents telling when the program would be visiting the school. Both student I's and K's mothers were involved in the creation of the newsletter as well. The input from all PAC parents may have been to increase the information within their families and community. This appeared to be the case in this family, but having three students involved in the program probably created more of an impact on the family.

Student I's mother said that her daughter was "quite impressed with the show". She said that her daughter told her different things including the "hairs standing up" (see
Footnote 7) and that she had friends who participated in the show. Student I, according to her mother, talked a little more than usual about science for a few days following the Roadshows until the novelty wore off. Then over Spring Break, she became involved in other things. Student I's mother said that she "can't honestly say it [the Roadshows] did change her [daughter's] attitude. It did take her interest if things were presented well". Student I's mother was comparing her daughter's reaction to the presentation style of some television science shows with that of the Roadshows. It is true that the students will be comparing what they experience with the Roadshows to television.

Her mother thought that there was a short term effect on her daughter due to the Roadshows. She thought that it was short term because she had not "seen [her daughter] keyed up and talking about things they did [in the Roadshows] and she doesn't go around reading extra science stuff. It is not a prime thing with her". This seems to be a very honest and thorough assessment of her daughter and the impact of the Roadshows program on student I.

This parent also thought that the Roadshows had an impact on her as a parent as well: "only in seeing the way she [her daughter] talked about it - so enthusiastic, I feel that I have to do this [take them to SCIENCE WORLD] and have to have more interest in taking them to science oriented places". This information confirms that there was an impact on this family. It also reveals an important impact on this parent that was not anticipated. The show and her daughter influenced her desire to invest more time and energy into the science education of her children.

About two months following the interviews at the school, the researcher received a thank you note from this student and it said that she had been to SCIENCE WORLD
with a friend. Most likely, the free passes that the researcher gave to the students for participating in the interview were a stimulus in their visit to SCIENCE WORLD. Also in her written information to Mr. B. she said she went to SCIENCE WORLD with her family and saw the Plasma Ball. It appeared that her mother followed through with her desire to visit SCIENCE WORLD. This is a very positive result that can partially be attributed to the Roadshows.

The Roadshows had an impact on this family and on student I. Her family became more involved in science because of the Roadshows, it appears.

Student J

Student J went to SCIENCE WORLD the summer before the interviews. He had always liked science, but liked it more following the Roadshows. He said he thought about the program after seeing it because "he shocked [his] brothers" by rubbing his fingers on the trampoline at home.

He recognized the Roadshows equipment following the show, but because he was not in the pre-Roadshows interview group, it is unknown if his knowledge was only from the Roadshows. Previous visits to SCIENCE WORLD had probably exposed him to the Van der Graaf Generator. He said he "might have thought the equipment was scary before" he saw the Roadshows, but "now they are more interesting" and he would like to work with them after seeing the show. The Roadshows appeared to influence his opinion of the equipment used to demonstrate electricity.

He talked about the Roadshows program to his parents. His father remembered him talking about the program and especially remembered the details about his son's hair standing on end (see Footnote 7) when he was a volunteer. Student J also talked to his
family about passing the shock demonstration\(^8\). According to his father, his son always talked about science, so he did not talk about science more than usual after the Roadshows. His father, however, thought that the Roadshows program had an effect on his son. The father thought that it "sparked more interest and also renewed his interest" in science. Student J talked about the program for a couple of days and told his grandparents about it as well. The father did not think that there had been a change in his son's attitude toward science. He thought the Roadshows was a nice presentation, however.

Student J spoke to the interviewer about the Science Fair project he presented last year on solar systems. He said that he wanted to do a Science Fair project next year on how electricity works. He also thought he would like to have a job like the Roadshows teacher and "sort of" was interested in being a scientist. He is, however, the only student who said that as a scientist he wanted to do electricity shows. His view of a scientist was not the typical stereotype. He thought that scientists could be ordinary people, but that they are smart.

Because this student was a volunteer during the Roadshows, it was thought that perhaps the impact on him would be greater than on the students who were not chosen as volunteers. It is difficult to determine if this is true or not. Because he already liked science before the Roadshows and was only interviewed once, little comparison is possible between before and following the show. This student was one of the few

\(^8\) This demonstration is performed with the Van der Graaf Generator. After the machine is turned off, the student on the insulating platform touches someone holding hands with a line of students standing on the floor. As the student on the platform is grounded, the extra electrons travel to the ground through the students on the floor. Usually several students feel the small shock down the line of students.
students who said he thought about the show while he was playing with his friends and brothers. In addition, he was one of the few students that related something in his daily life to the Roadshows. He said he "thought about the show when [he] turned on [his] lamp" (Table 30, Appendix 3). These two examples demonstrate that this student was able to relate the Roadshows content to his every day life. This is a very encouraging finding. This researcher believes that transfer from the Roadshows to daily life is essential for the Roadshows to have a large impact on a student.

Student J said he knew more about science and will do more science now that he has seen the Roadshows. The impact on this student is evident.

Student K

Student K was one of the few students who did not like science before the Roadshows. She changed her mind following the Roadshows and decided she liked science. She thought the Roadshows made her more interested in science. She thought that she knew more about science, especially about electricity because of the show. She thought she learned things from the Roadshows as well.

Student K's mother thought that the Roadshows had an effect on her daughter. "It made her more aware and she realized that science was more fun". "She talked more about it [science] and seemed more keen, she has a more positive attitude now about science" according to her mother. Student K's mother was surprised that her daughter had chosen a Science Fair project soon after the Roadshows. The Science Fair was almost a year away and so her keen interest in a new project was an indication to her mother that a change had taken place in her daughter. Her mother thought that her daughter's enthusiasm about planning a Science Fair project was new.
Student K had chosen a Science Fair project on comics and ink and mentioned this in the interview. She also said she was interested in a project about electricity, how it worked and where it came from. This student constantly referred to the Roadshows program as the Science Fair Roadshows. This suggests that the Roadshows and Science Fair were not two separate events in her mind. This may explain her immediate interest in a project for next year after the Roadshows. Science Fairs are not discussed in the Roadshows presentation.

Student K was not interviewed until 4 weeks following the Roadshows program, yet she remembered details about all the equipment used in the show. This indicates her ability to remember details and also suggests that the detailed memories the other students had about the Roadshows were not due to the reinforcement of ideas during the interviews. Because student M, student K's interview partner, had not attended the Roadshows, student K did not hear information about the show from him either. Therefore, the details provided by student K were only from her experience with the Roadshows.

Considering student K was labelled a "special needs student" by her teacher, it was thought that perhaps she might not remember as much about her Roadshows experiences as the other students. In fact, she did not show less ability in the interviews. Her ideas were clear, concise and detailed. She remembered seeing all four pieces of equipment in the Roadshows. Not all the other students who were interviewed remembered all four pieces of equipment. Student K seemed to be better than some of the other students at straining out the extraneous information from the Roadshows and remembering some of the basic and most important messages of the show.
She remembered that the Plasma Ball's glass insulates people from the electricity, stopping electricity from escaping. She also remembered that the Tesla Coil was dangerous. For the other two pieces of equipment she remembered the visual aspects of the demonstrations suggesting that perhaps she is a visual learner. In addition, she was interested in the SCIENCE WORLD teacher's job because of the involvement "with kids".

The Roadshows method of presenting information may have been a good approach for student K because of the predominance of spectacular visual effects. Special needs students sometimes respond to alternative methods of presentation (personal experience). This may be the case with student K. Traditional teaching methods in the classroom may not be reaching her easily. Perhaps because of the focus on the auditory learning in the classroom, this student was less stimulated to learn science there. Student K decided she liked science more following seeing the Roadshows and perhaps this is due to the visual nature of the program.

It appeared that there was a large change in student K's attitude toward science due to the Roadshows. This is thought to be a short term impact on her. In the long term, she will need to see that science is fun and visually interesting from other sources. If she does experience this, she might maintain her positive attitude about science. Over a long period of time, the Roadshows would not be able to take credit for maintaining a change in her attitude. A longitudinal study, however, may be able to shed more light on the long term effects of the Roadshows program on student K and other students.

Student L

This student was originally chosen to participate in the interviews, but because he was absent on the day he was scheduled to be interviewed, he only participated in the non-
interview portions of the study. These portions included attending the Roadshows program, drawing a picture about the Roadshows and writing comments for Mr. B. about the Roadshows. Student L's parents were also involved in the study by being interviewed over the telephone.

Written comments made by student L and comments made by his mother both indicated that he liked science before the Roadshows. Last year he went to SCIENCE WORLD with his dad. He also watched "Bill Nye the Science Guy". He was sick the day before the Roadshows and told his mom he had to go to school the day of the program, he "could not miss it" according to his mother. From his mother it sounded like he really wanted to go to participate in the program.

He enjoyed the Roadshows presentation according to his mother. She also said that her son talked about the Roadshows. He talked about electricity and static and the hair "standing on end" (see Footnote 7) and talked about people saying that "you can see electricity, but that isn't right". He was referring to one of the rules of electricity explained in the Roadshows that you cannot see electricity, only the effects of it.

Both the interview with student L's mother and this student's own written comments indicated that he talked about the Roadshows. Even though he talked about science at home following the Roadshows, his mother did not think that he talked about it more than usual. His mother thought that the Roadshows had an impact on her son, however.

According to L's mother, it was hard to get him to do his Science Fair project in the Spring because he has a "hard time writing", but "he paid attention more to what was said in the Roadshows because of who it was (presenting the show)". He was
impressed by SCIENCE WORLD his mother said. She also thought that the
Roadshows "made her son feel different about science", but no large differences were
evident yet in his attitude. Student L still thinks it is hard work to do the writing in
science.

He could not wait to go to SCIENCE WORLD after seeing the Roadshows and this
was another indication that the program had an impact on him according to his
mother. His mother thought that the program was excellent because "it gives the kids
something to be interested in. They will take more interest in science".

Another indication that student L had a positive experience at the Roadshows was his
drawings. He circled the happy face on the questionnaire and drew the Plasma Ball. An
interview with this student would have revealed more information about the impact the
Roadshows had on him, but it appeared that he had a positive experience in the
Roadshows presentation.

Student M
Even though this student never saw the program and was somewhat confused about
why he was at the interview, some of his answers during the interview were
noteworthy. This student was a "control" for the study as he was the only interviewee
who did not see the Roadshows. Some of his attitudes may be typical of other students
in his school.

His idea about scientists was somewhat stereotypic. He did not usually talk to his
friends about science, and did not do any science at home. He did not have any ideas
about what to choose for a Science Fair project either. He had been to SCIENCE
WORLD and other science oriented places. When asked what came to mind when he
heard the word science, he said "not much". He said science is "OK", he likes it, it is "not too bad". Some of these answers are similar to other interviewed students before the Roadshows. There were some surprising things that this student also said, however, especially because he had not seen the show.

Some of his answers about materials used in the Roadshows were similar to those of students who attended the show. It is possible that either he heard information from other classmates about the show, made up his answers, adapted them from his partner in the interview or had some experiences at SCIENCE WORLD which gave him information. It is known that his friends told him that he "should have been there" (at the Roadshows) to see the Plasma Ball and "all the people lined up" (in the demonstration, see Footnote 5). The information his friends told him, may have been used to answer the questions in the interview. He said that he remembered the ball (Plasma Ball), thought that the show was fun and because the show was fun he said it gave him "a good feeling". This is unusual for a student who did not attend the show.

This student said he probably would have drawn the Plasma Ball because "it was good and fun" and that he would have "circled the happy face because it [the show] was fun". He had seen the Plasma Ball at SCIENCE WORLD previously and it is likely that he had seen some of the other pieces of equipment used in the Roadshows at SCIENCE WORLD as well. If given a choice he would work with the Plasma Ball and the Tesla Coil. He said that the Tesla Coil looked interesting and it could kill you. It is true that the Tesla Coil is dangerous. He may have learned this from SCIENCE WORLD or from his friends.

It was strange for a student who had not seen the Roadshows to say the show was fun. He may have felt pressure to answer the questions in the interviews. He may have been
confused about the reason for his participation in the interviews. His teacher warned
the interviewer that he was also a special needs student and may not be of a great deal
of assistance during the interviews. Perhaps the situation was confusing to this student,
so he tried to cope the best way he could in the interview by answering the questions.

It was not known until part way through the interview that this student had not been
to the Roadshows, so he was interviewed in a similar manner to those students who
saw the show. From his answers to questions about the show, a few things were
evident. Student M was good at adapting to a difficult situation. His confusion was not
readily apparent. Somewhere, either in the interview, in school or at SCIENCE
WORLD he had experiences related to science equipment. These materials had an
impact on him. He talked easily about the Plasma Ball and showed interest in the Tesla
Coil. He said the Roadshows was a positive experience. Perhaps this suggests an
impact on a non-participant in the Roadshows through the discussion of the program
with his friends. His prior knowledge and experience at SCIENCE WORLD also had
an impact on him.

There were 12 students involved in the interviews for this study. Ten of these 12
students had a positive impact on them due to the Roadshows. In addition, the
Roadshows also had an impact on parents, teachers, librarians, and others within the
community studied.

The interviewed students showed more interest in science following the Roadshows
program in comparison to before the Roadshows. Their definition of science changed
following the Roadshows. These students asked science oriented questions following
the presentations. The students said that they "felt good" following the Roadshows.
Many conversations and discussions were stimulated by the Roadshows. Information about the Roadshows was communicated to the people in the community by those who saw the Roadshows. Students talked to each other, teachers talked to each other, teachers and students talked to each other and to administrators. Then, after school, many of these people talked to their families and the students talked to shop keepers and librarians. Some of the students tried to talk to the researcher by phone.

Following 4 weeks, the students remembered their experiences with the Roadshows. The students changed their minds about the equipment. They liked the equipment more after seeing the shows, they wanted to work with the pieces of equipment more and generally found the equipment more interesting following the Roadshows. The ideas the students had about the equipment persisted from 1 week to the next. Many of these ideas stayed with the students for 4 weeks and possibly more. The Roadshows had an impact on most of the students for at least 4 weeks.

5.9 Comparison Studies
The results from this study suggest that there is an impact on students from an informal science education program which travels to schools. Because there has been little research performed on outreach programs from science centres, it is unknown if this impact is being made by other science centre programs. Comparisons to existing studies in museums will be made to see if there is evidence of impact from similar programs elsewhere. It is understood that the contexts of these other programs are sometimes similar to the Roadshows, but others are markedly different.

There has been one other study performed on the Roadshows. This was performed in 1994 and was a quantitative study (EDUCOM, 1994). Some of the study's results are
similar to those found in this study. Other EDUCOM results suggest impacts of the Roadshows not found in this study.

Sixty-nine percent of the teachers surveyed by EDUCOM in the Fall of 1993 thought that the Roadshows presentations helped the students to understand that science is not difficult. Fifty-nine percent of teachers thought that "students have become more curious and creative about scientific investigations as a result of the program". Overall the teachers "believed that the SCIENCE WORLD Roadshows presentations had a positive effect on student attitudes toward science. According to the EDUCOM (1994) study, "in retrospect, 100 % of the responding teachers were pleased that they and their students participated in the program". "Ninety-eight percent of the teachers would recommend the SCIENCE WORLD program to other schools". In addition, 70% of the teachers thought that the program made them "more aware of the importance of science and technology".

When these results are examined from an impact viewpoint, it appears that the Roadshows had a positive impact on the students and teachers who participate in the program. The large numbers in EDUCOM study may be representative of the way teachers in British Columbia think about the Roadshows. The EDUCOM results are more generalizable because of their large sample size, where the present study results are not.

The students themselves were also asked about the Roadshows in the EDUCOM study. It was found that "the majority of primary students (K-Grade 3) were very happy with the presentation (77%) and believed that the ideas were easy to understand (67%)". Fifty-eight percent of these students thought that they "became involved in the presentation" and 72% of the students thought that they were more "interested in
science now that [they] have seen the SCIENCE WORLD presentation" (the Roadshows). The intermediate students in Grades 4-7 "felt good about the presentation" (69%). Fifty-one percent of the students thought that the ideas were easy to understand. Forty-two percent said that they were more interested in science because of seeing the Roadshows. In comparison to the present study where 73% of the Grade 5 interviewees thought that they were more interested in science, the EDUCOM result is a lower percent for this category. The large sample size in the EDUCOM study gives a slightly different and more generalizable picture, however.

This picture is one of the Roadshows program where most of the students had a positive experience. The quantitative and qualitative studies in tandem provide a broad perspective of the Roadshows program. The results complement each other and support the idea that the Roadshows had a positive impact on those who participated in the program. Beyond these two studies, there is also other information that can contribute to this claim.

Informally there have been many evaluations collected by SCIENCE WORLD on the Roadshows program. Over the past eight years, hundreds of evaluation forms have been collected. The results provide a wide variety of information, most of which is positive. The evaluation forms provide rating scales on how well the performers related to the audiences, how well they explained the information and how appropriate the pace of the show was. In addition, the evaluations (see Appendix 1.3) also ask about the appropriateness of the show for the students.

Almost every evaluation that has been returned says that the program was appropriate for the students, well paced and that the performers related well to the audience. Questions about educational content, presentation style, amount of student interaction,
student enjoyment and enthusiasm shown by the presenter were almost always rated between 7 and 10 on a scale of 10, with the average score at about 9 (where 10 was the highest value). In addition, evaluation forms said that the Roadshows met the needs of special education or disabled students, and that the teachers would recommend the program to another teacher or school.

SCIENCE WORLD evaluations often had comments on them such as "Excellent presentation!! Kids were totally involved and those children really into science 'sparkled'. I do think they all left loving science". Other unsolicited letters from the students included comments such as "thank you for showing us all those cool things", "I liked it when you showed us the electricity with static", "I hope you come again", "the class had no bad comments about you", "I thought it was very 'shocking'. I'm interested in science". These comments are just a sample of those received regularly. In addition, SCIENCE WORLD also received some comments which indicated that the program was doing what it hoped to do; "thank you for the fascinating Roadshows you put on for us. For once instead of being bored and talking I was laughing, paying attention and having a lot of fun". This type of unsolicited information is a valuable method of evaluating the program. The students who sent these also appeared to be impacted positively by the Roadshows.

In addition, there have been many newspaper articles and pictures with captions created after the Roadshows have visited a community. There demonstrate the reception the Roadshows have received in communities around British Columbia. A community newspaper in South Green Lake/70 Mile area, a fairly remote area in BC, said that "students had another treat Tuesday, Feb. 22 [1994], when they were visited by SCIENCE WORLD from Vancouver. The adjective used to describe how they felt about the event was 'awesome'". This type of comment is common from students and
has been seen in other newspaper articles written about the Roadshows. All articles the researcher has seen has had positive reactions from communities to the Roadshows program.

The EDUCOM study, the SCIENCE WORLD questionnaires and the news clippings have the same message. The Roadshows produces a positive reaction in the community and make a positive impact on the students who participate in the program.

From personal communication with several other museums in Canada and the United States, the results from their questionnaires are generally similar to those found on the Roadshows evaluation forms. The other centres' programs are well received. Teachers, participants and outreach staff from science centres surveyed around North America think that the programs are enhancing students' image of science and are a positive experience for all involved.

The Museum on the Move program from the Minnesota Museum of Science performed a study on their science presentations for students in schools. The findings from this museum's study are similar to those from the Roadshows study. Those people who experienced the program felt that participation, fun and learning were all desirable components of the informal science education program (L. Thomas, personal communication, November, 1994).

A museum study discussed in Falk and Dierking's (1992) work focused on the participatory nature of informal science education programs. This study showed that Grade 3 students recalled what they did more than details about where they were. They remembered events where they had "high personal involvement". This
Roadshows study found that the volunteers who were personally involved in the program had strong recollections about that part of the program in which they personally participated. These students may remember their experiences longer than those students who were not volunteers. The participation aspect of the Roadshows is an important facet to the shows. It's impact on the students should be studied further.

At the 1994 ASTC Conference, the pros and cons of the Oregon Museum of Science and Industry's (OMSI) informal science education program format were listed as a part of a discussion between science centre staff from various organizations. One of the largest "pros" was the participation aspect of the program. Their program also involved many children volunteers from the audience. The cons listed for this program were specifically small things attached to that program such as the need for a radio microphone.

The Oregon Museum of Science and Industry's program was involved in a study on their informal science education program. This Oregon Government study found similar results to those found in the Roadshows studies (L. Thomas, personal communication, November, 1994). It was evident from their study that the students remembered details about the concepts in the show. This suggests that students were learning content from the Oregon Museum of Science and Industry's shows.

Other studies on science centres in the past usually revolved around exhibit use. However, occasionally demonstrations have been listed as a component of the visitors' experiences which have been examined. The study on the Ontario Science Centre Science Circus mainly revolved around the physical exhibits, but demonstrations were included in the study. The results indicated that the use of the word exhibits also encompassed demonstrations in this instance. Not only was this study performed on
experiences of science centre visitors who saw demonstrations, but the experience was also an outreach event where the Ontario Science Centre's Science Circus was travelling. The similarity of the demonstrations to those of the Roadshows (personal experience) make it possible to compare the results of the Circus study to the present study.

The Circus was enjoyed by visitors and the participatory element was a major contribution to the enjoyment (Gillies, 1981). Teachers and parents who accompanied students to the Science Circus repeatedly said that active participation made the experience "better" for the students.

The Ontario Science Circus and the SCIENCE WORLD Roadshows have both indicated that the participatory nature of these informal science programs has resulted in a positive impact on the audiences. The teachers who accompanied the students to the Roadshows also thought that the hands-on nature of the program was one of the best aspects of the show. Participation has always been something that students attending the Roadshows appear to enjoy. At Roadshows presentations including the one for this study, almost all of the students had their hands up to be a volunteer during the show. This is testimony to the desire on the part of the students to participate. In the interviews as well, many of those students who were chosen to participate in the Roadshows said they were privileged to be a volunteer and enjoyed their experiences. Those students who were not chosen to be volunteers talked about their friends who volunteered. For those students who were not chosen, it was a disappointment.

According to the study on the Circus (Gillies, 1981), fun and learning took place during the Circus and most people said they learned something new. Teachers were
impressed with the "educational potential of the Science Circus" (p. 32). The Science Circus "offered ... substantial potential for learning" (Gillies, 1981, p. 32). The potential for learning was realized with the Roadshows as well according to the statements from the students. All of them said they learned something new. They also said that they enjoyed themselves, so fun and learning took place together in the Roadshows as well.

The Circus experience could be used as a supplement to classroom experiences according to the teachers and could be even more effective with backup information for the teachers before or following the Science Circus visit. This type of statement is familiar to SCIENCE WORLD as well. Teachers are provided with follow-up activity packages but often forget to use them. Other science centres send out pre and post activity packages to the schools they visit (personal experience, ASTC Conference, 1994).

The Ontario Science Centre Science Circus was also found to be appropriate to students of all ability levels. The teachers thought that the Science Circus "could accommodate and be potentially valuable in an educational sense, to children of varying academic ability" (Gillies, 1981, p. 32). This has been found with the Roadshows as well, both in this study and through the evaluations sent to SCIENCE WORLD. Teachers also said that the Roadshows were good for their special needs or ESL students because of the animated and visual nature of the program. Because the approach to the content is quite different from that used in a classroom, it is not surprising that many students will respond well to the Roadshows format. Those student who are kinesthetic and visual learners may not able to actively participate in the classroom or may not be visually stimulated. These students may have new
opportunities for learning in the Roadshows and the Ontario Science Centre's Science Circus.

According to Gillies (1981), "teachers thought that the Science Circus would help students develop a positive attitude towards science and technology" (p. 32). It may also stimulate a general interest in science (Gillies, 1991). The students interviewed for the Roadshows said that they liked science more following the show. They also said that they were more interested in science. These results are again parallel.

From the limited number of studies available on informal science education programs, the conclusions about informal science education programs appear to be similar. The format of the program works to engage young people in science. Students learn that science is fun. This type of program also stimulates discussion about science and encourages the learning of science content. Students show an interest in science after participating in informal science education programs. These programs have an impact on students.

5.10 Methodology Discussion
Study Assumptions
It was assumed, as discussed in the methods section (Chapter 3) that the study area would be far enough away from SCIENCE WORLD, in Vancouver, that the students would have low exposure to the science centre. Not only did the Market Research in July of 1994 show this to be incorrect, but the results of this study also showed this assumption to be wrong.

The majority of the students who saw the Roadshows had also been to SCIENCE WORLD and all the interviewees had been to SCIENCE WORLD. It was hoped that
the students in the study would not have had experience with SCIENCE WORLD, potentially providing the students with a larger impact from the Roadshows. Because they had experience with SCIENCE WORLD it is thought that the impact of the Roadshows is lower than if the students had not been familiar with SCIENCE WORLD. The impact on a small town, further away from Vancouver, would make a better test site if a future study on the impact of the Roadshows is performed.

Fortunately few people at the school had seen a Roadshows program. This meant that there was still a possibility that some of the materials in the program would be new to the students even though they had been to SCIENCE WORLD. If the students had all seen a Roadshows presentation previously, the study of the impact on them would have been much less meaningful.

Qualitative Methodology

Qualitative studies have advantages and disadvantages. Their results are not usually generalizable, but they give an in-depth look at one situation. The researcher becomes a factor in the equation and influences the outcome of the study by being a participant and a newcomer to the setting. But, because of this situation, the researcher is able to gain new insight that could not otherwise be gained.

The researcher for this study was both an outsider, as the researcher at the school, and an insider, as manager of SCIENCE WORLD's Outreach programs, knowing the Roadshows program. Being an outsider at the school had advantages. "Some exceedingly valuable information comes to the outsider simply because [s]he is one" (Trice, 1970, p. 77). Teachers told the researcher things that they may not have told an insider. For instance, they said that they were totally overwhelmed with what was going on in their school on a daily basis and they could barely keep up. They may not
have told this to someone inside the school or school board. This information put the
study into perspective. The study was one more detail in the daily hectic life in a
school that the teachers had to cope with. One teacher openly said that she thought the
timing of the study could not have been worse from the teachers' perspectives.

Information such as this from teachers and other insiders in the school "can contribute
to the research and by doing so increase its validity and ... commitment to its results"
(Orpwood and Souque, 1984, p. 39). In this case, the honesty from the teachers
certainly adds to the validity of the study. It is however, doubtful that the teachers had
added commitment to the study results because of their discussion with the researcher.
Their situation was one of survival on a daily basis. In fact when a thank you cake was
given to the staff following 4 weeks of the researcher being in the school, some of
them did not know what the thank you was for. The research was not on their minds.

The appearance of the researcher being an outsider was maintained with the students.
They did not know the researcher in any other context except in the interviews. The
interviews were designed to be non-judgmental in nature. This lack of judgment may
have provided the students with a different kind of freedom than they may have
experienced in the classroom. They may have thought they had more opportunity to
discuss what they were thinking with the researcher, an outsider. Casual conversation
with students was a luxury that their teachers probably did not have. The researcher
may have been able to learn things about the students' attitudes and content knowledge
from the Roadshows that other professionals in the school may not have been able to
learn. The attention the students received from the researcher may have been a positive
experience for the students. Being an outsider and respecting the student's viewpoints
appeared to make some of the students think that they were special. Therefore the
outsider status for the researcher was a benefit to the study.
The researcher was also able to gain useful information by probing answers from the students during the interviews. This method of data collection was worthwhile, but can be overdone. While sometimes the researcher thought that she cued the interviewees too much in the interviews, Falk and Dierking (1992) said that they thought that with increased appropriate cueing in their own study interviews, their subjects would have remembered more about their experiences.

The students in the Roadshows study were asked what they learned. They were also asked what they remembered. It is interesting to note that sometimes what they said they learned and what they said they remembered were different. Falk and Dierking (1992) assert that the "recollections reflected in [their] interviews are not only what people remember but what they learned from their museum experience" (p. 123). Falk and Dierking did not ask directly what people learned from their museum experience and they admit that their interviewees "may have learned many other things [that they did not recount in the interview], but did not associate them with their museum visit" (Falk and Dierking, 1992, p. 124). By asking direct questions, direct answers were obtained in this study and they were more useful than questions asked in the pilot study which were more implicit. What people learned and remembered were gleaned from this study because of the researcher's questions and probes.

The actions and presence of the researcher in the school influenced the study and so did the research locations in the school. A familiar surrounding was chosen as the room for the interviews to decrease the intimidation of the interviews for the students. The location of the Roadshows program in the gymnasium was also familiar to the students, providing a novel experience, but not a novel setting. According to Falk and Dierking (1992), location of learning "has a tremendous impact on how, what, and
how much one learns" (p. 112). "Learning and memory are subjective and contextually influenced" (Falk and Dierking, 1992, p. 112). Because the Roadshows and the interviews both took place in familiar settings, it is suspected that the locations were positive learning environments for the students. In addition, the settings may have assisted the students in remembering details about the Roadshows. The students were never asked if they were comfortable in the settings, however.

Only one student commented about the setting of the interviews. He mentioned that the location was changed on the last interview from the medical room to the hallway. This indicates that he noticed the location of the interviews. Other students may have noticed as well and did not comment. The hallway was a disruptive interview environment which did not lend itself to concentration. The medical room was quieter, but may have carried a negative feeling with it for the students because it was the room where sick children go. In future studies, it is recommended that the children be asked how they respond to the room in which they are interviewed.

The locations chosen for this study may have enhanced the results because of their familiarity to the students. It is recommended that future studies also use interview and program sites which are of low novelty to the study participants.

Falk and Dierking (1992) wrote about the methods they used in interview research on recall of museum experiences. Their method was "designed to facilitate recall without unduly biasing responses" (p. 116). They asked the interviewee to recall "everything that happened when he visited the museum" (p. 116). During the Roadshows interviews, the students were asked what they remembered about the program, a blanket question designed to elicit whatever came to mind for the student. The question was designed to minimize leading the interviewees. According to Falk and
Dierking (1992), "this line of research is still new to museum studies, (but) patterns in
visitors' long-term memories emerge that enable preliminary generalizations regarding
learning to be made" (p. 116). This statement indicates that the questions in the
interviews increased the potential of this study to produce valuable data about
students' experience with the Roadshows after 4 weeks.

Falk and Dierking (1992) found that the memories from a one time visit to a museum
lasted one interviewee forty years. While a visit to a museum is not the same as a one
hour Roadshows experience, it is possible that the students in this study will remember
their Roadshows experience for longer than 4 weeks. It is also possible that the
method of eliciting the recall has provided information that is relevant beyond the 4
week period of the study.

"Despite years of research on museum behavior and learning, the data that provide
evidence of museum learning are limited and not always reliable" (Falk and Dierking,
1992, p. 115). Most of the research projects are known as "recollection studies" (p.
115). They are usually qualitative studies with small numbers of subjects, similar to
this research. While it is recommended that interpretations of such study results must
be "viewed with caution" (p. 115), Falk and Dierking (1992) also admit that the
studies have provided information otherwise lacking about museum experiences.

Within the last ten years the Science Council of Canada (Orpwood and Souque, 1984)
performed some studies on how science was being taught in the classroom and this has
added to some of the available information about science learning contexts as well.
According to their work, situational "studies in education ... have, in recent years, been
increasingly used to ... approach more closely the level of practice" (p. 46). These
types of studies have been used to find out what really goes on in a given situation and
there has now been "clearly established...legitimacy" about the "potential value of this type of research" (Orpwood and Souque, 1984, p. 46). They go on to show that not only are science learning contexts more complex than originally thought, but also when the setting of a study is portrayed in detail, it helps the people outside this situation judge how relevant it is to their situation (Olson and Russell, 1984). Therefore, they can make informed decisions about the value of the information based on this knowledge. It is hoped that this study will be relevant to museums, science centres and teachers in the formal education system. They may be able to learn about how informal science education programs work and how they are received by students.

In qualitative studies, the researcher needs to interpret and judge the significance of results (Olson and Russell, 1984). It is hoped that the interpretations presented here will stimulate discussion about informal science education, its impact on students and its place in educating Canadian young people.
Chapter 6 Conclusions

6.1 Summary of Findings and Conclusions
Six questions were asked in this study and the answer to all of them was positive. The students showed more interest in science following the Roadshows; their definition of science changed; they knew more about science; they thought they asked more science oriented questions following the Roadshows and experimented more. In addition, the Roadshows stimulated many conversations, discussions and positive feelings about science. The students remembered their experiences with the Roadshows 4 weeks following the program.

Of the 12 students interviewed for this study, the majority 83% (10/12) were "impacted" by the Roadshows program as measured by their responses. These results were better than the researcher expected. These numbers cannot be extrapolated to the entire population of the students who saw the show at this school or to any other school, but they give an indication of how these students responded to the Roadshows program. The potential impact the program could have on other students, in other schools around British Columbia, is suggested by these findings.

Before the Roadshows, the students already had positive thoughts about the word science. Students interviewed for this program had also had a variety of exposure to science education through visits to SCIENCE WORLD, museums, science stores and other science oriented places. While measurements of attitude are difficult, this study used the students' expression of their own attitudes as the measure of change for the study. The students said they liked science more after the program and that their attitudes had changed. Some different ideas came to mind for them when they thought about the word
science following the show. They thought science was "more fun" and was "more about electricity".

Most of the students were already curious and asked questions before the Roadshows. Following the shows they generally thought they were more curious about science. They also said they would ask more questions because of the show. Although the students said they would ask more questions, it is possible that their actions could be different from their intentions.

Most of the interviewed students (11/12) who saw the Roadshows experimented or read about science at home before the show. Almost three-quarters of the students said they would "do more science" at home after the show. In addition, almost 50% said they would "do science at home" on electricity after the show when none of them said they did so before the show.

All interviewed students talked about their Science Fair projects before the Roadshows. Following the program, most of the students said they were planning a Science Fair project on electricity for next year. This was a change from the topics they chose previously! Electricity was a topic area that was the focus of the Arcs and Sparks show, so it is clear that the show had an impact on the students' project choices.

The Roadshows had other positive impacts on the students in this study. Some of the interviewed students wanted to visit SCIENCE WORLD after seeing the show. Many of the students said they left the program feeling good and were sorry that it ended. All the students said that thinking about the Roadshows was a positive experience. They were reminded about the show when they saw things like lightening, bananas, balloons, lamps
and when they got static electricity shocks from a trampoline. These results show that the students relate the Roadshows to their world. Previously, it was unknown if the Roadshows influenced students in any way and if they were reminded of the program by any thing in their lives. Now it is known that the Roadshows influence the thinking of the students in this study.

The students attributed many of their changes in ideas, answers and attitudes about science to the Roadshows. Student K showed a marked change in her attitude toward science. She did not like science before the Roadshows presentation and liked it after the show. She said the Roadshows had changed her mind. It is thought that the visual presentation style used in this show may have helped this student see science in a different way. She responded positively to the way the Roadshows was presented.

According to Falk and Dierking (1992), school programs should "be structured to include as many approaches as possible" (p. 153). They comment that the classic "problem" child from the classroom responds well in the museum learning environment. This has also been found with the Roadshows. In fact, perhaps student K is an example of the problem child responding well to the museum environment (Falk and Dierking, 1992). She was labelled "special" by her teacher and responded positively to the Roadshows. She changed her attitude about science because of the Roadshows. The Roadshows provided an opportunity for learning, because of the varied approaches used.

The Conference on Learning in the Informal Setting (Shettel, 1987) also discussed alternative methods of teaching, and the use of magic and fun, as ways to "get a young person interested in science-related subjects" (p. 244). "Incongruities and counter-intuitive results ('gee-whiz' stuff) are good ways to get the attention of the audience and arouse
interest" (p. 244). It is thought that some of the demonstrations used in the Roadshows create interest in science due to their thought provoking nature.

The equipment used in the Roadshows generated many questions from the students. During the interviews, discussions about the equipment were frequent. Often, students wanted to know what one piece of equipment did or recounted what they remembered seeing. The students had a high recognition of the equipment used in the show. They remembered many details about the equipment, how the pieces looked and sometimes how they worked. The students often changed their ideas about what a piece of equipment did because of seeing the Roadshows. Students wanted to work with the pieces of equipment and were more interested in the equipment because of the show. Many of them wanted to buy a Plasma Ball after seeing the Roadshows presentation and this piece of equipment was drawn more frequently than any other demonstration in the show. The students listed it as one of their favorite demonstrations along with the liquid nitrogen. The demonstrations and the equipment were memorable for the students.

"Most museums of science and technology glorify machines. Displayed in pristine condition, elegantly painted or polished, they can make the observer forget the noise, dirt, danger and frustration of machine-tending" (Alexander, 1979, p. 75). While it is true that the Roadshows are also somewhat guilty of presenting equipment that looks good, it is also true that their use stimulated discussion and interest in the science, technology and history of the machines. The equipment was not "painted and polished" and often the danger and noise were very evident in the shows. The students remembered the danger of the machines, so they were not just glorified in the Roadshows. However, if the program wishes to represent contemporary machines, then SCIENCE WORLD needs to show how technology is used in the "real world" more than it currently does.
In addition, the Roadshows still need to retain some exhibits to demonstrate ideas and history related to each piece. "The principle that some ... exhibits should be ... demonstrations, provided simply to explain how the historical objects work, is ... well established" (Wilson, 1987, p. 24). Science centre education has established the importance of using equipment/exhibits and machines to help explain ideas. This keeps the relevance of the information high and interest piqued. Wilson justifies the use of machines and equipment because of their historical value. The Tesla Coil is a good example of how the Roadshows gives some historical perspective to the harnessing of electricity. It is used in a manner that allows students to learn about the dangers of electricity and the concepts of static versus current electricity. One student commented on the distinction between static and current electricity showing that this message is being heard. Other students asked about Tesla and his invention, the Tesla Coil.

Communications between people about the Roadshows revealed the richest information in this study. There were many different forms of communication about the Roadshows which took place in the community; conversations; letters between the parent group and other parents; memos in the school and telephone calls. Sometimes the researcher was involved in these communications, but most frequently, the communication was between various community members. The Roadshows stimulated conversations between many people; between students and their families for several weeks after the shows; between students for up to 4 weeks after the shows; between teachers and students and others. From the written information that the students supplied in the Grade 5 class, 85% of the students talked about the Roadshows to several different people, spreading the message into the community about their experiences in the Roadshows.
Parents were exposed to both information about the Roadshows and their children's attitudes about the Roadshows through conversations with their children. The parents were also given information about the Roadshows through the parents' newsletter and one conversation with the interviewer. Based on this information, they formed their own opinions about the program.

All the parents' opinions were positive. The Roadshows had an impact on the parents through their children. The types of impacts include changes in the conversations in their homes and in some cases, changes in their actions as parents. Some of the parents said they would try to take their children to SCIENCE WORLD and take a greater interest in exposing their children to science. Roadshows have an influence on parents and as a consequence, the impact of the Roadshows could increase. These children may have more exposure to science education in the future due to the Roadshows.

The students' discussions with their parents, with librarians and merchants helped spread communication about the Roadshows in the community. While it is clear that the discussions between students, merchants, and librarians was brief and not usually specifically about the Roadshows, there was also evidence that the Roadshows may have caused, or at least stimulated new conversations. The students asked about books that related to the Roadshows and they asked about purchasing materials used in the Roadshows. The conversations both created an impact on the community and also demonstrated the interest in science because of the Roadshows.

It is also possible, however that the researcher's contact with the stores and libraries may have spread more information about the Roadshows program than the conversations with the students. One of the librarians produced a memo to her staff asking for science book
counts relating to the Roadshows. This memo was her idea, but was a result of the questions from the researcher. Consequently, the name Roadshows was probably spread into the library community more by the study than by the students. This is a positive impact on the community and on SCIENCE WORLD, but was not the purpose of the study. As expected in a study such as this, the researcher had an influence on the results of the study and the people with whom she interacted. In future studies, the merchants and librarians should be asked if they felt that more information was given to them about the Roadshows by the conversations with the students or with the researcher. Because the information from the researcher was specifically about the program, it is suspected that the librarians and shop keepers may have thought they learned more from the researcher. This was not intended by the study, but was an artifact of the method used in the study.

The study depended upon many people reporting what they thought about the program. This included the parents, librarians, merchants and the teachers. The teachers were instrumental in helping the researcher find out more about the students' ideas. One teacher said that "some students have come to see that being a 'scientist' is not knowing lots about science, but is being curious about science and wanting to find out the why and how". It is possible that there could be a long term impact on the way students think about science due to the Roadshows. This study did not investigate long term influence of the Roadshows, however.

This same teacher thought that "after experiencing the Roadshow, students will be more excited, prepared and confident for next year's science fair". While schools in the past have asked for the Roadshows program in preparation for Science Fairs in the Spring, there is no proof that the Roadshows would prepare students or make them confident about future fairs. Perhaps the Roadshows could be used to stimulate excitement for future Science
Fair projects just after students have completed a fair. Indeed the data indicated that the students got ideas for their next Science Fair projects from the Roadshows program. More studies investigating the potential link between the Roadshows and the students' ability to choose projects and prepare confidently for Science Fairs are needed before these claims could be accepted.

Communication between the teachers and the researcher not only gave insight into what the Roadshows stimulated in the students, but also gave information about how the Roadshows influenced the teachers. The teachers gave their own views of the program. Some teachers said they thought the program had a lasting impact on the participants (teachers and students) and others did not think it did. All teachers talked about the program to their students, colleagues and a few said they talked to their own families. This indicates an impact from the Roadshows on the teachers as well as on their students.

One teacher, Mrs. H., spoke of the impact the program had on her. She thought the program stimulated her to continue teaching science, and also encouraged her to change classroom activities so there is more of a hands-on component. It reminded her that science can be taught in the classroom with simple and inexpensive materials. She and some other teachers also said they learned some science content from the Roadshows. While it was not expected that content would be absorbed by the students or the teachers watching the shows, it is encouraging to learn that some of the teachers felt they learned content. This is a positive result from the program.

Communication also took place between the researcher and the students during the interviews. This study has found that the interviews themselves had some impact on the students. Many students told the researcher that they "felt different" from the other
students because they were chosen to be involved in the interviews. Some thought they were lucky or special because they were chosen. Indeed, one student said she "felt left out" until she was chosen to be involved with the interviews. The interviews appeared to be a status symbol for some of the children. They may have learned that there was some importance attached to the interviews by the way that the teachers and principal responded to the researcher's requests.

The various forms of communication about the Roadshows were responsible for increasing the knowledge in the community about the Roadshows program and about science. The Roadshows, through conversations between the participants, had an impact on more than just those children who saw the show. There was impact on the Principal, teachers, secretary, parents, siblings, aunts, uncles, cousins, families of the teachers, store clerks, librarians and perhaps others that this study did not reveal. The researcher contributed to this communication as well.

The format of the Roadshows had an impact on the show participants. The format was effective at stimulating interest in science. The sights and sounds of the demonstrations plus some of the interesting and valuable information in the shows made an impression on the students. The dynamic nature of the program provided both new visual and new auditory stimulus to the students and added to the "memorability" of the program. According to Spurgeon (1990), science education programs must combine methods of teaching which use the senses in order to be effective.

The Roadshows was effective at teaching the students some content. The students learned science content from the Roadshows and remembered details of the shows for at least 4 weeks. Students learned by participating in the show, being a volunteer, and by discussing
the program. Spurgeon (1990) agrees that students should have "imaginative participation" (p. 10) in programs in order to ensure a positive learning experience.

Many types of evidence in this study indicate that the Roadshows have had an impact on the participants in the program. Data from a second study conducted on the Roadshows adds to this evidence. The EDUCOM (1994) study and this present study show similarities in the experiences that people had with the program. The teachers involved in both these studies were pleased with the program and some thought that the program had a positive effect on students. The two studies point to an increase in positive attitudes toward science because of the program. The students thought they learned something new from the program and they liked the participation aspect of the program. In the EDUCOM study, the teachers were asked about students' involvement in the presentation and the impact the program had upon the students' attitudes toward science. The results were again positive. Corroborating data from the two studies provides further evidence of the impact the Roadshows has on students and teachers.

The positive pretest scores of the EDUCOM study regarding science attitudes confirmed that many students already had a positive attitude toward science before the Roadshows. The EDUCOM study found no change in student attitude after the Roadshows, but the present study found some individuals exhibited attitudinal changes. It is possible that the qualitative methods of the present study may be better able to gauge a change in attitude than a quantitative study such as the EDUCOM study. However, because of its large sample size, the EDUCOM study revealed trends and more potential for generalizations than the present study. Both studies are valuable instruments for finding out how the Roadshows were received by students and teachers.
The Roadshows programs are very similar to the successful programs found in other science centres. The topics, format and methods of presentation are all similar. This similarity indicates a formula which works. This formula combines science centres and schools for the purpose of teaching science in an enjoyable manner.

The Roadshows use many techniques recommended in the literature for creating positive experiences for children in science programs. Through the literature, it has become evident that there are many specific ideas about how to enhance science education that closely match the goals of the SCIENCE WORLD Roadshows. Evaluation of the attainment of these goals was not the focus of this study, but the basis for choosing these goals was soundly grounded in the literature (Fayard, 1991; Spurgeon, 1990; Lisowski, 1985; Orpwood and Souque, 1984; Roberts, 1983).

The Roadshows use both informal and non-formal (Maarschalk, 1988) science education techniques. The Roadshows, being an outreach initiative, "encourage the natural enthusiasm, creativity and curiosity of a child" and nurture the teachers (McVoy, 1987, p. 146) by virtue of the fact they travel to a school where the learning is already taking place. By extending beyond the walls of SCIENCE WORLD, the Roadshows contributed to the network of science educators.

By travelling, the Roadshows also makes experiential learning of science accessible to all students, and hence all families, all schools and all districts, regardless of location, socio-economic standing, or race. Science must be accessible. Accessibility can also be viewed from another perspective. Not only does the Roadshows reach into the communities, but it reaches into the minds of the participants by being a hands-on and minds-on program. This type of program is what is recommended to make science a meaningful part of children's
learning (Hodson, 1993; Blosser, 1990). The Roadshows challenge conceptions about science and involve children in solving problems. Experiments during the program encourage thinking and participation. Both Blosser, (1990) and Lisowski (1985) feel this is essential to a good science education program.

The program is interesting and fast paced. It also relates to students' everyday lives. According to Cajete (1988), relating science education to something which is familiar gives context for the learning, thus making the learning meaningful. When meaning is given, there is motivation to understand what is being taught. The positive response to the program and enthusiasm seen by the children in this study affirm the motivational nature of this program.

As Lucas found in 1991, the informal and entertainment nature of science education programs can supply scientific knowledge. The Roadshows have also been found to provide content knowledge within the non-traditional presentation style of the program.

Spurgeon (1990) describes how science should be taught. The following description could easily be about the Roadshows approach to science. He says that people intending to teach science "shouldn't go only with the objective of teaching facts. They must illustrate their concepts by stressing experiential learning. They should use a diverse combination of methods including seeing, hearing, writing, drawing, smelling, and touching" (p. 10). His other advice includes using "methods of delivery suitable to the age group" (p. 10) and keeping individual style in the presentations. The students should be spoken to as "fellow participants in the joy of science" (p. 10). Students should have encouragement to use "imaginative participation in every way possible" (p. 10). One scientific discipline should not be pushed more than another - all sciences should be represented. "A broad, unbiased
presentation is usually much more interesting than one which is narrow and concentrated" (p. 10). "Science is fun, as most people doing it find" (p. 9). "It is imagination combined with curiosity. Science is curious art" (p. 9). The Roadshows have presented science as a fun endeavor where curiosity is the key. The literature and the data from the study suggest that the Roadshows program is being presented in a manner which "impacts" students in a positive way.

6.2 Recommendations for Future Studies

Several different follow-up studies could be conducted on the Roadshows. A follow-up study should be conducted investigating the long-term effects of the Roadshows on students. Another study could be performed to find out if the students followed through with their Science Fair project ideas. In addition a study should be conducted to examine the relationship between Science Fair projects and the Roadshows.

In ideal conditions this present study should be replicated at different times of the year in a variety of schools. The timing of this study, right after the Science Fairs were over, was a coincidence, but may have resulted in an overly active interest in science by the students. It is recommended that this type of study be conducted in September and perhaps in January before the Science Fairs begin. It would be interesting to see if the Roadshows in January would then influence the choice of Science Fair projects in the Spring.

This type of study could also be conducted in communities that are farther away from SCIENCE WORLD where fewer students have access to visiting the science centre and therefore limited exposure to science before seeing the Roadshows. Results may be different in such a study.
In future studies, the timing of the study must be carefully decided. The school's situation must be considered before dates of the study are set. By considering the other events taking place in the school, the researcher can design a study to best accommodate the participants.

Many informal SCIENCE WORLD Roadshows evaluation forms have been returned from teachers around the province, rating the program. Another study could take these evaluations and quantitatively analyze them and recommend program changes from the results. Changes to the evaluation forms may also provide new information not previously gleaned from this study or earlier evaluation forms.

In this study a few students did not seem satisfied leaving the Roadshows program, not knowing the answer to the last question posed in the show. The use of discrepant events without providing an answer to the puzzle was done intentionally in the show, but may have resulted in unpredictable responses from the students. More study needs to be conducted on the use of demonstrations where the students are not given the solution to the problem posed. Does the benefit outweigh the potential negative effect? This was not discovered in this study.

Lisowski (1985) says that the relationship between science and technology and their interaction with society can be addressed in science education. She thinks that students need a high understanding of science because of the predominance of technology in society. Once they understand some things about science, students will be better able to deal with issues in society related to science. It is, therefore essential from this point of view, that the Roadshows program consider integrating some reference to societal impact of science and technology if it is to be considered successful. If these changes are made to
the program, further studies should be conducted to see if changes in students' understandings of societal issues take place.

This study on the Roadshows was useful for gaining insight into how a travelling science education program affects the population involved in the program. More studies on this format will give a fuller picture of the impact of these types of programs and hopefully convince sponsors to continue with their funding. The impact of the Roadshows warrants continued support.

Epilogue

In the Spring of 1994, the Roadshows program was cancelled due to lack of funding and a new focus for Outreach programs on the whole community instead of on the school. However, in January of 1995, the Roadshows were temporarily reinstated within the Lower Mainland of Vancouver. New funding was available and the schools were still calling SCIENCE WORLD for the Roadshows program.

During the first few months of 1995, the researcher was able to use the information from this study to improve the Roadshows program. The performers were told about the results of the study and how they could potentially impact the students. They were also told how to avoid problems identified in the Roadshows from the study. The following is the advice given to the performers.

The performers were told to continue to emphasize the rules of electricity. They were encouraged to make these rules clear and to repeat them throughout the Arcs and Sparks show. They were told to continue to mention the fact that electricity is dangerous, but
were requested to de-emphasize the problems with the Tesla Coil. They were told to tell the students that the Tesla Coil is not a practical way to power our homes because all the electrical equipment would always be on. The performers were asked not to collect a variety of answers from the students about the reasons the Tesla Coil will not work as a power source because the students in the study often remembered the strange and unimportant answers to this question.

The Arcs and Sparks show has been rewritten so that a discussion about who scientists are, and what they do, is not an integral component of the show. The students do not see a scientist at work during the Roadshows and so to eliminate confusion about what a scientist does, this emphasis in the show was removed.

The performers were encouraged to continue to allow the students to discuss information among themselves during the show when appropriate. This type of discussion was found in the study to be a valuable learning opportunity for the students as long as they were discussing information relating to the show. The performers were also encouraged to continue to relate much of the show to the students' every day lives and to ask the students to think about what they have at home which relates to the show.

Other small pieces of advice were given to the performers relating to the findings of the study. In order to help them understand how the show was presented, the performers were asked to watch video tapes of Arcs and Sparks presentations from 1994 and earlier. The way in which the performers presented the shows in the past has been recommended as the method to continue to present the Arcs and Sparks show for students in schools throughout British Columbia.
Bibliography


Labour Canada. (1986). *When I grow up... Career expectations and aspirations of Canadian schoolchildren*. (A pilot project undertaken for the Women's Bureau of Labour Canada. Published by authority of the Minister of Labour, Government of Canada.) Ottawa: Minister of Supply and Services Canada.


Appendix 1.1

Photographs of Equipment

FIGURE 1 Plasma Ball

FIGURE 2 Tesla Coil

FIGURE 3 Jacob's Ladder

FIGURE 4 Van der Graaf Generator
Appendix 1.2
Survey of Museums

Thank you for taking a few minutes to fill out this short survey.
Name: ___________________________________________ Title: __________________________
Museum: __________________________________________
Address: __________________________________________
Fax: ___________________________________________ Phone: __________________________
E-mail Address: __________________________________________

1) Do you have a travelling presentation such as the Roadshows described above?  
   Yes ___ No ___ (Please check one.)  
   If no, thank you for responding. Your response is important to the study.

2) If you do have a travelling presentation, what are the goals of the program?

3) Are your programs province/state wide? Yes ___ No ___

4) Have any studies been done on your program? Yes ___ No ___

5) If studies have been done, were any of these studying the effectiveness, impact or goal attainment of the program? Yes ___ No ___ Please elaborate about these results.

6) If no studies have been done on your program, is there anything you have received informally that would give you an indication of the impact your program is having on the participants or the community?  
   Yes ___ No ___ If you have received informal information such as letters phone calls, drawings, media write-ups etc., what do they indicate about your program?

7) Can you recommend any people or recent sources of information which could help answer these questions on similar programs? Please indicate below.

Thank you for your time and responses.
This information will be shared with SCIENCE WORLD and any other institutions who request it.
SCIENCE WORLD Roadshows Evaluation

SCIENCE WORLD appreciates your feedback.

Date of Presentation: ________ Attendance: # of Students: ________ Grade(s): ________

Please check the appropriate response.

1. Do you teach science? Yes ____ No ____

2. Was the program length suitable for the audience? Yes ____ No ____

3. Where all safety precautions taken during the presentation? Yes ____ No ____

4. Please rank the Roadshows program on the following scale from 1-10, where 1 is the lowest and 10 is the highest. Please circle only one number.

<table>
<thead>
<tr>
<th></th>
<th>Lowest</th>
<th>Highest</th>
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<tr>
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<td>1 2 3 4 5 6 7 8 9 10</td>
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</tr>
<tr>
<td>l)</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

5. If there were any special students in the audience, were their needs met during the program? Yes ____ No ____ If no, what do you recommend?

6. Would you recommend this program to another teacher or school? Yes ____ No ____
   If no, why not?

Thank you for your participation in this evaluation.

Please mail the completed form to:
Outreach Division, Education Department
SCIENCE WORLD British Columbia
1455 Quebec Street
Vancouver, B.C., V6A 3Z7
Appendix 1.4

List of Science Centres Contacted

List of places surveyed as of 1993/94 school year

Canadian Museums Contacted

<table>
<thead>
<tr>
<th>Name of Centre</th>
<th>Location</th>
<th>Method of Contact</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ontario Science Centre</td>
<td>Toronto, Ontario</td>
<td>Fax, phone, mail</td>
<td>Study on circus</td>
</tr>
<tr>
<td>Edmonton Space and Science Centre</td>
<td>Edmonton, Alberta</td>
<td>Fax</td>
<td>No outreach</td>
</tr>
<tr>
<td>Science North</td>
<td>Sudbury, Ontario</td>
<td>Fax</td>
<td>Similar programs</td>
</tr>
<tr>
<td>Discovery Centre</td>
<td>Halifax, Nova Scotia</td>
<td>Fax</td>
<td>Similar programs</td>
</tr>
<tr>
<td>Alberta Science Centre</td>
<td>Calgary, Alberta</td>
<td>Fax</td>
<td>No outreach yet</td>
</tr>
<tr>
<td>Aitken Bicentennial Exhibition Centre</td>
<td>St. John, Nova Scotia</td>
<td>Fax</td>
<td>No outreach</td>
</tr>
<tr>
<td>Electrium</td>
<td>Varennes, Quebec</td>
<td>Fax</td>
<td>No outreach</td>
</tr>
<tr>
<td>National Museum of Science and Technology</td>
<td>Ottawa, Ontario</td>
<td>Fax</td>
<td>No response</td>
</tr>
<tr>
<td>Saskatchewan Science Centre</td>
<td>Regina, Saskatchewan</td>
<td>Fax</td>
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United States Museums Contacted

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<th>Response</th>
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<td>Denver Museum of Natural History</td>
<td>Denver, Colorado</td>
<td>Fax</td>
<td>Survey results</td>
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<tr>
<td>Museum of Science and Industry</td>
<td>Tampa, Florida</td>
<td>Fax</td>
<td>Programs are similar</td>
</tr>
<tr>
<td>Museum Name</td>
<td>City, State</td>
<td>Contact Method</td>
<td>Programs Details</td>
</tr>
<tr>
<td>-----------------------------------</td>
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</tr>
<tr>
<td>Monterey Bay Aquarium</td>
<td>Monterey, California</td>
<td>Phone</td>
<td>Programs similar</td>
</tr>
<tr>
<td>Science Museum of Minnesota</td>
<td>St. Paul, Minnesota</td>
<td>Fax and Phone</td>
<td>Programs similar</td>
</tr>
<tr>
<td>Carnegie Science Centre</td>
<td>Pittsburgh, Pennsylvania</td>
<td>Phone</td>
<td>Survey results</td>
</tr>
<tr>
<td>Pacific Science Centre</td>
<td>Seattle, Washington</td>
<td>Fax and Phone</td>
<td>No response, but staff visits, similar</td>
</tr>
<tr>
<td>Ohio's Centre of Science and Industry</td>
<td>Columbus, Ohio</td>
<td>Fax and Phone</td>
<td>No response, Carnegie Centre gave information, similar programs</td>
</tr>
<tr>
<td>Oregon Museum of Science and Industry</td>
<td>Portland, Oregon</td>
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<td>Similar programs</td>
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<td>Exploratorium</td>
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<td>Different programs</td>
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<td>Chicago Academy of Science</td>
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<tr>
<td>Miami Museum of Science</td>
<td>Miami, Florida</td>
<td>Fax</td>
<td>No response</td>
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<td>14 Responded</td>
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</table>
PERMISSION FORM FOR PARTICIPATION
IN THE UBC STUDY ON SCIENCE WORLD'S ROADSHOWS

A) Parents or guardians, please circle one option and fill in the blanks.

I consent/I do not consent to my child ____________________________ (Please Print Your Child's Name Here)
participating in the study conducted by Allisa Ritchie at Sullivan Elementary School during
the Spring of 1994.

B) Parents or guardians, please circle one option and fill in the blanks.

I will accept/I will not accept a phone call regarding this project.

Here is my phone number so that you can contact me ____________________________
The best times to reach me are: ____________________________

C) I have read this information and acknowledge receipt of a copy of the consent form.

Signed ____________________________
Parent or Guardian

Date ____________________________

Please return this form as soon as possible (before March 9th, 1994).

Thank you for your time.
Appendix 2.1
Study Questions

1) Do the students who participated in the Roadshows show more interest in science as a result of the Roadshows program?

2) Do the students change their ideas about science following the Roadshows?

3) Do the students ask more science oriented questions following the Roadshows?

4) What conversations and discussions do the Roadshows stimulate?

5) What thoughts do the students have of the Roadshows?

6) Do students remember program content and their Roadshows experiences after 4 weeks?

The impact of the Roadshows will be gauged by the answers to these questions.
Appendix 2.2

Pre-Roadshows Interview Questions

Pretest Questions, March 10, 1994

1) a) Have you heard of Science World? What have you heard? When?
b) Have you ever been to Science World in Vancouver?
c) Do you ever go to other science-oriented places? (Aquarium, Planetarium...)
d) Do you know what the Roadshows program is?
e) Has Science World been here before? When?
f) Do you remember anything from that program? What?
g) Did you have a favorite part of the program? What is that?

2) Have you ever seen any of this equipment before? (Show 4 pictures at the same time of equipment typically used in the Arcs and Sparks program: Plasma Ball, Tesla Coil, Van der Graaf Generator, Jacob's Ladder).
b) What do you think it does?
c) Do you find it interesting? Do you have any questions about it?
d) Would you like to work with this material? Why or why not?

3) Do you do any science at home?
b) Do you talk to your friends about it?
c) Do you have any science hobbies? Do you do these hobbies by yourself or with a friend?

4) What comes to mind when you hear the word science? Is it good or bad?

5) Do you like science?

6) If you are curious or puzzled about something do you ask questions?
What kinds of questions do you ask?
7) Is it OK if you have a wrong answer to a science question in your classroom?
8) Do you talk to people about science? Who? What do you say? What do they say?
9a) Did you talk with your friends about the Roadshow last time it visited? OR
b) Do you ever talk about Science World to people? Who? What do you say? What do they say?
10) Do you ever hear people talking about Science World or the Roadshow's presentation? Who? What do they say?
11) If you were a scientist, what kind of work would you do? Where would you work?
12) Do you think science is hard to understand? Do you think that only really smart people do well in school science?
13) Do you think that you would want to be a scientist?
14) Describe scientists to me. What kinds of people do you think they are?
15) Do you think that only men in white lab coats do science?
16) Do you think that anyone can be a scientist?
17) Can both boys and girls be scientists? Do both boys and girls grow up and choose to be scientists?
Appendix 2.4

Post Roadshows Interview Questions

Questions for March 18, 28 and April 14, 1994

1) Have you ever been to Science World in Vancouver?

2) Do you ever go to other science oriented places? (Aquarium, Planetarium...)

3) Has Science World ever been to your school before last week (or before last month)? When was that? What do you remember about that show?)

4) Have you ever seen this equipment before? Where? When? What do you think it does?

5) Before the Roadshows you said you thought it did _______. I am interested in why you say something different this time. It doesn't matter that you said something different, this is not a test.

6) Do you find this equipment interesting? Do you have any questions about it?

7) Would you like to work with this material? Why or why not?

8) After seeing a Roadshows program did you think about it?

9) What did you think about? Is this a nice/fun thing to think about or not?
10a) Did you feel good when you left the program? Why do you think that is?

b) What did you draw about the program to show to someone who had not been to it? Why?

c) Which face did you circle? Why?

d) If you were going to rate the program by giving it a mark what kind of mark would you give it?

11) Did the Roadshow make you think about science in a different way?

12) What do you think about science now? Do you like it? Why/Why not?

13) Before the show you said ____ about science. I am interested in why you think about science differently now.

14) Do you think you learned anything in the Roadshow? What?

15) If you are curious about something, is it OK to ask questions about it?

16) Is it OK if you give the wrong answer to a science question in school?

17) Will you ask more questions now if you are curious about something?

18) Before the Roadshows you said ____. Can you tell me why you say something different this time?

19) Did you know Science World was coming to your school? How?
20) Did you ask any questions during the show? What did you ask? Why? Did you learn anything from asking this question?

21) Do you usually talk to your friends about science?

22) Before the Roadshows you said ______. Can you tell me why you say something different this time?

23) Did you talk with them about the Roadshows after the show? What did you say? What did they say?

24) Did they have a favorite part of the show?

25) What about you, did you have a favorite part to the show?

26) Was there a part of the show that you or your friends did not like? What was that?

27) Did you hear other children talking about the Roadshows after the show? What were they saying?

28) Did you hear the teachers or other adults talking about the show before we arrived?

29) Did you hear the teachers or other adults talking about the show after we left? What were they saying?

30) Did you ask your teacher any questions about the Roadshow after it was over?
31) Did you go home and tell anyone about what you saw in the Roadshows presentation? or not? Who did you tell? What did you say? What did they say?

32) Did you do any science at home after the Roadshow?

33) Before the Roadshows you said that you do science at home already. Did you do a different type of science after the Roadshow than what you usually do?

34) Did you get any ideas for science fair projects from this program? (no) What ideas can you think of now for a science fair project that you get from seeing the Roadshows. (yes) What idea did you get?

35) Did you take any science books out of the library because of seeing this program? What kind of science books did you take out. Why?

36) Did you talk to anyone in your community, like a librarian or store clerk about the Roadshows or not?

37) Did you buy anything new because of the Roadshows? Or did it make you want to go out and buy anything after seeing the show?

38) Could you see yourself working in a science career? Doing what? Where? What would you do?

39) Would you like to have a job like the Roadshows teacher?
40) Would you like to work with this material?

41) Do you think that only men in white lab coats do science?

42) Can boys and girls both be scientists?

43) Do both boys and girls choose to be scientists?

44) Do you have any questions you want to ask me about the Roadshow?

45) Now that you have seen the program, are there questions that you feel you can ask now that you would not ask before? (Did the Roadshows program give you more confidence to ask questions about science?)

46) Are you more interested in science because of the Roadshows or less?

47) Do you think that you know more about science after seeing the Roadshow (once or twice) or not? What do you know more about?

48) Will you do more science on your own or at home now that you have seen the Roadshow? or not?
Appendix 2.5

Sample Transcript

1. Pretest March 10, 1994  
2. Students A and B  
3. R: May be you can tell me your names  
4. (B) and (A)  
5. R: So go ahead and ask me your questions  
6. A: Yeah, like what kind of questions will they be like?  
7. R: They are not going to be personal questions and no test questions, I only want to know what I think about things. And my name is Allisa, you don’t have to call me Miss Ritchie and it is going to be really casual, relaxed, you can leave any time you want, if you have to go to the bathroom you can leave, if you are feeling uncomfortable you can leave, just let me know OK. It’s just research I’m doing because I want to find out what people like you think about thing. OK so it is not going to be a test. Basically I just want to be a test at all, I just want to make you comfortable so that you can relax and tell me what is going on in your head.  
8. So the first question is have you ever heard of Science World?  
9. A: Yes  
10. B: Yes  
11. R: What did you say?  
12. A: I’ve been there  
13. R: Oh you’ve been there.  
14. B: So have I. I have... I go to guides and we have a sleepover there.  
15. R: Oh you’ve had a sleep over there. And when were you there?  
16. A: I’ve been there a couple of times. I went there with my uncle  
17. R: You went there with your uncle.  
18. A: I went there with my mom  
19. R: Wow  
20. A: I’ve been there a couple of times  
21. R: Oh that’s great.  
22. B: I always go there with my grandma or my mom because like they always spoil me and.  
23. R: Oh
26. A: They have a show there and it's called um
27. B: yeah, sometimes it is different like it changes every 2
months or something
28. A: Yeah
29. B: I seen the earthquake one
30. A: I saw this one where this guy stands on an airplane and he
stands on top of it and then jumps off or something.
31. R: He stands on an airplane?
32. B: Yeah he jumps off, he is really good.
33. A: The airplane moves right and you get the feeling like you
are in the airplane. Like he turns around and everything like
that(Omi max theatre of a stunt plane and jumper)
34. B: Like he turns around and AHHHHHHH.
35. R: Really? I don't know that exhibit.
36. A: It is in the OMNIMAX
37. R: Oh it is in the movie
38. R: Oh I see I know what you are talking about now
39. R: So um do you ever hear anyone else talk about Science
World?
40. B: Um
41. A: Yea
42. R: What do they say
43. B: Have you seen this have you seen that
44. R: OK
45. R: Do some of your classmates go to SW?
46. B: Yeah
47. A: Yeah
48. R: OK
49. R: And Uh have you ever been to any of the other places to do
with science around Vancouver?
50. B: Uh... (laugh)
51. R: Can you think of another place that may have something to
do with science or...
52. R: You know biology or rocks or...
53. A: Oh yeah I have this ...
54. A: It is like this store
55. A: Oh what store is that
56. A: Science and Nature store
57. And one is in the market and one is in the mall
58. Is that close by
59. Yeah
60. I think it is Willowbrook Mall or something
And what do you do there
Like there is all this science stuff, like the images of all these
different rocks and you buy one like crystal growing kits and
yeah
and like there are different kinds of things that have to do
with science and nature
wow
and there is all this music on like and
I bought a crystal growing kit and it didn’t grow.
And they didn’t grow?
No
Did you buy it at the store?
Yeah
And mine had all these crystals...
OK mm that’s interesting
OK now what about some other places that have to do with
the stars or...
Do you ever visit any of those kinds of places?
Museums
Yeah
Like what kind of museums?
The Art Museum
And I have been to the one in Victoria
and lots of museums and one in Sacramento
to see my cousin and I got to miss school too
So do you know what the name of a program from science
world called Roadshows is?
Yeah
Have you heard that name before?
Um
You have?
Yeah
Um cause, I can’t remember what school I used to go to, but I
used to go to school in surrey I forget what it was, but I was about
5 or 6 years old and they did a Roadshow there.
Oh I see.
What about you?
No
No you’ve never heard the name before. OK
Well because you’ve had different experiences, I’m going to
ask you different questions, OK?
Just because I want to know a little bit about what you
remember.
96. OK so what do you remember about that program?
97. I just know it was gun.
98. It was fun. OK
99. So do you remember anything about what they did
100. No
101. No
102. Yeah, that was a long time ago for you wasn’t it.
103. Yeah
104. Do you have a favorite part of the program that you remember?
105. No
106. No
107. OK
108. that is fine
109. Now I have some pictures here and I am just wondering if any of you, either of you have seen these pictures before?
110. Yeah
111. You have?
112. Have you seen these pieces of equipment before?
113. I’ve seen that one
114. A: I’ve seen that one too at Science World
115. OK all righty that is, I’ll just label these, A, B, C, and D
116. OK you’ve both seen A.
117. OK what about any of the other ones?
118. B: I think I might have seen that one (B)
119. Like what does it do? Is it absorbs electricity?
120. That’s right it gives electricity off at the top here
121. Just watch your elbow a little bit, ’cause that’s the microphone OK?
122. Yeah I think I have seen that one at Science World
123. At Science World
124. and what about you where have you seen that one?(B)
125. I’ve seen it in the science part like where you can talk into things and it goes whoooa and stuff.
126. At Science World?
127. Yeah
128. So what does this thing do (A)?
129. You touch it and like the electricity comes....
130. Can you feel it?
sometimes
You don’t really kind of like....
It doesn’t shock you, Oh that’s good OK.
All right and these ones you don’t think you have seen
before?
No
What do they really do?
Well This one gives off electricity
All of these have to do with electricity, just in different
forms
Oh I see.
Oh yeah OK
All right, OK that’s good.
OK Do you find
Sorry I’m not finished with these
Do you find these interesting? Do you have any questions
about them?
We talked a little bit a bout what they did, a little bit
yeah
How does that work?
How does this work? That’s a good question
This is number C and this has a little spark at the bottom
and it goes up between these two pieces of metal and so the spark
gets bigger and bigger and bigger and then it moves across
between these two pieces.
Oh yeah like in Frankenstein’s movie.
Oh yeah like in Frankenstein’s movie.
Um Like what are the names for them?
The names
A is plasma ball
B is a Tesla coil
I’ve heard of plasma like plasma grenades like in movies.
No it’s not the same thing.
C is called the Jacob’s ladder and
D is called a Van der Graaf generator
Van der Graaf generator (in tandem)
Yeah pretty big names eh?
OK
OK any do you have any other questions about it?
What school is this?
Oh what school is this, oh that is a very good question. I took these
pictures a long time ago.
164. I think these were probably in Surrey as well, but ah I’m not sure
165. It looks like George Vanier
166. Does it?
167. I’m sorry I can’t remember
168. That’s a good question
169. I guess I had better find out eh (Found out later - photos from Squamish and told Supreet)
170. Maybe it was my old school and maybe I can remember, like maybe I can answer the questions, but I can’t remember
171. Oh that’s OK it is not a test. You don’t have to remember, If you don’t remember that’s fine.
172. OK so do you think you’d like to work with any of those materials?
173. Yeah
174. Yeah
175. Yeah, why?
176. Because
   Well, they’re fun.
177. Yeah
178. They’re fun, Why?
179. They look fun
180. Yeah.
181. Why do they look fun?
182. Because....they...just like....cause like I like electricity right.
183. You like electricity.
184. Oh yeah.
185. Yeah
186. It is powerful.
187. Yeah
188. I like to touch it to see how it works. And to learn about it.
189. And why do you think it would be fun?
190. Cause it would be fun
191. It would be fun
192. You would be learning things about it while you would be having fun.
193. Good, OK, All right
194. Do any of you do any science at home?
195. Um
196. Yeah
197. I grow stuff, like my mom buys
198. Grow stuff like what kind of stuff?
199. Like crystals and like rock growing stuff
200. and my mom buys science books and we have to do...
201. But you like to do them?
202. Yeah they are good, especially the experiments
203. Like what kinds of experiments
204. like um like get like chalk and you put it in vinegar and it
   all melts and
205. Yeah that’s cool
206. and it is like acid rain on um what is it, the affects on acid
   rain on... sort of thing what’s it called...
207. Something that is like chalk
208. yeah like the statues when they are covered with chalk
209. there are certain types of rocks too
210. Yeah and there are different types of experiments like
   Volcanoes
211. Volcanoes yeah
212. And I can make whatever I want
213. And Melissa what kind of science do you do at home.
214. I have this little book at home that’s this big and it has
   130 pages in it and every two pages like cause one science thing
   takes up two pages yeah and um I did one of my I did my science
   fair things on that and I did OK
215. Was that something you chose to do or you had to do for
   school?
216. Um my dad said you have to do this, so I had to do it
217. But did you like doing it?
218. it was fun yeah
219. Oh that’s good
220. OK
221. Do you talk to your friends at all about science outside
   the of classroom?
222. yeah
223. B: Mmm some times like oh have you seen that, oh man
   it’s so awesome.
224. Laugh
225. A: We talk about it everywhere.
226. OK
227. And what about you Melissa?
228. Yup
229. You do too?
230. Yeah
231. What is there anything specific you talk to them about?
232. Everyone else's science things and what their uh ribbon was and stuff
233. OK was that to do with the Science Fair project, the ribbons?
234. Yeah
235. OK
236. yeah
237. We ask everyone else about that and we would ask like things everyone has seen like have you seen that, cool and awesome.
238. Laugh
239. Do you have any science hobbies, so something that you do on a regular basis that has to do with science- Melissa?
240. Um well I would like if horses are like science cause I
241. Nature
242. Yeah that can be sure
243. Cause like me I have a horse and like I have to take him for tests and stuff
244. Oh like what kinds of tests?
245. Like um rabies tests and worms tests and um blood tests to see if he has any thing wrong with him so.
246. Oh that is interesting
247. So what kind of science do you think that is?
248. Nature science?
249. OK yeah that's right

250. OK so that's your hobby you like to spend a lot of time with your horse.
251. And what about you Super?
252. Not really a hobby but not that I can think of right now?
253. No
254. OK and you do these hobbies by your self B?
255. Um Sometimes my friends come with me.
256. Sometimes your friends come with you OK.
257. All right what comes to mind when you hear the word science.
258. Melissa you don't have to put your hand up.
Electricity and animals and stuff
What about you A?
Fire and water and nature
OK
and are those good things that come to mind for you or not?
Good things
Good Things
OK why is that positive? Why is that good
It is pretty hard to explain.
It is hard to explain
yeah
Do thinking about those things make you feel good or make you feel bad?
It makes me feel so
So-so
Yeah
It has no effect on me
I has no effect? Yeah
OK
Kind of like well it is hard
OK So do you like science?
Yeah
Yeah
Do you like science in Class?
Yeah
Yeah
Do you like science out of class?
yeah
yeah
So if you were curious about something or puzzled about something would you ask a question about it?
yea
yea or I would go to a book and do like tones of research about it
Yeah or ask my parents and if they don’t know I’d ask my grand father and if he doesn’t know I would take some books out on it and if the books don’t tell me then I’d go to the encyclopedia to see if it can tell me and if it doesn’t... I’m puzzled.
Puzzled
Yeah
293. So what kinds of questions do you ask?
294. What is it how does it work what’s it’s name
295. Sometimes you see things on TV, like inventions
296. Inventions on TV?
297. yeah
298. How to crack an egg
299. Like stuff, Like ....like....stuff, Like stuff on TV, I always
   ask my parents well do you know about that and all I know is like
   I like it so I ask everybody...
300. You ask every body about it
301. Yeah I want to know if anybody knows anything about it
302. OK
303. cause I like it
304. Do you think it is OK if you give a wrong answer to a
   science question in your classroom?
305. Yeah
306. Yeah cause you learn... you learn from your mistakes
307. You learn from your mistakes?
   Yeah.
308. Yeah
309. That’s good.
310. If you don’t make mistakes you really don’t learn
   anything.
311. And so it is OK if you have a wrong answer?
312. Yeah
313. Well That’s good.
314. And do you talk to people about science other than
   people in your school.
315. Yeah
316. Yeah
317. So who would they be?
318. My parents, my grandpa, my uncles, my aunt, my sister
319. My parents, my grandma, my brother -like friends and
   family.
320. OK and what do you say to them?
321. About science?
322. Well f you were talking to them about it, could you give
   me an example of what you would say?
323. What is it and how does it work?
324. OK so questions.
325. Yeah
OK
So the last time that the visited did you talk to your friends about...?
Yeah, we talked um... they came around the end of the year so we talked until the end of the year.
You talked until the end of the year about it with your friends?
Yeah
And what kinds of things did you say?
Um like well like the same part but um I forget what it is not um that it was really fun, cool and radical.
Radical eh?
Yeah
CK
An about Science World Did you talk to people about going to Science World?
Yeah
Yeah
Yeah and What kinds of things do you say about science world itself?
Like I said before, awesome.
Yeah
CK
That it is cool, and other things, like I had fun.
You had fun, OK.
And what did they say? Have any of your friends had any comments about what you said?
Yeah
What kinds of things did they say?
Same thing, awesome, cool...
OK now what if they haven’t been what did they say?
They really didn’t say anything.
They don’t say anything?
Yeah
They don’t know about it.
Cause they really don’t know about it.
OK Do you ever hear any teachers or anybody, adults in the school talking about Science World?
MmHmm
Mm Hmm
And what do they say?
Umm

Like have you been back, there is a new exhibit, have you asked questions and they ask question

They ask you questions?

Yeah

Like what kind of questions do they ask you?

Like how many, like if you round off, how many, about how many exhibits are there?

OK

About that

No they really ask have you been there like is there an exhibit like this like we’re doing something in science like nature or something and like sometimes they would use the actual Science World there like the exhibit there.

Oh so they tell you about a new exhibit at Science World?

An they would ask us if we had been there?

OK and do they ever talk about the Roadshows program?

No

No

No you haven’t heard the teacher talking about the Roadshows program?

Yeah

But after we got the notice

yeah

OK after you got the notice.

so what did he say about the Roadshows program?

He said like there is a Roadshows program coming from Science World and yeah from SW

and it will be on the 17th. That is my birthday, St. Patrick’s day.

Oh It’s your birthday. Oh I’ll have to write that one down.

My birthday is the next day.

Oh

OK Birthday on the 17th, we’ll have to remember that

Yeah it is St. Patrick’s day so it is easy to remember.

Uhu

I guess it is like a present to me.

That’s right, oh that’s great.

Oh by the way Supreet, your birthday on St. Patrick’s day do you ever dye your hair green.
Laugh
No
Green clothes, not green hair.
I thought I would paint my face green.
OK well I don’t think that too many people dye their hair green.
OK so did your teacher say anything else about the Roadshows?
Well... He said it was a good program.
Yeah
He said it was a good program. Why did he say that? Do you have any idea? Did he
Yeah
Because it is educational and it is fun.
And he said at his old school that it came there.
Oh so he’s seen it before?
Yeah
Oh OK.
What did he tell you about it?
He told us that it was fun and ... mmmm it was fun..... and radical and cool.
Oh did he use the word radical?
Mmmm so so.
So if you wanted to be a scientist, what kind of scientist would you be?
Animal scientist.
Animal scientist?
Yeah or
You too?
Yeah.
What kind of work would you do?
Um like Test animals.
But not hurt them right?
No, to test them for like rabies or something.
Worms
I don’t want to test rabies.
I want to test the speed of it because the cheetah is my favorite animal.
What is your favorite animal?
The cheetah.
Cheetah and Cheema (his last name).
So they run fast.

Yeah and like they’re smart, like how smart are they?

What did you say about their babies?

Like do they look after their babies properly, like do they take care of them are they nice to them and take them with them are they nice to them or do they just don’t care or do they just leave them like some animals like who just leave them alone and like some animals they really take care of their babies.

Oh OK. So that is wild animals that you’re talking about

Yeah

I would like take them like capture them and put them into this cage....but

No.

I do like wild so like they really wouldn’t notice me...

So I would get a good answer

Oh that’s good. You’ve got it all planned out.

Yeah because If you put them in a cage they wouldn’t act the same, they’re in a different habitat.

They would be acting different and doing different things.

you are right

Would you like to work on wild or domestic animals?

Wild

Wild as well?

And what kinds of testing would you do?

Um Like see if they fall down and break their leg could you help their leg or you got a put it to sleep.

Yeah but there are some (lizards) that can like can like rip off their tails if someone grabs it

EEK

Like it just cracks off, they can run away

Then they can grow one sometimes two sometimes grow three

Yeah by accident

Wow, huh that’s interesting

OK well just a couple more questions.

We are almost finished here.

So um you would both like to work with animals.

Where would you do this kind of work?

Out in the wild.
454. Yeah.
455. In the wild? Is there a specific place?
456. Probably in Africa because that is where cheetahs are
457. Yeah
458. I would have a camper with extra food and camouflage
   and stuff.
459. Oh that's interesting and why would you camouflage it?
460. So like if I had it white, let's say I had a white camper
   and like they'd go don't go near there, don't go around there cause
   there is a person there.
461. Oh so they could see it
462. Yeah
463. I see.
464. They would hide themselves so that they like they really
   wouldn't notice me and really wouldn't be scared.
465. So they wouldn't be scared if it was camouflaged
466. They would run away. If it was camouflaged they
   wouldn't be scared.
467. Oh that's really smart. Boy you guys have some great
   ideas that's really smart.
468. That's great.
469. So do you think that science is hard to understand?
470. Sometimes
471. Mmm no
472. Sometimes
473. No not really
474. Do you think it is a hard subject in school
475. No
476. No
477. No? Why do you think it is not hard.
478. Because school isn't hard.
479. Sometimes
480. sometimes it is
481. Yeah
482. OK
483. No but um really the books explain it clearly so that we
   know what they're saying.
484. Uh Hu
485. So there are scientific words that we don't have a clue to,
   like if they have hard words right eh like hard words they try to
   break up to give them easier and easier so it is not so hard for us.
Yeah
And if we are really stuck we can look them up in the back.
So do you two study hard
Yeah
Yeah I guess.
Yeah you do.
So do you think that only really smart people do well in school with science?
No
No
You daunt have to be...
There might be someone who is dumb in every subject but who is really really really good in science.
like they might be getting D’s in every
Like F’s in every subject except one and they might be really good in that, they may be getting A’s in that.
Uh
Yeah
It really depends on what your mind is like and what you really like.
OK so how is our time doing. I just want to ask you a couple more questions.
So what do you think a scientist looks like?
He can look like anything.
Yeah
Scientists may not like wear the big white coat and a beard and everything he could just be like a normal guy and wear normal clothes.
Yeah
Or he could be a hippie or something with long hair.
OK but you both said he does that...
Or she
Or she
Id doesn’t matter like it could be a boy or girl. They may, they don’t have to wear the big white things with ....
Yucca
You said Yuck Melissa, Why is that.
Because I don’t like, I didn’t like people well like Doctors who wear all white. I gives me the creeps.
Why?
I don’t know, I don’t like getting needles.
Oh
I got my booster shot when I was five and all I did was scream.
OK so the white lab coat reminds you of your booster shot.
Yeah
Sometimes scientists wear normal clothes
So you said that both boys and girls can be scientists? Is that what you said?
Yeah
Yeah anybody can.
OK so do boys and girls actually choose, both of them choose to be scientists?
yeah
Yeah
Are there male and female scientists out there now you think?
Yea lots.
I think.
All right
That’s the end of my questions, do you have any questions for me?
Um....
No?
How long is this Science World thing going to be? The science Roadshow thing?
The Roadshow, it’s an hour long.
An hour?
So the show you’ll see is an hour.
Only an hour like they don’t come 3 times or...
There are 3 shows in one day and you will probably just see one of them.
An the kids get to go up and touch stuff right?
You might, you might.
Oh
How many classes will be there at once.
3 classes
like intermediates together, like 5,6,7?
yes that’s probably how it will be.
Like....
Let's let Melissa get this one out if she can.
Do you know how many exhibits there are going to be, like how many things they're going to be showing?
Well there's going to be lots of different things that you'll be seeing. Probably with the Arcs and Sparks show that you're seeing, there will probably be at least 15 or 20 different things.
Oh
It's going to be about like what you see?
Yup.
Like how are they going to present it?
I saw this show where there were a couple of guys that were pretending like they were scientists and...
And I remember that
Was that a Roadshow?
Yeah, I don't know
Oh and they had these masks and
Ohhh
They were special effects type of people. They would make these changes and you couldn't really notice.
Oh I don't think that's the science world show.
No
No
Like how are you going to do this?
No it is not just going to be show and tell it will be a lot of fun.
Yeah, so that was what I was going to say, like a boy and a girl.......
Asked Supreet later but before he saw show:
Do you want to be a scientist?
No
Why not?
Can't make that much money and...
OK
And my Dad is in Real Estate, so...
Appendix 2.6

Questions Asked Teachers and Responses

Questions for teachers on March 28, 1994 (11 days after program)

1) What is your name?

2) What grade do you teach?

3) Did you see a Science World Roadshows presentation?

4) Which one?

5) What did you think about the Roadshows presentation you saw.

6) What was the part of the show that you liked the most? Why?

7) What was the part of the show that you liked the least? Why?

8) Did you talk to anyone about the program? Your students, other staff, family, people in the community such as librarians or shop keepers? or not?

What did you talk about?

9) Do you think that there has been any effect on you due to the Roadshows presentation? Do you think that your view of science has changed due to the Roadshows or not?

If yes how has it changed? Attitude? Definition of science? Do more science?

10) Have you heard the children talking about the SCIENCE WORLD programs? If yes, what did you hear?

11) Have you heard the school staff or other adults talking about the SCIENCE WORLD programs? If yes, what did you hear?

12) Have you noticed any increase in the children's interest in science since the SCIENCE WORLD presentations?

13) Have you noticed any increase in the number of questions asked by children about science or science related materials.
14) Has there been an effect on your students due to the SCIENCE WORLD programs? If yes, in what way? How? Why? Has this affected their attitude about science?

15) Do you think there has been an influence on the school due to the SCIENCE WORLD programs? What about on the community itself?

16) Do you think that there will be any lasting impressions on anyone due to the Roadshows? More than 3 weeks?

17) How is the log book coming along? (comments, questions and activities)

Sample Response from Grade 4-5 Teacher

1. Ms. W.

2. 4/5

3. Yes

4. Arcs and Sparks

5. Excellent

6. Demonstration of how current passes from one person to another. Impressive and a valuable lesson.

7.

8. Students, other staff. Excellent presentation. Good to have it come to school, so all can see it.

would not be possible to take all children to Science World with present budget restraints.


10. No.

11. Yes See 8 above.
12 No.

13. No

14. Don't know.

15. Intent to use program again.

16. Yes. Yes.

17. Little immediate response from children, other than follow-up pictures and captions, No

later comments or questions.
Appendix 2.7

Questions Asked Parents

The parents of the interviewed students were asked these questions.

1) Before you received the letter, did you know that your child participated in a SCIENCE WORLD program at school?
2) How did you know?
3) What did your child say to you about the program?
4) Has your child talked about science in the last week?
5) Is this more or less than usual?
6) In your opinion has the Science World program had an effect on your child?
7) In what ways?
8) Have you noticed any specific changes in your child's attitude toward science? What are the changes? What gave you the impression that there was a change?
9) What is your opinion about the Roadshows?
10) Has there been any effect on you due to the SCIENCE WORLD program?
### Table 1

<table>
<thead>
<tr>
<th>Student</th>
<th>Comments about SCIENCE WORLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>He has been there with his uncle and mom. He talked about OMNIMAX with stunt flying. &quot;It is awesome. It is cool. I had fun. My friends say the same thing awesome, cool.&quot; Teachers say &quot;have you been back, there is a new exhibit&quot;. Teachers ask &quot;is there an exhibit like this?&quot; &quot;We're doing something in science like nature or something and sometimes they would use the actual SCIENCE WORLD there like the exhibit there&quot;.</td>
</tr>
<tr>
<td>B</td>
<td>She went with her Grandma and mom and with guides sleepover. She talked about OMNIMAX movie with stunt flying and the earthquake program. Teachers asked her how many exhibits there were there.</td>
</tr>
<tr>
<td>C</td>
<td>&quot;It has a lot of science stuff in it, I went in the summer, that is when I usually go. I like it. My dad talks about it, like when we are going and stuff.&quot; &quot;Sometimes I ask why did they have it or what is used for [exhibits]&quot;.</td>
</tr>
<tr>
<td>D</td>
<td>&quot;I went about a month ago&quot; (Feb. 1994). &quot;I like it. My mom talks about it&quot;.</td>
</tr>
<tr>
<td>E</td>
<td>She went with class last year. &quot;It is neat. It has lots of stuff. It has all those models and stuff&quot;. She talked about the OMNIMAX. She saw the Tropical Rain forest. &quot;It taught us lots of stuff&quot;. She talks to people about it &quot;a little bit if they've been there&quot;. &quot;Last year for my guide pack we went to sleep over there and we talked about it quite a bit. Like if they saw certain things. He [teacher] talked about the interview and stuff - we'd probably get one, but some people would get 3 interviews&quot;.</td>
</tr>
<tr>
<td>F</td>
<td>He went there with the class last year. &quot;I like it a lot&quot;. He talked about OMNIMAX &quot;where you can see the picture all around you&quot;. &quot;The one where you were really small and the grass was really tall&quot;. He heard the teacher talk about Science World by saying that it was &quot;coming to our school instead of us going to Science World&quot;. He talked about it &quot;if we are doing something at school with it [Science World]&quot;. &quot;The teachers said that it was coming to our school instead of us going to Science World&quot;.</td>
</tr>
<tr>
<td>G</td>
<td>She went with the guides to the sleepover last year. &quot;I liked it&quot;. &quot;The teacher said that people were going to be interviewed&quot;.</td>
</tr>
<tr>
<td>H</td>
<td>&quot;Once this summer&quot; he went to Science World. &quot;I've been there more than once, lots. I like it&quot;. &quot;The teacher said that the SCIENCE WORLD Roadshow was coming. I told my mom that SCIENCE WORLD was coming to our school&quot;.</td>
</tr>
<tr>
<td>I</td>
<td>&quot;I went with my group of brownies, we had a camp over there in any room, last year&quot;.</td>
</tr>
<tr>
<td>J</td>
<td>&quot;I think I went last summer&quot;.</td>
</tr>
<tr>
<td>K</td>
<td>&quot;It was neat&quot;. She went to Science World last summer.</td>
</tr>
<tr>
<td>L</td>
<td>Was not interviewed</td>
</tr>
<tr>
<td>M</td>
<td>&quot;It was fun&quot;. He went to Science World about a year ago.</td>
</tr>
</tbody>
</table>
Table 2
Have the Students Heard of the Roadshows?

<table>
<thead>
<tr>
<th>Student</th>
<th>Roadshows Visited Before?</th>
<th>Heard of Roadshows?</th>
<th>Where?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>No</td>
<td>Yes</td>
<td>Only heard of the name after he got the notice. The teacher said there was a Roadshows program coming from SCIENCE WORLD and it would be on the 17th of March, 1994. The teacher said it was a good program because it is &quot;educational and fun&quot;.</td>
</tr>
<tr>
<td>B</td>
<td>Yes</td>
<td>Yes</td>
<td>Her previous school the program visited. Her teacher had seen it at his old school also. He said it was &quot;radical and cool&quot;.</td>
</tr>
<tr>
<td>C</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>No</td>
<td>Yes</td>
<td>Her teacher used the name Roadshows in reference to the students' interviews. He said that SCIENCE WORLD would be doing a couple of shows and that the students would be interviewed after.</td>
</tr>
<tr>
<td>F</td>
<td>No</td>
<td>Yes</td>
<td>The teacher used the name in reference to their interviews. He said that there were going to be 3 shows.</td>
</tr>
<tr>
<td>G</td>
<td>No</td>
<td>Yes</td>
<td>She heard the name only when the teacher said that the SCIENCE WORLD Roadshows were going to visit and in reference to the interviews.</td>
</tr>
<tr>
<td>H</td>
<td>No</td>
<td>Yes</td>
<td>Only when the teacher said that the SCIENCE WORLD Roadshows were coming in reference to the interviews.</td>
</tr>
<tr>
<td>I</td>
<td>No</td>
<td>Yes</td>
<td>The teacher told them about a week before. She also heard it from her mom because she and K's mom &quot;sort of knew because they do the newsletter so they have to do it up before hand. The letter just told a little bit about it&quot; and what [SCIENCE WORLD] would do.</td>
</tr>
<tr>
<td>J</td>
<td>No</td>
<td>Yes</td>
<td>&quot;Our teacher told us a little bit&quot;. &quot;I heard it from the newsletter&quot;. The notice that went home with the newsletter also gave information.</td>
</tr>
<tr>
<td>K</td>
<td>No</td>
<td>Yes</td>
<td>&quot;Mr. B said that it was coming&quot;</td>
</tr>
<tr>
<td>L</td>
<td>No interview</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

*There were two letters that went home about the Roadshows. One was sent from the Parent's group and the other was sent from this researcher.*
Table 3
Have the Students Visited Other Science Oriented Places?

<table>
<thead>
<tr>
<th>Student</th>
<th>Other Places Students Visited</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Science and Nature Store, Museums in Victoria and Sacramento.</td>
</tr>
<tr>
<td>B</td>
<td>Science and Nature Store, Art Museum</td>
</tr>
<tr>
<td>C</td>
<td>None</td>
</tr>
<tr>
<td>D</td>
<td>None</td>
</tr>
<tr>
<td>E</td>
<td>None</td>
</tr>
<tr>
<td>F</td>
<td>Canada Place movie on volcanoes</td>
</tr>
<tr>
<td>G</td>
<td>Planetarium, museums with artifacts</td>
</tr>
<tr>
<td>H</td>
<td>School, the Planetarium, museums with school, &quot;one in Surrey this year and last year we went to one about the Indians or Haida or something&quot;.</td>
</tr>
<tr>
<td>I</td>
<td>&quot;Used to go to a whole bunch in Ontario&quot;</td>
</tr>
<tr>
<td>J</td>
<td>None</td>
</tr>
<tr>
<td>K</td>
<td>&quot;Not usually unless it is with a school field trip&quot;</td>
</tr>
<tr>
<td>L</td>
<td>Not interviewed</td>
</tr>
<tr>
<td>M</td>
<td>&quot;Sometimes like the dam&quot;</td>
</tr>
<tr>
<td>Student</td>
<td>Is Science Hard to Understand?</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>A</td>
<td>&quot;No, sometimes, not really&quot;.</td>
</tr>
<tr>
<td>B</td>
<td>Sometimes</td>
</tr>
<tr>
<td>C</td>
<td>Sometimes, &quot;it really depends what you are doing&quot;.</td>
</tr>
<tr>
<td>D</td>
<td>Sometimes</td>
</tr>
<tr>
<td>E</td>
<td>&quot;It depends&quot; Agreed with student F.</td>
</tr>
<tr>
<td>F</td>
<td>&quot;It depends if it is complex or simple&quot;</td>
</tr>
<tr>
<td>G</td>
<td>Not asked</td>
</tr>
<tr>
<td>H</td>
<td>Not asked</td>
</tr>
<tr>
<td>I</td>
<td>Not asked</td>
</tr>
<tr>
<td>J</td>
<td>Not asked</td>
</tr>
<tr>
<td>K</td>
<td>Not asked</td>
</tr>
<tr>
<td>L</td>
<td>Not interviewed</td>
</tr>
<tr>
<td>M</td>
<td>Not asked</td>
</tr>
</tbody>
</table>
Table 5
Did the Students Like Science Before and After the Show?

<table>
<thead>
<tr>
<th>Student</th>
<th>Comments about Liking Science Before</th>
<th>Comments About Liking Science After</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Likes it.</td>
<td>Liked it more after. &quot;it is more fun&quot;. &quot;I thought it would be just boring and just seeing stuff&quot;.</td>
</tr>
<tr>
<td>B</td>
<td>Likes it.</td>
<td>Liked it more after. &quot;it is more fun&quot;. &quot;I used to think that science is 'now I am going to pour the liquid nitrogen into the water' AHHHHH&quot;. &quot;It is boring science&quot;.</td>
</tr>
<tr>
<td>C</td>
<td>&quot;I like it a lot&quot;. He likes working with science stuff.</td>
<td>He likes science more &quot;now 'cause I know the nitrogen stuff cause I never knew about that before. It is fun, you learn different things that you didn't know about before&quot;.</td>
</tr>
<tr>
<td>D</td>
<td>Likes it.</td>
<td>Likes it after &quot;cause now I know more about it. It is fun and interesting&quot;.</td>
</tr>
<tr>
<td>E</td>
<td>&quot;It is one of my favorite subject in school&quot;.</td>
<td>&quot;I understand it more&quot;. She likes it more</td>
</tr>
<tr>
<td>F</td>
<td>Likes it. &quot;It is okay&quot;.</td>
<td>&quot;I understand it more now too&quot;. He likes it more.</td>
</tr>
<tr>
<td>G</td>
<td>&quot;Okay&quot;</td>
<td>Likes science more after. &quot;Because she [Roadshows teacher] explained how it works and well the electricity was really good&quot;.</td>
</tr>
<tr>
<td>H</td>
<td>&quot;Okay&quot;</td>
<td>&quot;Sort of liked science more&quot; after. &quot;We know how it works now so we can do other stuff with it&quot;.</td>
</tr>
<tr>
<td>I</td>
<td>N/A</td>
<td>Always liked science, but liked it more after seeing the Roadshow</td>
</tr>
<tr>
<td>J</td>
<td>N/A</td>
<td>Same as student I.</td>
</tr>
<tr>
<td>K</td>
<td>N/A</td>
<td>&quot;I like science now&quot;. She didn't like it before the Roadshows. Something different came to mind after - that &quot;science can be fun&quot;. She changed her mind because she &quot;really likes&quot; SCIENCE WORLD.</td>
</tr>
<tr>
<td>L</td>
<td>No interview</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>N/A</td>
<td>&quot;It is okay. I like it, it is not too bad&quot;. He did not see the show.</td>
</tr>
</tbody>
</table>
### Table 6
**Science at Home Before and After Roadshows**

<table>
<thead>
<tr>
<th>Student</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>He grows crystals and rocks, does chalk and vinegar experiments on acid rain and volcanoes from a book.</td>
<td>&quot;More electricity and I'll do experiments with it&quot;. Did his volcano experiment again.</td>
</tr>
<tr>
<td>B</td>
<td>Experiments from a book at home, looks after her horse, sometimes her friends will come with her. Tried crystal growing kit.</td>
<td>&quot;I did baking soda and vinegar because it just came to my mind&quot;. &quot;I was seeing what would happen if you mixed the oil an the gas [for her motorbike] and if you mixed the two gases together and poured them in and if you mixed two oils together and poured them in the oil thing, so I wanted to see if it would run better or worse and it ran better&quot;.</td>
</tr>
<tr>
<td>C</td>
<td>&quot;You put them [baking soda and vinegar] together and it overflows&quot;.</td>
<td>He wants to go buy a Plasma Ball to see if it still works.</td>
</tr>
<tr>
<td>D</td>
<td>No science hobbies no science at home.</td>
<td>She does &quot;kind of little experiments&quot;.</td>
</tr>
<tr>
<td>E</td>
<td>&quot;The odd time I do an experiment or something. Like a volcano.&quot; She does experiments from a booklet.</td>
<td>&quot;Wanted to do more in the booklet. I did that balloon experiment. I tried to time it but it wouldn't stick to the wall&quot;.</td>
</tr>
<tr>
<td>F</td>
<td>&quot;Look up stuff in dictionaries or encyclopedias for my mom or dad. Build car models&quot;.</td>
<td>&quot;I ask a lot of questions when my dad is doing his electrical.&quot; &quot;I tried the balloon thing too but it didn't work because it was an old balloon&quot;.</td>
</tr>
<tr>
<td>G</td>
<td>&quot;Lots, made a lung for school&quot;</td>
<td>Nothing</td>
</tr>
<tr>
<td>H</td>
<td>&quot;Lots for school&quot;</td>
<td>Nothing</td>
</tr>
<tr>
<td>I</td>
<td>&quot;Baking soda and vinegar, we had to use it for our volcano&quot;. Also did an experiment with an egg in salted water with the Grade 4 science teacher.</td>
<td>&quot;I did do some other stuff. I do some experiments with batteries and screwdrivers sometimes. With my dad outside in the garage&quot;. She got the idea from a book and electricity part from the Roadshows.</td>
</tr>
<tr>
<td>J</td>
<td>&quot;I was just experimenting at home with vinegar and baking soda&quot;. He did the same egg experiment with student I and got the volcano idea from the teacher.</td>
<td>He would do the same kind of science as before the show.</td>
</tr>
<tr>
<td>K</td>
<td>&quot;Trying to stick my brother's hair in the socket&quot;.</td>
<td>None</td>
</tr>
<tr>
<td>L</td>
<td>No interview</td>
<td>N/A</td>
</tr>
<tr>
<td>M</td>
<td>None</td>
<td>N/A</td>
</tr>
<tr>
<td>Student</td>
<td>Science Fair Project Before</td>
<td>Science Fair Project Ideas After</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>A</td>
<td>Did not talk about it.</td>
<td>How electricity works.</td>
</tr>
<tr>
<td>B</td>
<td>An experiment</td>
<td>Plasma Ball and how it works.</td>
</tr>
<tr>
<td>C</td>
<td>Earthquakes</td>
<td>&quot;I might be doing something about electricity next science fair&quot;.</td>
</tr>
<tr>
<td>D</td>
<td>Electromagnets</td>
<td>No new ideas.</td>
</tr>
<tr>
<td>E</td>
<td>Earthquakes</td>
<td>&quot;The bucket of hot ice that was quite interesting, so I might try that if I can find any. I'd like to do that nitrogen thing except it is kind of dangerous&quot;.</td>
</tr>
<tr>
<td>F</td>
<td>Earthquakes and the telephone</td>
<td>&quot;Maybe doing something on electricity. I learned quite a lot from there and I thought I could use it in a science fair project next year&quot;.</td>
</tr>
<tr>
<td>G</td>
<td>Respiratory system or digestive system.</td>
<td>Hair sticking up</td>
</tr>
<tr>
<td>H</td>
<td>Plate tectonics</td>
<td>Batteries, &quot;about how light works&quot;</td>
</tr>
<tr>
<td>I</td>
<td>&quot;I did a volcano with Susan&quot;</td>
<td>&quot;You could do one on electricity&quot;.</td>
</tr>
<tr>
<td>J</td>
<td>&quot;I did a project on the solar system&quot;</td>
<td>&quot;On how electricity works&quot;.</td>
</tr>
<tr>
<td>K</td>
<td>Did not talk about it.</td>
<td>&quot;The thing that makes your hair stand up. I'd like to prove how the electricity works and where it comes from. Or idea from Archie comic on how to make pictures blush&quot;.</td>
</tr>
<tr>
<td>L</td>
<td>No interview</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Did not talk about it.</td>
<td>No ideas, did not see the show.</td>
</tr>
</tbody>
</table>
## Table 8
### Interest in Roadshows Equipment

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Yes</td>
<td>Yes</td>
<td>&quot;Yes. &quot;It would be fun, it is powerful&quot;.</td>
<td>&quot;Yes, It looks like a lot of fun and it is practical. My parents would like it because it is educational&quot;.</td>
</tr>
<tr>
<td>B</td>
<td>Yes</td>
<td>Yes</td>
<td>&quot;Yes, it would be fun, you would be learning things about it while you would be having fun&quot;.</td>
<td>&quot;Yes and your parents wouldn't be screaming at you&quot;.</td>
</tr>
<tr>
<td>C</td>
<td>Yes</td>
<td>Yes</td>
<td>&quot;I like working with science stuff. Yes so I can learn what it does&quot;.</td>
<td>Yes. &quot;Cause I know what it does&quot;. &quot;Not quite as much as before because it has been such as long time I have just lost interest.&quot;</td>
</tr>
<tr>
<td>D</td>
<td>Yes</td>
<td>Yes</td>
<td>&quot;Yes, I think it would be neat to find out what it does&quot;.</td>
<td>Yes. &quot;Yeah I know what it does&quot;.</td>
</tr>
<tr>
<td>E</td>
<td>&quot;They look interesting&quot;.</td>
<td>&quot;More interesting. Now I know quite a bit about them so they're more interesting&quot;.</td>
<td>&quot;Yeah probably. They look really complicated to work&quot;.</td>
<td>Yes</td>
</tr>
<tr>
<td>F</td>
<td>Agrees with student E</td>
<td>&quot;Yeah because when I was up and putting my hand on the plasma ball you can't really feel anything, but you touch someone and you give them a shock&quot;.</td>
<td>&quot;It would probably be neat. I like stuff that is complex&quot;.</td>
<td>&quot;Yeah I think so&quot;.</td>
</tr>
<tr>
<td>G</td>
<td>(Asked after) No</td>
<td>&quot;A lot yeah 'cause she explained it, how they work&quot;.</td>
<td>No</td>
<td>&quot;No, 'cause I'm not really into science&quot; Yeah But wanted Roadshows job because you would &quot;get to work with machines&quot;.</td>
</tr>
<tr>
<td>H</td>
<td>(Asked after) &quot;Well yeah sort of I guess&quot;.</td>
<td>Yeah</td>
<td>Yeah</td>
<td>&quot;No, I'm not really into science, I'd rather play sports. Yeah&quot; But &quot;would like to work with it&quot;.</td>
</tr>
<tr>
<td>I</td>
<td>N/A</td>
<td>Yeah</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>J</td>
<td>&quot;They might be scary because you don't know what they are going to do&quot;.</td>
<td>Yeah</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>K</td>
<td>N/A</td>
<td>Unclear</td>
<td>N/A</td>
<td>Like to work with Plasma Ball &quot;because I like it&quot;.</td>
</tr>
<tr>
<td>L</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>M</td>
<td>Yes the Tesla Coil looked interesting to him</td>
<td>N/A</td>
<td>Yes</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Table 9
What Comes to Mind When Students Think About the Word Science?

<table>
<thead>
<tr>
<th>Student</th>
<th>Before (03/17/94)</th>
<th>After (03/18/94)</th>
<th>After (03/28/94)</th>
<th>After (04/14/94)</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&quot;Fire, water and nature&quot;</td>
<td>&quot;Science is a part of anything&quot;.</td>
<td>&quot;Anything, everything, science made practically anything you can think of. Science can be dangerous and it can be good for you&quot;</td>
<td>&quot;TV shows like the science show, Science World Science World show, everything to do with science&quot;</td>
<td>Change added a recognition of danger.</td>
</tr>
<tr>
<td>B</td>
<td>Electricity, animals</td>
<td>Electricity, static, food</td>
<td>&quot;Electricity water and nitrogen Almost anything, animals, plants, people, homes, electricity, clothes, buttons&quot;.</td>
<td>Animals</td>
<td>Change, added nitrogen, but she thought her answer was the same.</td>
</tr>
<tr>
<td>C</td>
<td>Information and inventions</td>
<td>&quot;More about inventions than about information and stuff&quot;.</td>
<td>&quot;Inventions and just the world and space, the solar stuff&quot;.</td>
<td>&quot;Inventions and creations&quot;.</td>
<td>Same.</td>
</tr>
<tr>
<td>D</td>
<td>&quot;Things you have to find out. It is a good thing that comes to mind&quot;.</td>
<td>&quot;It is more about finding out stuff - experimenting&quot;.</td>
<td>&quot;Trying to figure stuff out. the purpose of stuff&quot;.</td>
<td>&quot;Inventions and things you have to find out&quot;</td>
<td>More from C's answer.</td>
</tr>
<tr>
<td>E</td>
<td>Experiments</td>
<td>More to science, research</td>
<td>&quot;Complicated machines, experiments, research and stuff&quot;.</td>
<td>&quot;People in lab suits, and gray fuzzy hair, research and experiments&quot;</td>
<td>Answers differ, but thought the answer was the same.</td>
</tr>
<tr>
<td>F</td>
<td>Experiments and inventions</td>
<td>&quot;More to it than inventions&quot;</td>
<td>&quot;Electricity and men in lab suits and women in lab suits and experimental tubes and stuff&quot;.</td>
<td>&quot;People in lab suits, and tubes and chemicals going through it&quot;</td>
<td>Change due to show.</td>
</tr>
<tr>
<td>G</td>
<td>Science was &quot;okay&quot;.</td>
<td>&quot;The electricity was really good&quot;</td>
<td>No interview</td>
<td>No interview</td>
<td>Liked science better after</td>
</tr>
<tr>
<td>H</td>
<td>Science was &quot;okay&quot;.</td>
<td>Same as student G</td>
<td>No interview</td>
<td>No interview</td>
<td>Liked science only a little better after.</td>
</tr>
<tr>
<td>I</td>
<td>Experiments and &quot;fun&quot;</td>
<td>No interview</td>
<td>Experiments and &quot;fun&quot;</td>
<td>No interview</td>
<td>No change because Science Fair project was also positive before show, but liked science more after.</td>
</tr>
<tr>
<td>J</td>
<td>&quot;Fun&quot;</td>
<td>No interview</td>
<td>&quot;Fun&quot;</td>
<td>No interview</td>
<td>Liked science more after.</td>
</tr>
<tr>
<td>K</td>
<td>&quot;Boring&quot;</td>
<td>No interview</td>
<td>No interview</td>
<td>Not boring. &quot;Science can be fun&quot;</td>
<td>Change cause she likes Science World.</td>
</tr>
<tr>
<td>L</td>
<td>No interview</td>
<td>No interview</td>
<td>Experiments and &quot;fun&quot;</td>
<td>No interview</td>
<td>Liked science more after.</td>
</tr>
<tr>
<td>M</td>
<td>N/A</td>
<td>No interview</td>
<td>No interview</td>
<td>N/A</td>
<td>Did not see show.</td>
</tr>
</tbody>
</table>
Table 10
Students' Questions

<table>
<thead>
<tr>
<th>Student</th>
<th>Ask questions before?</th>
<th>Types of questions before.</th>
<th>Ask more questions after?</th>
<th>More curious? About what?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&quot;Yes and if my parents or grandfather don't know the answers I'd look it up&quot;.</td>
<td>When he sees inventions he asks others if they know about it.</td>
<td>&quot;Yes, I will remember about it [the Roadshows] and know it [science] will be more fun than I thought&quot;.</td>
<td>&quot;Yes. About liquid nitrogen, who invented it and why he invented it and where he invented it&quot;.</td>
</tr>
<tr>
<td>B</td>
<td>&quot;Yes or I would go to a book&quot;.</td>
<td>&quot;What is it how does it work, what's it's name&quot;</td>
<td>Yes</td>
<td>&quot;Yes. Why when you stick [something in liquid nitrogen] does it steam and go pshhh?&quot;</td>
</tr>
<tr>
<td>C</td>
<td>Usually</td>
<td>&quot;When I did my seismograph on why they have it and why they use it. I ask my dad or the library&quot;.</td>
<td>Yes</td>
<td>&quot;Yes, why did they make [Jacob's Ladder] if it didn't exactly do anything?&quot;. Yes more curious about electricity&quot;.</td>
</tr>
<tr>
<td>D</td>
<td>Sometimes</td>
<td>&quot;What does it do? Curious about my electromagnets I wanted to know what it was. I asked my dad&quot;.</td>
<td>Yes</td>
<td>&quot;Yes about the Plasma Ball&quot;, then, same as C. Yes curious about electricity.</td>
</tr>
<tr>
<td>E</td>
<td>Yes</td>
<td>&quot;How do you use it and what does it mean if it is a different complicated word&quot;. Asks her mom or dad or a teacher.</td>
<td>&quot;Yes, 'cause if you don't ask questions you probably won't really get to know anything&quot;.</td>
<td>&quot;Yeah it is interesting that you can't see electricity&quot;.</td>
</tr>
<tr>
<td>F</td>
<td>&quot;Quite a lot&quot;.</td>
<td>&quot;How does it work?&quot; Asks his mom or dad</td>
<td>&quot;Yes. You won't learn anything [otherwise]&quot;.</td>
<td>&quot;Yeah, I got a little curious on how does electricity form. If it is all around us how does it form?&quot;</td>
</tr>
<tr>
<td>G</td>
<td>Not asked</td>
<td>Not asked</td>
<td>No, but agreed with H.</td>
<td>&quot;Yeah electricity&quot;.</td>
</tr>
<tr>
<td>H</td>
<td>Not asked</td>
<td>Not asked</td>
<td>&quot;Sort of I guess, I don't know. You will ask more questions because you know about more stuff to ask about&quot;.</td>
<td>&quot;Yeah, how it makes your muscles [contract], so you don't touch it&quot;.</td>
</tr>
</tbody>
</table>
Table 10 Continued

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Not asked</th>
<th>Not asked</th>
<th>&quot;Yes, electricity. The chair lift [skiing] was run by engines and I asked if it was run by electricity or engines or gas and stuff&quot;.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Yes</td>
<td>Not asked</td>
<td>Not asked</td>
<td>&quot;Yes, electricity&quot;.</td>
</tr>
<tr>
<td>K</td>
<td>Not very much</td>
<td>Not asked</td>
<td>Not asked</td>
<td>&quot;Yes, why does electricity go through your body?&quot;.</td>
</tr>
<tr>
<td>L</td>
<td>No interview</td>
<td>No interview</td>
<td>No interview</td>
<td>No interview</td>
</tr>
<tr>
<td>M</td>
<td>Yes</td>
<td>Not asked</td>
<td>Not asked</td>
<td>N/A</td>
</tr>
</tbody>
</table>
### Table 11
**Students Talking About the Roadshows with Relatives**

<table>
<thead>
<tr>
<th>Student and Dates</th>
<th>Comments made to Relatives</th>
<th>Comments and Questions from Relatives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong> March 18</td>
<td>&quot;I said to my parents I want to go to Science World&quot;.</td>
<td>&quot;They said OK on spring break. My brother was telling my parents the same thing that I was saying. But he was telling my sister that someone got electrocuted and she was saying 'I don't believe you guys'&quot;.</td>
</tr>
<tr>
<td><strong>A</strong> March 28</td>
<td>He responded to his mother's question &quot;yes I went to the Roadshow, oh yeah I forgot to tell you. I thought I told you&quot;. Then he told her about what they did there and experiments and those &quot;balls and the static electricity ball and...&quot;. He talked to his brother and sister. &quot;My brother helped me cause he was there too. I told about the static electricity ball and the long one with the ball on the top. And I talked about the Jacob's Ladder. I got to tell them about the liquid nitrogen. I could not answer all of their questions&quot;.</td>
<td>His mother asked &quot;did you go to the Roadshow? You forgot to tell me about it.&quot; His brother told about the Plasma Ball. &quot;People had a million questions, they asked how it worked and who did it.&quot;</td>
</tr>
<tr>
<td><strong>A</strong> April 14</td>
<td>&quot;Not this week with my parents, but last week I told my sister again when she was having a banana. I asked my brother if he saw J's hair stand up&quot;.</td>
<td>&quot;My brother said that Tim's hair stuck up but J's just barely stuck up&quot;</td>
</tr>
<tr>
<td><strong>B</strong> March 18</td>
<td>&quot;I told my parents that we had the science Roadshow and J, man, he got hair to go up and then he had to stand in this little, wee little box thing, and he stood in it and then he held the electricity static ball&quot;.</td>
<td>&quot;You're kidding right?&quot;</td>
</tr>
<tr>
<td><strong>B</strong> March 28</td>
<td>&quot;I told my grandparents, my great grandparents, my uncle, my aunt, my mother, and my parents. We had this Roadshow. The Plasma Ball was favorite. I told them what a Plasma Ball was. I told them if you put your hand, well first you've got to turn it on, then you've got to put your hand on it and if you hold someone else's hand or something and then if that person is holding a neon light bulb, and another person is holding the end, that the light bulb would go on. I could answer practically all of their questions&quot;.</td>
<td>&quot;What was your favorite part? What is a Plasma ball? They asked how many things were there and how long was the Roadshow&quot;.</td>
</tr>
<tr>
<td><strong>B</strong> April 14</td>
<td>&quot;We just talked about what happened and stuff. We talked about bananas and joked about the liquid nitrogen&quot;.</td>
<td>Joked with B about liquid nitrogen.</td>
</tr>
<tr>
<td><strong>C</strong> March 18</td>
<td>&quot;I told my mom about the Nitrogen and the Plasma Ball&quot;.</td>
<td>&quot;It sounded interesting&quot;.</td>
</tr>
<tr>
<td><strong>C</strong> March 28</td>
<td>&quot;I did say [to mom and dad] I wanted to go to the science place when Star Trek™ was there. I told my mom what was there [at the Roadshows]. Everything, the Nitrogen, the Plasma Ball and how they made the ball or the light on and stuff like that. I asked my mom a question like how cold Nitrogen is. Nitrogen is 235 below zero I think&quot;.</td>
<td>Her mom asked what was at Roadshows. &quot;She said nitrogen is 30 below&quot;.</td>
</tr>
<tr>
<td><strong>C</strong> April 14</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
Table 11 Continued

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>March 18</td>
<td>&quot;I told my mom and dad what I saw&quot;. Same as C's parents response, &quot;sounded interesting&quot;.</td>
</tr>
<tr>
<td>D</td>
<td>March 28</td>
<td>&quot;I told my aunt about it. I just told her what was there and what we saw. I told her about the Plasma Ball and stuff like that&quot;. Her aunt thought it sounded &quot;neat&quot;.</td>
</tr>
<tr>
<td>D</td>
<td>April 14</td>
<td>&quot;I told my mom about coming to the interview&quot;. No</td>
</tr>
<tr>
<td>E</td>
<td>March 18</td>
<td>&quot;I told my mom. She saw a different presentation because she teaches Grade 3. I told them about the banana peel and how it froze and how it became all mushy. Well we saw the show and we talked quite a bit about it. I talked to my grandma, I just told her what happened and what it was about&quot;. &quot;My mom told me about the vacuum cleaner and try[ing] to hold the balls up. The teacher said he wanted to see it himself&quot;. She heard about the &quot;vacuum thing&quot; from her mom and her friend's sister. They tried to &quot;put two or a couple of balls in the air and to see who could hold them up the longest&quot;.</td>
</tr>
<tr>
<td>E</td>
<td>March 28</td>
<td>No</td>
</tr>
<tr>
<td>E</td>
<td>April 14</td>
<td>Did not talk about it. No</td>
</tr>
<tr>
<td>F</td>
<td>March 18</td>
<td>&quot;I told my sister. I told them about the banana peel and how it froze and how it became all mushy&quot;. No</td>
</tr>
<tr>
<td>F</td>
<td>March 28</td>
<td>&quot;I told my sister once, 'cause she is in Grade three and she had a different program than we did. I told her about the Plasma Ball and how when I touched it and I touched Christie and gave her a shock but you can't really feel anything&quot;. Her sister &quot;told [her] about the vacuum thing&quot;.</td>
</tr>
<tr>
<td>F</td>
<td>April 14</td>
<td>Did not talk about it.</td>
</tr>
<tr>
<td>G</td>
<td>March 18</td>
<td>&quot;I told my mom that the Roadshow came to school and that it was really neat and you learned about electricity and everything&quot;. No</td>
</tr>
<tr>
<td>H</td>
<td>March 18</td>
<td>&quot;I told my mom that SCIENCE WORLD came to our school&quot;. &quot;I forget if they did&quot;.</td>
</tr>
<tr>
<td>I</td>
<td>March 28</td>
<td>&quot;I told my parents cause my brother and sister saw it as well. I told them about when J and Tim had to stand in the plastic boxes and they had to put their hand on the...[Van der Graaf]. My brother is in Grade 2 and my sister is in Grade 4, she saw the same show as I did&quot;. &quot;My brother was talking about what he saw. He saw a different show&quot;.</td>
</tr>
<tr>
<td>J</td>
<td>March 28</td>
<td>&quot;I told my parents. I told them what kind of machines were there and how you...[interrupted]. I said that I had, I was standing in a box and I had my hand on a ball and I shook my head around and my hair stood up. My brother saw it, he is in Grade 1&quot;. &quot;They said that it was neat&quot;.</td>
</tr>
<tr>
<td>K</td>
<td>April 14</td>
<td>&quot;I told them it was the science fair Roadshow, then my brother cut me off and filled in the rest. It was the same one as me&quot;. &quot;He said that he really liked it and he wants it to come back before he leaves the school&quot;.</td>
</tr>
</tbody>
</table>
## Table 12
Students Talking About Roadshows With Friends

<table>
<thead>
<tr>
<th>Students</th>
<th>Students' Comments and Questions</th>
<th>Friends' Comments and Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&quot;What did you think of it? Was it good?&quot;.</td>
<td>&quot;I liked this one, I liked that one - the big one that was really powerful [Tesla Coil] and the Liquid Nitrogen. Did you see that it was awesome. Hate to touch that (Tesla Coil)&quot;.</td>
</tr>
<tr>
<td>B</td>
<td>&quot;What did you think of it? Was it good? I asked Carolyn what happened 'cause I wasn't there [for a portion of the show]&quot;.</td>
<td>&quot;It was good. I liked the plasma ball, the static thingy, and the Liquid Nitrogen. Sandra wanted to definitely [put her hand in the Liquid Nitrogen]. It is rad, it's cool and all that stuff. Carolyn explained it&quot;.</td>
</tr>
<tr>
<td>C</td>
<td>&quot;You had the Plasma Ball there and what it does&quot;.</td>
<td>&quot;The Nitrogen thing was cool and the plasma ball. Pete said it was rad. It [the Plasma Ball] was interesting&quot;.</td>
</tr>
<tr>
<td>D</td>
<td>Talked about the Plasma Ball.</td>
<td>It (Plasma Ball) was cool.</td>
</tr>
<tr>
<td>E</td>
<td>We talked to our teacher about the banana and what happened. It was great. He missed it. I talked to my friends about the banana again cause I like that part it was really neat and I talked to them about the hair sticking up.</td>
<td>He said he wanted to see it himself. My friend liked the thing that made your hair stick up. My friend in my class he said it was rad. I heard about the vacuum thing. My friend's sister said that they tried to put two or a couple of balls in the air and to see who could hold them up the longest.</td>
</tr>
<tr>
<td>F</td>
<td>He (teacher) should have (seen it). I told L that it was quite neat.</td>
<td>I said yeah. C liked the Plasma Ball. I hear people talking about it it was so neat and stuff like commenting about the Roadshow.</td>
</tr>
<tr>
<td>G</td>
<td>It was rad.</td>
<td>About the Plasma Ball and how many people there was and everything.</td>
</tr>
<tr>
<td>H</td>
<td></td>
<td>I heard Jackie say that it was rad.</td>
</tr>
<tr>
<td>I</td>
<td>They liked it when they had to stand in the plastic bucket and shake their hair. G, E and Jane said that.</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>Somebody liked it, the Nitrogen. My friends were just saying about the models - the Plasma Ball and stuff</td>
<td>The favorite part for friends was mostly the Plasma Ball.</td>
</tr>
<tr>
<td>K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Not interviewed but saw the show.</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Did not see the show.</td>
<td></td>
</tr>
</tbody>
</table>

*L is original student chosen to be interviewed, student M is the student who was interviewed.*
<table>
<thead>
<tr>
<th>Student (if known)</th>
<th>Answer to question from teacher &quot;Have you talked about the Roadshow?&quot;</th>
<th>Same as previous answer given to the researcher?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown</td>
<td>Yes. I've talked about the Roadshow with my family and friends</td>
<td>Same as previous answer given to the researcher?</td>
</tr>
<tr>
<td>Boy</td>
<td>No I haven't</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Yes. I have talked about it after I saw it, with my parents and family.</td>
<td>Yes.</td>
</tr>
<tr>
<td>Boy</td>
<td>Yes, I've talked about it with my dad.</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>No I have not.</td>
<td>No, she said earlier that she did talk to her mom.</td>
</tr>
<tr>
<td>J</td>
<td>I have talked about the show with my parents, aunt and uncle and my brothers.</td>
<td>Yes, but more information here.</td>
</tr>
<tr>
<td>Unknown</td>
<td>No I have not.</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>Yes, I have talked about the show to Mr. B., my brother, sister, Ms. Richie, my friends, parents.</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Yes I talked about it with my mom.</td>
<td>Yes, but more information from interview.</td>
</tr>
<tr>
<td>H</td>
<td>Yes my mom and dad I told them that it was coming to school and I talked about it with Miss Ritchie.</td>
<td>Yes, but more information here.</td>
</tr>
<tr>
<td>Unknown</td>
<td>Yes! I have talked about it lots of times with my parents and grandparents.</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Yes I have talked about it with my parents.</td>
<td>Unknown, he did not attend the interview.</td>
</tr>
<tr>
<td>Unknown</td>
<td>Yes, I've talked about the show to my mom.</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>Sometimes with my parents at dinner.</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>Yes, I have talked about the Roadshow with someone.</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>Yes I have talked to my mom about it.</td>
<td></td>
</tr>
<tr>
<td>Boy</td>
<td>Yes, I've talked with my parents about it.</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Yes, I have talked about the Roadshow to my family.</td>
<td>Yes</td>
</tr>
<tr>
<td>F</td>
<td>Yes, I have talked about the Roadshow with my sister.</td>
<td>Yes</td>
</tr>
<tr>
<td>Boy</td>
<td>Yes with my mom and dad.</td>
<td></td>
</tr>
</tbody>
</table>
Table 14
What Face the Students Chose After Seeing the Roadshows

<table>
<thead>
<tr>
<th>Grades</th>
<th>Number of Happy Faces</th>
<th>% of Happy Faces Per Group</th>
<th>Number of Neutral Faces</th>
<th>% of Neutral Faces Per Group</th>
<th>Number of Sad Faces Per Group</th>
<th>% of Sad Faces</th>
<th>Number of No Choice</th>
<th>% of No Choice per group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindergarten</td>
<td>13/14</td>
<td>93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1/14</td>
<td>7</td>
</tr>
<tr>
<td>Grades K/1</td>
<td>13/19</td>
<td>68</td>
<td>6/19</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grades 1/2</td>
<td>23/24</td>
<td>96</td>
<td>1/24</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 2</td>
<td>13/14</td>
<td>93</td>
<td>1/14</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 3</td>
<td>23/29</td>
<td>79</td>
<td>5/29</td>
<td>17</td>
<td>1/29</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Grade K-3</td>
<td>85/100</td>
<td>85</td>
<td>13</td>
<td>13</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Grade 4/5</td>
<td>14/14</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 5</td>
<td>23/24</td>
<td>96</td>
<td>1/24</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 6</td>
<td>16/19</td>
<td>84</td>
<td>3/19</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 6/7</td>
<td>15/18</td>
<td>83</td>
<td>3/18</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals Grade 4-7</td>
<td>68/75</td>
<td>91</td>
<td>7/75</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K- Grade 7</td>
<td>153/175</td>
<td>87</td>
<td>20/175</td>
<td>11</td>
<td>1/175</td>
<td>0.6</td>
<td>1/175</td>
<td>0.6</td>
</tr>
</tbody>
</table>
Table 15
Recognition of Roadshows Equipment Before the Shows

<table>
<thead>
<tr>
<th>Student</th>
<th>Plasma Ball</th>
<th>Tesla Coil</th>
<th>Jacob's Ladder</th>
<th>Van der Graff Generator</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>X</td>
<td></td>
<td>X(^c)</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>X</td>
<td></td>
<td>X(^c)</td>
<td></td>
</tr>
</tbody>
</table>

\(^c\) The Students said that they had seen this equipment before, but misidentified it as a bubble maker.
Table 16
Recognition of Roadshows Equipment After the Shows

<table>
<thead>
<tr>
<th>Student</th>
<th>Plasma Ball</th>
<th>Tesla Coil</th>
<th>Jacob's Ladder</th>
<th>Van der Graff Generator</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>B</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>C</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>E</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>F</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>G</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X(Science World)</td>
</tr>
<tr>
<td>H</td>
<td>X</td>
<td>X</td>
<td>X(BC Hydro)</td>
<td>X</td>
</tr>
<tr>
<td>I</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Not Interviewed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>X(Science World)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^d This Student did not see the show
^e SW represents Science World
^f Two X's indicate that the students saw the equipment in two different locations. The location other than the Roadshows is indicated.
### Table 17a
**Student A's Knowledge About the Plasma Ball**

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>You touch it and the electricity comes. It doesn't shock you.</td>
</tr>
<tr>
<td>After, March 18</td>
<td>He did not agree with Student B (see Table 16a). &quot;It does not come out. Cause you can't see electricity and you can't hear it. It is in a glass ball which insulates it so that the electricity, well it is not really electricity cause you can't see it. It is caused by electricity and it can't get out&quot;. Agreed with Student B about the air, so you can't get electrocuted. &quot;When we touch it it tries to get out but a little bit of it does. Not enough to give you a shock&quot;.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>If you keep a hand on it anyplace the electricity, the air caused by electricity will go to your hand and will try to get out, but you can't get shocked.</td>
</tr>
<tr>
<td>After, April 14</td>
<td>Remembered the Plasma Ball. &quot;I know more about it&quot;.</td>
</tr>
</tbody>
</table>

### Table 17b
**Student A's Knowledge About the Tesla Coil**

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Does it absorb electricity?</td>
</tr>
<tr>
<td>After, March 18</td>
<td>You don't want to go near it. Agrees with Student B about the air. It is so powerful that you can hold a light bulb and it will just light up, but you have to be holding it.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>You can't go near it or else you'll get shocked.</td>
</tr>
<tr>
<td>After, April 14</td>
<td>I thought about how dangerous it was. It can generate power but is not practical because it would cause noises and it is dangerous if you get too near to it and things would always be on if you don't know how to turn it off.</td>
</tr>
</tbody>
</table>

### Table 17c
**Student A's knowledge About the Jacob's Ladder**

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Like in a Frankenstein's movie (after given description by researcher)</td>
</tr>
<tr>
<td>After, March 18</td>
<td>We didn't learn that much about it. It is just a Jacob's Ladder and it doesn't do anything really. Cause the spark just goes up and there is no use for it. We saw the air the hot air it went and rises, it starting to rise up in the middle between the two rods. Just stopped when it came to the top, disappeared another one came and just kept on going.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>It is Jacob's Ladder and it isn't used for any real purposes. It just comes out of the bottom and goes to the top and then it comes out again. The first time I saw it I thought it was water sitting in there.</td>
</tr>
<tr>
<td>After, April 14</td>
<td>It doesn't do anything. The electricity goes up the wires.</td>
</tr>
</tbody>
</table>

### Table 17d
**Student A's knowledge About the Van der Graaf Generator**

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Not seen before.</td>
</tr>
<tr>
<td>After, March 18</td>
<td>It's like static and it you put negative and negative. They put something on it and it would pop away and this boy put his hand on it and his hair started sticking up. They had about five people and they all held pinkies and then there was a big snap and there was a big sound and everyone went Oww. And there was a another positive ball you hold it and it goes snap snap snap.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>It is the static electricity ball and you have a wand and you keep it near and it cracks, but I never saw any electricity come out cause I was on the other side.</td>
</tr>
<tr>
<td>After, April 14</td>
<td>It is static electricity ball and there is this wand that you put and it cracks and it makes a small zap.</td>
</tr>
</tbody>
</table>
### Table 18a
**Student B's Knowledge About the Plasma Ball**

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Agreed with Student A</td>
</tr>
<tr>
<td>After, March 18</td>
<td>When you touch it, the electricity goes through your hand or whatever you are touching and it goes down and through your body and down to the floor. It is the air cause when the air gets really hot and you can see the colour. Disagreed with Student A about a shock (table 15a). &quot;But that thing gives a shock&quot;, she said.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>When you touch it and hold a light bulb it can give electricity.</td>
</tr>
<tr>
<td>After, April 14</td>
<td>The Plasma ball someone touches it and you hold hands with another person and that person holds the light bulb and the other person holds the other end of the light bulb and the electricity goes through one person and to the other person holding the light bulb then through the light bulb then to the other person and then the light bulb glows.</td>
</tr>
</tbody>
</table>

### Table 18b
**Student B's Knowledge About the Tesla Coil**

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>It goes whoooa and stuff.</td>
</tr>
<tr>
<td>After March 18</td>
<td>It is too hot for you to touch, you can't touch it. But it gives electricity and it is the same as the Plasma Ball when you turn it on and the lights are out the air gets so hot it gets colourful. Agrees with Student A about light bulb.</td>
</tr>
<tr>
<td>After March 28</td>
<td>It can give electricity.</td>
</tr>
<tr>
<td>After April 14</td>
<td>Gives energy like if you wanted to turn on and everything in the house would go on and it works. I was wondering what would happen if you touched it like with a glove on.</td>
</tr>
</tbody>
</table>

### Table 18c
**Student B's Knowledge About the Jacob's Ladder**

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Like in a Frankenstein's movie (after given description)</td>
</tr>
<tr>
<td>After, March 18</td>
<td>Missed it due to late for show</td>
</tr>
<tr>
<td>After, March 28</td>
<td>Agrees with Student A about it. The air gets really really warm so it lights up.</td>
</tr>
<tr>
<td>After, April 14</td>
<td>They invented it because they were bored.</td>
</tr>
</tbody>
</table>

### Table 18d
**Student B's Knowledge About the Van der Graaf**

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Had not seen before</td>
</tr>
<tr>
<td>After, March 18</td>
<td>Missed most of it due to late for show. The boy had to shake his head. Agreed with Student A about the way it worked.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>If you stand in the bucket and hold that (wand) and you shake your head then your hair goes weeece (up).</td>
</tr>
<tr>
<td>After, April 14</td>
<td>The boy's in a container he was standing in it and he shook his head and all his hair stood up.</td>
</tr>
</tbody>
</table>
Table 19a
Student C's Knowledge About the Plasma Ball

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>You put your fingers on the glass and this beam would go to your fingers.</td>
</tr>
<tr>
<td>After, March 18</td>
<td>&quot;You touch it and you hold a light and somebody else holds it and it lights up. It is sort of like a battery&quot;. He still thinks a beam goes to fingers, but &quot;it also does something else it sends like electricity through your body so you can light up a light&quot;.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>When you touch it the electricity tries to find it's way out.</td>
</tr>
<tr>
<td>After, April 14</td>
<td>Plasma ball and I forget the name of the rest. It tries to, the little electricity, well it's not quite electricity, but the little beam sort of thing's trying to find a way out.</td>
</tr>
</tbody>
</table>

Table 19b
Student C's knowledge about the Tesla Coil

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Not seen before</td>
</tr>
<tr>
<td>After, March 18</td>
<td>No comment</td>
</tr>
<tr>
<td>After, March 28</td>
<td>No comment</td>
</tr>
<tr>
<td>After, April 14</td>
<td>I was talking about that one too</td>
</tr>
</tbody>
</table>

Table 19c
Student C's knowledge about the Jacob's Ladder

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Not seen before</td>
</tr>
<tr>
<td>After, March 18</td>
<td>This one makes the effect of electricity</td>
</tr>
<tr>
<td>After, March 28</td>
<td>It is just sort of like, not electricity, but it is sort of like electricity, I forget what she called it, just goes up the tubes and the little copper pipe things.</td>
</tr>
<tr>
<td>After, April 14</td>
<td>It makes two I think it is wires or something that go up with electricity, but not electricity, but something like electricity goes up there and</td>
</tr>
</tbody>
</table>

Table 19d
Student C's Knowledge About the Van der Graaf Generator

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Not seen before</td>
</tr>
<tr>
<td>After, March 18</td>
<td>The bands in here they go around really fast and there is a glass handle with another silver ball in there and if you connect, if you come really close about a centimeter away there is a spark a little purple spark.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>You have another silver ball thing and it has a glass handle and it has a wire and I think it goes into receive and you're about a centimeter to the silver ball and a little spark comes out.</td>
</tr>
<tr>
<td>After, April 14</td>
<td>It has another small ball identical to the one on top of the machine and it has a glass handle with a wire if you go a little closer like almost tap that a little spark comes off towards the smaller ball.</td>
</tr>
</tbody>
</table>
Table 20a
Student D's knowledge about the Plasma Ball

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Was not asked</td>
</tr>
<tr>
<td>After, March 18</td>
<td>Did not respond</td>
</tr>
<tr>
<td>After, March 28</td>
<td>Did not remember anything about it</td>
</tr>
<tr>
<td>After, April 14</td>
<td>Remembered the name after C said it</td>
</tr>
</tbody>
</table>

Table 20b
Student D's Knowledge About the Tesla Coil

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Not seen before</td>
</tr>
<tr>
<td>After, March 18</td>
<td>You hold the light more up to it it lights up</td>
</tr>
<tr>
<td>After, March 28</td>
<td>That one sends sparks off the top. And when the person with the light walked towards it, it lit up.</td>
</tr>
<tr>
<td>After, April 14</td>
<td>I remember the sparks coming off the top of this one</td>
</tr>
</tbody>
</table>

Table 20c
Student D's Knowledge About the Jacob's Ladder

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Not seen before</td>
</tr>
<tr>
<td>After, March 18</td>
<td>No comment</td>
</tr>
<tr>
<td>After, March 28</td>
<td>Had nothing to add to what C said</td>
</tr>
<tr>
<td>After, April 14</td>
<td>No comment</td>
</tr>
</tbody>
</table>

Table 20d
Student D's Knowledge About the Van der Graaf Generator

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Not seen before</td>
</tr>
<tr>
<td>After March 18</td>
<td>Agreed with Student C</td>
</tr>
<tr>
<td>After March 28</td>
<td>Did not remember</td>
</tr>
<tr>
<td>After April 14</td>
<td>Remembered the same as C</td>
</tr>
</tbody>
</table>
Table 21a
Student E's knowledge about the Plasma Ball

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>You put your hand on it. Electricity.</td>
</tr>
<tr>
<td>After, March 18</td>
<td>No comment</td>
</tr>
<tr>
<td>After, March 28</td>
<td>No comment</td>
</tr>
<tr>
<td>After, April 14</td>
<td>Plasma ball and you can't see electricity you can't hear it and it is lazy.</td>
</tr>
</tbody>
</table>

Table 21b
Student E's Knowledge About the Tesla Coil

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Did not recognize</td>
</tr>
<tr>
<td>After, March 18</td>
<td>It lights up if you push this button I think and it would power up a light after a far away energy field and it would have to be pretty big to do quite a big area. The reason that they are dangerous is that they would fall over.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>At the top, purple like gases. When he (Tesla) changes his mind because it (the Tesla coil) could fall over and it smells and you have to turn it off cause if it lights up the whole house if you just want one light on it is not a very good idea.</td>
</tr>
<tr>
<td>After, April 14</td>
<td>There was this experiment where you had this light and you put it closer to that, I don't know what it is called but it is one of those long tubes with the ball on it and when you go near it it would light up.</td>
</tr>
</tbody>
</table>

Table 21c
Student E's Knowledge About the Jacob's Ladder

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Is it a bubble maker?</td>
</tr>
<tr>
<td>After, March 18</td>
<td>It is Jacob's Ladder I think and the electricity travels up the two wires and you see some sparks of the heat it is making and it rises since hot air rises.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>When the wires meet they make light and stuff. The electricity travels up the two wires and they make a spark where they touch and since hot air rises it goes up</td>
</tr>
<tr>
<td>After, April 14</td>
<td>The electricity travels up the two wires then it makes a spark and it rises because hot air rises</td>
</tr>
</tbody>
</table>

Table 21d
Student E's Knowledge About the Van der Graaf Generator

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Looks like the Plasma Ball</td>
</tr>
<tr>
<td>After, March 18</td>
<td>No comment</td>
</tr>
<tr>
<td>After, March 28</td>
<td>It gets negative since two negatives attract so it comes off, they move away</td>
</tr>
<tr>
<td>After, April 14</td>
<td>If you touched it and you shake your head and stuff your hair would stand up</td>
</tr>
</tbody>
</table>
Table 22a
Student F's Knowledge About the Plasma Ball

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>It attracts your hand and when you touch the glass the electricity goes from your thumb into the centre</td>
</tr>
<tr>
<td>After, March 18</td>
<td>It is the Plasma ball and you put your hand on it or anything on it and it contracts. I think the carbon dioxide and something else. Electricity contracts on the top of the ball because it wants to find its way to the ground. I think the opposite (from before the show). The electricity is starting here and is going up to your thumb because it sees your thumb and it thinks that it is a way out because it wants to get to the ground.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>I liked the Plasma Ball. You put your hands on it and it goes at your hand thinking it is a way out of the ball because it wants to make it's way to the ground.</td>
</tr>
<tr>
<td>After, April 14</td>
<td>The only way you can see (electricity) is if you put some like carbon dioxide or like stuff like that and it gives it colour. When you put your hand on it the electricity comes to your hand because it thinks that it can get through your hand to the ground. It wants to travel to the ground.</td>
</tr>
</tbody>
</table>

Table 22b
Student F's Knowledge About the Tesla Coil

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>No recognition</td>
</tr>
<tr>
<td>After, March 18</td>
<td>The reason they aren't in houses today is that they're dangerous and they smell.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>When there is a tube with the small ball at the top I was figuring I couldn't really figure out how it would generate electricity. It is like a ball that comes through and you can just see the hydrogen or something in it because you, there must be something in it because...you can see it. At the very top of the ball. The man that was inventing it was thinking of the idea of getting everyone to buy one so that it would generate their house of elec...</td>
</tr>
<tr>
<td>After, April 14</td>
<td>The person who invented it thought that you could power houses and stuff with it except the problems were that you could knock it over and it smelled a lot and it was noisy.</td>
</tr>
</tbody>
</table>

Table 22c
Student F's knowledge about the Jacob's Ladder

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before March 10</td>
<td>Is it a bubble maker?</td>
</tr>
<tr>
<td>After, March 18</td>
<td>The show was about electricity (that is why they changed their minds about what this piece of equipment did)</td>
</tr>
<tr>
<td>After, March 28</td>
<td>Agrees with E</td>
</tr>
<tr>
<td>After, April 14</td>
<td>Agrees with E</td>
</tr>
</tbody>
</table>

Table 22d
Student F's Knowledge About the Van der Graaf Generator

<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before, March 10</td>
<td>Had not seen before</td>
</tr>
<tr>
<td>After, March 18</td>
<td>You put the tin plates on it and it would make it negative and then it would turn the tin plates into a negative source and you put something positive on and you'd all fly off because two negatives push away from each other.</td>
</tr>
<tr>
<td>After, March 28</td>
<td>It sends a negative it is a force of electricity and you put the ball on and it makes it positive?</td>
</tr>
<tr>
<td>After, April 14</td>
<td>It turned you into a negative source. And the ball is already a negative source and so two negatives don't make it even.</td>
</tr>
</tbody>
</table>
### Table 23

**Students G and H Knowledge About the Roadshows Equipment**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Comment from G March 18</th>
<th>Comment from H March 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma Ball</td>
<td>Drew it with a girl touching it. Got picked as a volunteer with it.</td>
<td>Had seen before. That &quot;one does electricity on the ball&quot;</td>
</tr>
<tr>
<td>Tesla Coil</td>
<td>Went in the light bulb with the shocking</td>
<td>Not sure if seen before</td>
</tr>
<tr>
<td>Jacob's Ladder</td>
<td>No comment</td>
<td>Had seen before at B.C. Hydro. &quot;Makes the electricity going up the wires, makes light&quot;</td>
</tr>
<tr>
<td>Van der Graaf</td>
<td>Had seen before at SW. Makes the shocks and makes your hair stand up</td>
<td>Not sure if seen before</td>
</tr>
</tbody>
</table>

### Table 24

**Students I and J Knowledge About the Roadshows Equipment**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Comment by I March 28</th>
<th>Comment by J March 28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma Ball</td>
<td>The SW sleep over we got to talk about all the stuff. I saw that one. And at school when it came. Drew it with Andrea putting her hand on it.</td>
<td>I saw that one when I went to SW.</td>
</tr>
<tr>
<td>Tesla Coil</td>
<td>Saw all of them at school when it (the Roadshows) came.</td>
<td>I saw it when I went to SW</td>
</tr>
<tr>
<td>Jacob's Ladder</td>
<td>I saw that one.</td>
<td>I saw it.</td>
</tr>
<tr>
<td>Van der Graaf</td>
<td>&quot;When you put the ball on it and you take it away it .....&quot; (it sparked). I saw that one.</td>
<td>I saw that one. &quot;When you put the ball on it and you take it away, yeah it sparks&quot;.</td>
</tr>
</tbody>
</table>

### Table 25

**Student K and M Knowledge About the Roadshows**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Comment by K on April 14</th>
<th>Comment by M on April 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma Ball</td>
<td>&quot;Gives off electricity and it is in a glass ball so the electricity can't escape&quot;.</td>
<td>He would like to work with the Plasma Ball just from seeing the pictures and prior experiences, because he likes it and saw at SCIENCE WORLD</td>
</tr>
<tr>
<td>Tesla Coil</td>
<td>&quot;You never want to put your hand on the ball&quot;</td>
<td>Also interests him to work with it &quot;cause it looks interesting. That one can kill you&quot;</td>
</tr>
<tr>
<td>Jacob's Ladder</td>
<td>&quot;Just the little do-dad that you brought. The electricity just goes up through it and it almost gets to the top and then it disappears&quot;</td>
<td>Did not see the show.</td>
</tr>
<tr>
<td>Van der Graaf</td>
<td>&quot;That one can make your hair stand up&quot;</td>
<td>He has seen hair stand up with a trampoline.</td>
</tr>
</tbody>
</table>
## Table 26
Did the Students Think About the Show After Seeing It?

<table>
<thead>
<tr>
<th>Student</th>
<th>Thought about show after?</th>
<th>What they thought about.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Yes</td>
<td>Inventions. I want to go to SCIENCE WORLD again. He thought about the Tesla Coil, how powerful it was and &quot;it wouldn't be good if you used it because if someone used it and the appliance was near by, a person didn't know it was on, they could get shocked&quot;. He thought about that nitrogen as well.</td>
</tr>
<tr>
<td>B</td>
<td>Yes</td>
<td>I want to get a membership for SCIENCE WORLD so I can go over there. I was wondering how long it took to invent them (pieces of equipment).</td>
</tr>
<tr>
<td>C</td>
<td>Yes</td>
<td>I hope it comes back again and it was really fun.</td>
</tr>
<tr>
<td>D</td>
<td>Yes</td>
<td>I thought about what I saw, like when they were touching the ball a bunch of people.</td>
</tr>
<tr>
<td>E</td>
<td>Yes</td>
<td>I thought about the banana part. I did that experiment when you rub the balloon on your hair and it sticks to the wall (twice).</td>
</tr>
<tr>
<td>F</td>
<td>Yes</td>
<td>I thought it was quite neat.</td>
</tr>
<tr>
<td>G</td>
<td>Yes</td>
<td>About Joe's hair standing up.</td>
</tr>
<tr>
<td>H</td>
<td>Yes</td>
<td>All this stuff like the funny stuff like the banana breaking.</td>
</tr>
<tr>
<td>I</td>
<td>Yes</td>
<td>I liked it. The electricity when you rub the balloon on your head. Yesterday I was playing with my friends and G's hair stood all on end.</td>
</tr>
<tr>
<td>J</td>
<td>Yes</td>
<td>I liked it. I thought about it cause I shocked my brothers. I rubbed my fingers on the trampoline. I was playing with my friends, they did that too and we were all getting shocks.</td>
</tr>
<tr>
<td>K</td>
<td>Yes</td>
<td>Just all of it. The static ball, that light seeing how far it could go and still keeping it lit.</td>
</tr>
</tbody>
</table>
Table 27

**Arcs and Sparks Show Drawings**

<table>
<thead>
<tr>
<th>Grade of Students</th>
<th># of Plasma Ball Drawings</th>
<th># of Tesla Coil Drawings</th>
<th># of Van der Graaf Drawings</th>
<th># of Jacob's Ladder Drawings</th>
<th># of Other Drawings&lt;sup&gt;8&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 4/5</td>
<td>10</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Grade 5</td>
<td>20</td>
<td>5</td>
<td>7</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Grade 6</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Grade 6/7</td>
<td>10</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Totals</td>
<td>46/85</td>
<td>15/85</td>
<td>15/85</td>
<td>8/85</td>
<td>14/85</td>
</tr>
<tr>
<td>Percentage of all Drawings</td>
<td>54</td>
<td>18</td>
<td>18</td>
<td>9</td>
<td>16</td>
</tr>
</tbody>
</table>

<sup>8</sup>The other drawings were mostly of the Liquid Nitrogen.

**Note.** Major demonstrations used in all the shows are listed in the Shows List Appendix.
## Table 28
**Drawings by the Grade 5 Interviewees**

<table>
<thead>
<tr>
<th>Students</th>
<th>Plasma Ball</th>
<th>Tesla Coil</th>
<th>Van der Graaf</th>
<th>Liquid Nitrogen</th>
<th>Number of Items Drawn</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>X</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>X</td>
<td>X</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>X</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>D</td>
<td>X</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>E</td>
<td></td>
<td>X</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>G</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>H</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>J</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>K</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>M</td>
<td>No drawing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>11/12</td>
<td>2/12</td>
<td>3/12</td>
<td>2/12</td>
<td>18</td>
</tr>
<tr>
<td>Percentages</td>
<td>92%</td>
<td>17%</td>
<td>25%</td>
<td>17%</td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>Learned/Remembered</td>
<td>What They Knew More About</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>I didn't know that Nitrogen was that dangerous. I thought about the other like the Tesla Coil, the Jacob's Ladder and the Van der Graaf Generator (he referred to them by their letter identifiers from the pictures). I learned about them. It is more fun. That science can be more fun. I remember the Plasma Ball, there were one, two, how many people, they all held hands and one of them touched the Plasma ball and two people would be holding the light bulb then the light bulb would light up. And then there were too many people. If they would have had buckets or jumped it might have worked, but it was hard to jump at the exact same time. We learned about the long with the ball on top and how powerful it was and about Liquid Nitrogen I thought it was expensive and it was cheap.</td>
<td>Plasma Ball, Jacob's Ladder, Tesla Coil, static electricity ball the Liquid Nitrogen.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>I learned about liquid nitrogen, cause I didn't know it existed. I never knew that nitrogen can make your hand like that, it can kill warts and stuff. The banana was warmer than the liquid nitrogen is very very cold and when you put the banana peel cause it is warmer, it got it froze from the liquid nitrogen, when you picked it up and then dropped it out it cracked all over and then a couple of minutes later it would be all mushy.</td>
<td>Everything, electricity, Plasma Ball.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>I learned something that if you touch the plasma ball and you have some people lined up holding hands, that the electricity will go right through them and the electricity will still light up the light.</td>
<td>Electricity, Nitrogen and how cold it is</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>I learned that electricity just goes right through you</td>
<td>Electricity, the Plasma Ball</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>It isn't safe to put your hand in a bucket of nitrogen and that there are three rules about electricity</td>
<td>Electricity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>That you can't see or hear electricity, that electricity is lazy</td>
<td>Electricity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Learned about electricity and everything. Learned how electricity is dangerous. A bolt (of lightening). And how you might get electrocuted and you can't take your hand off.</td>
<td>Electricity and how electricity is dangerous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>I learned a lot. How lightening and stuff. And how it makes your muscles stay. The man who invented the machines.</td>
<td>Electricity and how lightening starts at the clouds rubbing together and how you can't let go of anything</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>That electricity is lazy and it takes the easiest way to the ground. I learned more about electricity about volts and stuff and too much can kill you and how much can kill you.</td>
<td>Electricity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>You can't see electricity and you can't hear it.</td>
<td>Electricity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>How electricity works.</td>
<td>Not asked</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 30

**Have the Students Seen Anything that Reminded them of the Roadshows?**

<table>
<thead>
<tr>
<th>Student</th>
<th>Have the students seen anything reminding them of the Roadshows?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown</td>
<td>Yes, when ever I eat a banana it reminds me about the banana that broke in a million pieces!!!</td>
</tr>
<tr>
<td>Boy</td>
<td>No, I haven't.</td>
</tr>
<tr>
<td>D</td>
<td>Yes. When I saw a big lightening storm it made me think of it.</td>
</tr>
<tr>
<td>Boy</td>
<td>No I haven't.</td>
</tr>
<tr>
<td>G</td>
<td>No I have not.</td>
</tr>
<tr>
<td>J</td>
<td>I thought about the show when I turned on my lamp.</td>
</tr>
<tr>
<td>Unknown</td>
<td>Yes I saw a shirt that said SCIENCE WORLD on it and that made me think about it.</td>
</tr>
<tr>
<td>Unknown</td>
<td>Yes, I saw a small plasma ball at the Science and Nature store that made me think about the show.</td>
</tr>
<tr>
<td>I</td>
<td>Me and my family went to science world and saw the plasma ball.</td>
</tr>
<tr>
<td>H</td>
<td>Yes on TV.</td>
</tr>
<tr>
<td>Unknown</td>
<td>Yes, I have been reminded about it lots of times when I watch Bill Ney the science guy.</td>
</tr>
<tr>
<td>L</td>
<td>No I have not.</td>
</tr>
<tr>
<td>Unknown</td>
<td>No I didn't see anything that reminded me of the Roadshow.</td>
</tr>
<tr>
<td>Unknown</td>
<td>No I haven't.</td>
</tr>
<tr>
<td>Unknown</td>
<td>No, I have not seen anything that made me think.</td>
</tr>
<tr>
<td>Unknown</td>
<td>No.</td>
</tr>
<tr>
<td>Boy</td>
<td>No, I haven't.</td>
</tr>
<tr>
<td>B</td>
<td>Yes, I saw a science show like the Roadshow.</td>
</tr>
<tr>
<td>F</td>
<td>No, I haven't seen anything or heard anything that reminds me about the Roadshow.</td>
</tr>
<tr>
<td>Boy</td>
<td>Yes on TV.</td>
</tr>
</tbody>
</table>
Appendix 4.1

Completed Science World Evaluation

SCIENCE WORLD Roadshows Evaluation

SCIENCE WORLD appreciates your feedback. Thank you for taking the time to respond to the questions below. With your help we will be able to provide better Roadshows and services to schools and other venues around British Columbia.

Name of School/Venue: ____________________________  ELEMENTARY ____________________________

Community: _____________________________________________

Your Name and Position: _____________________________________________

Name of Presentation: please check which shows were performed at your school:

<table>
<thead>
<tr>
<th>Show</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Carnival</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arcs and Sparks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Fantastic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under Pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire and Ice</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Out of Energy

Classroom Workshop

Teachers’ Workshop

Other

Date of Presentation: ____________  Name of Presenter: ____________________________

Attendance:  # of Students: ___  Grade(s): ___  # of Adults: ___

Please check the appropriate response.

1. Do you teach science? Yes ___  No ___

2. Were you involved with the organization of these performances? Yes ___  No ___

   If yes, please go to #3. If no, go to #8.

3. How did you find out about the Roadshows program?

<table>
<thead>
<tr>
<th>Method</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outreach brochure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roadshows offerings form</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teachers’ bulletin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Members’ bulletin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word of mouth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newspaper/other advertising</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visit to SCIENCE WORLD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Was the booking process easy? Yes ___  No ___

5. Did you receive the date that you wanted? Yes ___  No ___

6. When you first heard about the Roadshows performances did you know that there was a performance fee? Yes ___  No ___

7. Did the performance fee cause any difficulties for your school? Yes ___  No ___

8. Was the program length suitable for the audience? Yes ___  No ___

9. Where all safety precautions taken during the presentation? Yes ___  No ___
10. Please rank the Roadshows program on the following scale from 1-10, where 1 is the lowest and 10 is the highest. Please circle only one number.

<table>
<thead>
<tr>
<th></th>
<th>Lowest</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Highest</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Suitability to grade level</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>b) Educational content</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>c) Suitable questions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>d) Show pace appropriate</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>e) Presentation style</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>f) Variety of materials</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>g) Amount of student interaction</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>h) Student enjoyment</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>i) Demonstrator's knowledge</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>j) Main points and concepts well explained</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>k) Demonstrator's rapport with students</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>l) Demonstrator's enthusiasm</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Please check and write the appropriate response.

11. If there were any special students in the audience, were their needs met during the program? Yes __ No __ If no, what do you recommend?

Draft - visually

12. Would you recommend this program to another teacher or school? Yes __ No __ If no, why not?

13. Would you be interested in classroom programs done by SCIENCE WORLD teachers? Yes __ No __ If No why not?
14. Did you know that we also offer teachers' workshops? Yes  No  What topics interest you most for a teachers' workshop?

15. What other topics would you like to see offered in the Roadshows performances?

16. Would you be interested in hands-on exhibits, set up in the gymnasium?  Yes  No  Currently, we offer a Science Week package that includes this option.

17. Would you book the Roadshows again? Yes  No  

Additional Comments:

Thank you for your participation in this evaluation.

Please mail the completed form to:

Outreach Department
SCIENCE WORLD British Columbia
1455 Quebec Street
Vancouver, B.C. V6A 3Z7
or fax  682-2923

SCIENCE WORLD British Columbia is a non-profit, self-supporting organization dedicated to inspiring a greater appreciation of science and technology through the presentation of science exhibitions and demonstrations, informal educational activities and province-wide outreach programs.

The Roadshows are sponsored by the Ministry of Education and by B.C. Hydro's Involvement in Education and Power Smart programs.

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Appendix 4.2

Roadshows Demonstrations List

This list gives the names and a brief description of the demonstrations presented in each of the three shows performed on March 17, 1994 for this study.

Science Carnival Show for Students in Kindergarten and Grade 1

- The Roller Coaster - A spinning plexiglass platform used to swing a cup around which is full of water. Jimmy is the name of the character taking the ride on the Roller Coaster.
- Needle Through the Balloon
- Caruba Tube - A corrugated tube is used to make sound
- Beach Ball - Various air blowing machines including a vacuum are used to suspend a ball.
- Lycopodium - This dust is put into a can. Air is blown into it while a flame is lit and there is a mini-explosion.
- Air Cannon - This is a box which blows smoke rings with two chemicals.
- Tornado tubes - Two pop bottles are connected and water is moved from one side to another using a spinning motion much like a tornado.
- Flying Bird - This demonstration has a plastic bird fly over the children's heads.
- Ernest the Bear - A bear on a rope that pedals his way along the rope while balancing.
- Water Trick - Uses a powder to absorb the water in cups so it appears to disappear.

Added to the Science Carnival Show for the Grades 1-3

- Plasma Ball - A large round ball that has long purple streaks of light inside it and an electrode in the middle of it which gives off electricity, lighting up the air inside the ball.
Arcs and Sparks Show for Children in Grades 4-7

- Jacob's Ladder - Two wires shaped like "bunny ears" give off electricity and a spark jumps the gap between them. The spark travels upward then extinguishes, another spark starts at the bottom where the wires are closest.

- Van der Graaf Generator - Belts inside this machine rub together and deposit negative charges on the top of the large silver ball. Shocks can be produced with this machine and people's hair can be made to stand on end.

- Tesla Coil - Is a powerful piece of equipment that produces long sparks.

- Liquid Nitrogen - This cold liquid is used to freeze things and show how much more efficient electricity can be in a super cold environment.

- Plasma Ball - Plasma Ball - A large round ball that has long purple streaks of light inside it and an electrode in the middle of it which gives off electricity, lighting up the air inside the ball.

The demonstrator was a young woman wearing a SCIENCE WORLD staff shirt that has a SCIENCE WORLD logo on it.

Several demonstrations had items in them that may look similar when drawn. The Smoke Rings, the Caruba Tube and the balloon may look round when drawn.
Appendix 5

Sample Drawings Figures 5-9

FIGURE 5 Drawing of Tesla Coil
FIGURE 6 Drawing of Jacob's Ladder
FIGURE 7 Drawing of Liquid Nitrogen with Banana
FIGURE 8 Drawing of Van der Graaf and Hair
FIGURE 9 Drawing of Plasma Ball