DragonflyTV: Going Places in Science Children's Viewing Study

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Contents

Figures

EXECUTIVE SUMMARY

DragonflyTV GPS: *Going Places in Science*

Children's Viewing Study

In March 2007, RMC Research Corporation completed work on a study of children's responses to a selection of *DragonflyTV (DFTV)* video segments as one part of the Summative Evaluation of the *DragonflyTV GPS: Going Places in Science* TV series[1]. This report presents findings from the Children's Viewing Study, which includes two distinct goals. The first goal addresses the qualities and characteristics of science television which contribute to effective educational television experiences for children. This study offered the first in an iterative process aimed at gaining a deeper understanding of the components that make up effective children's science television. The second goal looked specifically at children's attitudes towards science centers and experiments and how these were impacted by viewing *DragonflyTV GPS* segments.

RMC evaluators began this part of the summative evaluation by reviewing the *DFTV* investigation segments and developing a framework of qualities and characteristics of children's television. This framework formed the basis of the evaluation conducted with 146 fourth and fifth graders. After children viewed the segments[2], RMC evaluators collected data on their responses to the identified qualities and characteristics, and on the appeal and clarity of the segments. Analysis focused on further articulating these characteristics, and when possible, finding correlations between these characteristics and the success of the segments in engaging viewers and communicating science. The open-ended design of the study was employed to tease out these features and characteristics. Because each of the segments shown to children during the study offers a mix of features and characteristics, and individual elements are difficult to isolate, correlations between these elements and learning remain preliminary.

The second focus of the study related specifically to the collaboration underlying the production of this series of *DFTV*. Each segment of *DFTV GPS* was developed through collaboration between *DFTV* production staff and science center curators and educators at one of 17 science centers and museums around the country, and some component of each segment was taped at the respective institution. In addition to offering a professional development opportunity, this collaboration process was intended to provide a national stage for the dissemination of information about science centers—particularly, as an opportunity to present science centers as appealing destinations for children. In order to understand the impact of the inclusion of science centers in each of the investigation segments, children were given pre- and post-viewing surveys which addressed attitudes and perceptions of both science centers and science projects.

Qualities and Characteristics of Inquiry Segments

Study participants were shown six of the fifteen science investigation segments from *DFTV GPS* series. Their responses to these investigation segments, gathered through surveys and discussions, were analyzed to extract a set of qualities and characteristics which contribute to effective television experiences. These are presented below in two overlapping groups: storytelling and science elements.

[1] The other part of the evaluation is a study of the media and museum professionals involved in the TV series, titled *Study of Collaborations between Museums and Media*

[2] Segments viewed included: *Doghouse, Roller Coaster, Sail On, Dinosaur Dig, Light and Color,* and *Cactus*.

Storytelling

DFTV inquiry segments feature real kids doing real science. In each segment, two or more children engage in an investigation which is shaped by their own interests and motivations and conducted in real-life settings. Segments vary in the ways in which the children and/or investigation topics are introduced, the characters of the children, and a range of dramatic and visual elements. The table below presents the final conclusions concerning the storytelling attributes of *DFTV* segments contributing to learning in children's science television.

Figure 1

Storytelling Components

Story Set-Up	▪ Story set-up provides a means of establishing the relevance of science content. ▪ Stories involving familiar activities and situations were seen as more credible than others.
Dramatic Arc	▪ A clear progression of activities and final pay-off (in the form of a product or final test) contributed to segment strength.
Visual Appeal	▪ "Big action" footage such as the roller coaster was enjoyed by viewers. Also engaging were interesting visuals and animals. Sail boat races provided dramatic appeal. ▪ Cutting between two locations was difficult for some viewers to follow.
Child Investigators	▪ Acting "naturally" and not overly enthusiastic or corny contributed to the appeal of characters. ▪ Investigators who stayed "on topic" and got along well with and cooperated with one another were the most appealing. ▪ Viewers were interested in finding out about the children featured on the show, but when those scenes were too disconnected from the thread of the inquiry, they were disruptive rather than informative.

Science

In the ideal *DFTV* model, each investigation includes an inquiry question, hypothesis, data collection method, analysis and next question. The videos are designed to communicate science process and, to a lesser degree, basic science concepts.

Overall, children in the study were easily able to articulate the purpose of the investigations. In most cases, viewer responses were consistent in how they articulated the purpose of the investigation. With respect to science concepts, the complexity of the investigations varied considerably as did the degree to which students were able to accurately relate the information about the investigations. Because of the open-ended nature of the questions, it was often easier to assess appreciation of general concepts and processes than specific science facts. Nevertheless, results suggested that most students clearly understood both the methodologies employed in the investigations and conclusions reached.

The table below presents the final conclusions concerning the attributes related to the presentation of the science content which made the most significant contribute to learning in children's science television as suggested by this study of *DFTV*.

Figure 2

Science Components

Inquiry Type	▪ Engineering segments were most appealing to viewers, while the observational segments were the least appealing
Topic	▪ Some topics may be inherently more appealing to children ▪ Less appealing topics may benefit from the incorporation of storytelling elements that appear in the most popular segments. ▪ More abstract topics require greater scaffolding of the science content to help viewers understand the relevance and significance of the inquiry
Integration of Story and Science Investigation	▪ Story set-up providing a hook for viewers should be closely intertwined with the science content. ▪ Significance of the investigation should be established as part of the set-up (prior to data collection) to drive the investigation.
Clarity and Complexity of Science Content	▪ Richer science content may positively impact engagement. ▪ Underlying concepts should be clearly presented, and paced to enhance understanding. ▪ Repetition of concepts, test results, and investigator's observations through restatement provide greater clarity. ▪ Challenging ideas and content require sufficient screen time to handle them adequately.
Methodology and Data Collection	▪ Clarity and appeal of data collection may be improved by clear sequencing of individual variables, real-time investigator responses during data collection, and opportunities for direct observation by viewer. ▪ Extensive detail on data collection that is not tied to results or significance may detract from segment. ▪ Summary of results needs adequate emphasis to communicate the science.

Attitudes about Science Centers and Science Experiments

The pre- post-viewing survey results suggest that children entered the study with relatively positive attitudes about science centers and experiments, and that viewing *DFTV* segments had limited impact, either positive or negative, on these attitudes. Pre-study attitudes included positive associations with science museums which were characterized as "interesting," "fun," "exciting," and "places to learn;" while the information in science centers was seen as most valuable for science fair projects and school.

After viewing the segments, students responded more strongly to viewing friends as potential companions for future science center visits. Small increases were seen in the value of science center information for doing arts projects and in the perception of science centers as "surprising"

and also as "boring." The study was not designed to look at subgroup differences, but such diverging data—increases in the number of children selecting both "surprising" and "boring"—suggest either the development of distinct sub-groups, including students who do and do not enjoy science, or the growth of increasingly complex views, for instance that a science center visit could include both surprising and boring moments.

Children saw science experiments in a positive light, characterizing them as fun, as a social activity, and as something that can be done indoors, outdoors, and outside of school. After viewing the *DFTV* segments, children were positive about replicating the investigations demonstrated on the shows, but a significant number also expressed concern that they did not have the right materials or that their caregivers would not permit them to do such experiments.

Conclusion

The *DFTV* Children's Viewing Study suggests a number of important factors that heighten both the educational impact and the appeal of a *DFTV* segment. Factors related to the inquiry's construction include framing an inquiry within a relevant and clear question and developing the inquiry through clear sequencing of individual variables. While children were able to grasp the steps and outcomes of some of the more abstract inquiries, they did not find them as appealing when compared with other segments.

While some science subjects are inherently less appealing to children than others, more abstract science concepts and unfamiliar environments can benefit from careful scaffolding so that viewers clearly grasp the question investigated and can relate the new environments, situations, and concepts to what they already know. Children enjoyed inquiries of significance to them, even when the investigations were complex and even somewhat confusing, such as the investigation of the physics of roller coasters. A number of other factors add to the appeal of a segment, for instance, a dramatic story arc, the opportunity to visually follow experiments as they unfold, investigations that include animals, and a likeable group of children.

INTRODUCTION

In fall 2005, RMC Research Corporation contracted to conduct the Summative Evaluation of *DragonflyTV GPS: Going Places in Science*. In this fifth season of *DFTV*, program producers engaged in an innovative collaboration with science center professionals, involving them in developing science inquiry stories filmed in part at the science museums and centers. Summative evaluation activities for this season involved two separate studies. The first examined the collaboration between science center partners and television professionals, and is addressed in a separate report. This report examines the product of these collaborations—the major video segments featuring children conducting their own inquiries—and focuses on gaining a deeper understanding of the qualities and characteristics of science television which contribute to effective educational television experiences for children. Secondarily, it addresses the impact of viewing *DFTV GPS* segments on viewer attitudes to science centers and to science projects.

DragonflyTV is a half-hour PBS science series with a simple format: Real kids doing real science. The series does not feature child actors or adult presenters; instead, it captures ordinary kids doing their own science investigations and showcases them in fast-moving videos with a popular music soundtrack. In their own voices, the kids tell how they pursued their investigations, communicating the infectious excitement that comes with making their own discoveries.

DragonflyTV is about the process of science. Each episode features two or more investigations; in six- to ten-minutes segments, where children conduct a "full inquiry," as defined in the National Science Education Standards (National Research Council, 1996). The child investigators pose questions, design and conduct experiments, gather data, analyze that data, arrive at their own conclusions, and pose further questions. These investigation segments were the subject of this study.

Evaluation Goals

The Children's Viewing Study, constituting one component of the summative evaluation for *DragonflyTV: Going Places in Science* addressed two distinct evaluation goals, 1) examination of the characteristics, qualities, and elements of children's television that impact learning, and 2) the impact of these segments on children's perceptions of science centers and science projects.

Features and Characteristics of Children's Television

This evaluation was designed as the first stage of an iterative process examining the features and characteristics which impact learning in children's television. This evaluation was designed as an open-ended inquiry to articulate potential characteristics and features which impact children's learning, through analysis of children's responses to the segments tested and a set of proposed characteristics. While anecdotal evidence was collected on children's learning, the focus was on teasing out which features and characteristics contribute to learning in children's television as the basis for producing more effective children's science television. Because each of the segments shown to children during the study offers a mix of features and characteristics, and individual elements are difficult to isolate, correlations between these elements and learning remain preliminary.

Perceptions of Science Centers and Projects

The second goal focused the museum-television collaborations at the heart of the *Going Places in Science* series, and examined the impact of viewing *DFTV GPS* segments on children's attitudes towards science centers and science investigations.

Methodology

The child response part of the summative evaluation was conducted in two phases. In the first phase, RMC evaluators reviewed the fifteen Season Five science inquiry segments and developed a framework of qualities and characteristics that were likely to affect viewers' ability to learn from the programs, such as the amount of background information provided about the child investigators, investigation type, level of activity, inclusion of cooperative and/or competitive components, and the accessibility of materials, background information on the investigation, and concepts. This framework then informed activities in the second stage. A discussion of these characteristics appears in Appendix A.

In the study's second phase, RMC evaluators gathered feedback on six science inquiry segments from 146 fourth and fifth grade children. Students from a total of seven classes in two cities (Arlington, MA and Seattle, WA) participated.

The six segments were selected from the original fifteen segments in order to represent the range of qualities and characteristics identified during the first stage. They included different types of investigation, such as experimental and observational inquiries, different configurations of child investigator teams, such as girls, boys, and mixed gender teams, and other characteristics. All of the children in the study watched the same six science investigation segments.

The evaluation gathered feedback from the viewers on which of the segments' qualities and characteristics they felt were most effective. Viewers also answered a series of questions about their perceptions of science centers and science projects to elicit outcome data on changes in attitude as a result of watching the *DFTV* segments.

Data Collection Schedule

Data collection sessions took place in each class on three days over a two-week period as follows:

Day 1. Teachers received a short pre-viewing survey for students to complete before the first RMC evaluator visit.

Day 2. RMC evaluators collected data during a one hour and 15 minute session. Students watched three science investigations; after each, they completed short surveys. At the conclusion of the three segments, the entire class discussed the three segments they watched that day.

Day 3. The Day 2 protocol was repeated on the third day. Child viewers watched three more segments, completed surveys, and participated in discussions. At the conclusion of the class discussions, they completed a post-viewing survey. Day 3 sessions were extended to one and a half hours to accommodate the post-viewing surveys.

Instruments

Pre- and post-viewing surveys: These surveys contained eight multipart, closed-ended questions about viewer's perceptions of science centers and science projects. The post-viewing surveys also contained a question in which children were asked to rank the six segments from favorite to least favorite.

Segment Surveys: Segment surveys asked viewers to respond in writing to three open-ended questions about each science investigation: 1) What was this investigation about?; 2) What did you learn from the investigation?; and 3) Could you see yourself doing an investigation like this? Why or why not?

Focus Group Discussion Questions: Discussion questions were designed to probe more deeply into children's responses to particular segments and the components that appealed to them. Questions included what they liked or disliked about particular segments, what contributed to or detracted from a sense of authenticity, what they liked or disliked about the children in the different segments, and why they might or might not want to pursue science center and/or other activities portrayed in the story.

Copies of all data collection instruments form Appendix B.

Participants

Elementary schools in Arlington, MA and Seattle, WA were identified for the study. A total of 146 students participated in the study, roughly divided between girls (47%) and boys (53%), and fourth (48%) and fifth (51%) graders. Students were drawn from seven classes.

Figure 3 shows the class level and gender distribution of children participating in the study.

Figure 3: Participants by Grade and Gender

Pre-Viewing survey	Frequency	Percent	Post-viewing survey	Frequency	Percent
4th grade	70	49.3%	4th grade	69	48.3%
5th grade	72	50.7%	5th grade	73	51.0%
Total*	142	100%	Total*	142	100%
Female	70	47.9%	Female	69	47.3%
Male	76	52.1%	Male	77	52.7%
Total	146	100%	Total	146	100%

*Totals based on gender are less than 146 because of incomplete data provided by participants.

Analysis and reporting

Quantitative data were entered into SPSS, a statistical software program that facilitates quantitative analysis. Frequencies and means were calculated as appropriate to the type of question. Content analysis was conducted on qualitative data.

The findings are presented in two sections. The first section presents findings related to viewers' responses to individual segments; the second section presents findings related to their perceptions of science centers and science projects.

Statistical data are presented in figures. Unless indicated, responses were consistent across grade levels and genders. In the figures, data are organized to highlight changes in pre- and post-viewing responses. Complete data from the pre- and post-viewing surveys and tallies of responses to Question 3 of the Segment Surveys ("Could you see yourself doing a similar investigation?") form Appendix C.

FINDINGS

This section presents findings from all components of the children's viewing study, including pre- and post- survey data, segment survey data, and focus group responses. They have been organized into two sections:

A. Segment Characteristics: This includes data drawn from each of the three data collection activities on responses to specific segments and characteristics, as well as summaries of the open-ended responses given in the Survey Segments, data on the investigation rankings, and focus group responses related to viewers' perspectives on the different segments and key characteristics.

B. Perceptions of Science Centers and Science Experiments: This includes pre- and post-survey data on questions related to perceptions of science centers and science experiments. Data are presented in terms of changes in viewers' attitudes before and after watching the *DFTV* segments.

A. Segment Characteristics

Segment Analysis: Learning and Replicability

The segment surveys were designed to capture baseline information providing a broad overview of the relative clarity of the content and learning from each segment. Viewers completed open-ended questions on the purpose of each investigation, what they learned, and whether they would be interested in replicating the activities shown. Thus responses varied in the ways in which children interpreted the questions and the complexity of the answers given. Some children gave one- or two-word responses, while others replied more extensively. The summary statements take all responses into account; however, the quotes provided favor the more extensive comments. As a rule, fifth grade responses were more elaborate than fourth grade responses. The sections below begin with descriptions of the story and science investigations for each segment.

Doghouse

Story: In *Doghouse*, two girls reflect on the climate in Arizona and realize that while their homes are air-conditioned, their dog's house is not.

Investigation: The girls learn about construction techniques at the Arizona Science Center's "Many Hands Make a Home" exhibit, and test what they learn on a house for their dog.

Investigation Purpose: Responses to this question were consistent. Both fourth and fifth grade viewers saw this investigation as primarily about building a doghouse and/or trying to make a doghouse cool in hot temperatures. Some provided more background information about the investigation; for example a fourth grader described the investigation as "*How to make a doghouse cooler so the dog won't get hot*." A fifth grader said, "*This investigation was about two girls who live in Arizona, where it's dry and hot. When they get warm they go into the air conditioning. Their dog can't do that, so they build him an air conditioned doghouse*." Some viewers used technical terms such as "swamp coolers" and "heat absorbency" in describing the purpose of the investigation.

Knowledge gained: While most of the fourth grade comments were general—"*How to make a doghouse cold*"—some offered more specifics on the mechanisms for cooling the doghouse. For example, one student said, "*I learned that you can make a doghouse cooler by making a mist blower*." A smaller number of responses identified learning about how colors affect the

temperature of a house, such as "*lighter colored houses are cooler than darker colored houses.*" A few responses suggested that the investigation introduced students to new possibilities, such as "*I learned that you can use simple machines to make some things,"* and "*I learned that impossible tasks can be well possible."* One student applied knowledge gained from this segment to another arena of life, stating "*that I'm lucky to be on the yellow team in soccer."*

The fifth grade responses indicated similar trends; most viewers noted learning about swamp coolers and air conditioning dog houses and how color affects a building's temperature. For instance, one student said, "*I learned that there is actually a mist system that can be in a doghouse,"* and another that, "*I learned that blowing on water will cool the air."* More fifth grade students commented on the association of color and heat, or mentioned evaporation. Comments include: "*I also learned that darker things absorb hot air while light (energy) repels off of lighter colored houses,"* and, "*I learned that evaporation can not only condense and make a cloud, but also cool down the air."* A smaller set of responses identified learning about running an experiment, such as, "*I learned that it is not that hard to do such an experiment like that, if you do research and get the proper materials."*

Investigation Replication: Sixty percent of the viewers said they would be interested in conducting a similar investigation. In both grade levels, the most common reasons given were a love of animals, such as "*I could see myself doing that. I could because I love dogs and helping them,"* and "*I believe that dogs deserve the same comfort as us,"* and enjoyment in building things, such as "*I like building and experimenting with things"* and "*I like to work with tools and science."*

The major reasons viewers gave for why they could not see themselves conducting this investigation concerned not having a dog or not needing a dog house. A small number of viewers said that they would not do this activity because they don't like constructing things, such as "*I am not so fond of building things."* A few comments did not fall into either category, but implied a perception by the viewer that they were incapable of completing the activity, such as "*I couldn't see myself doing an investigation like this because I'm not very creative,"* and "*I could not see myself doing this investigation because I'm not that smart."*

Roller Coaster

Story: Two boys—roller coaster aficionados—discuss their favorite sections of a roller coaster, and wonder why some parts are more exciting than others.

Investigation: They visit the Carnegie Science Center, where they design their own roller coaster in an interactive exhibit, and test an accelerometer on a roller coaster simulator. They continue their investigation on "Phantom's Revenge," a roller coaster at a nearby amusement park, investigating how the acceleration (g's) measured on different parts of the ride relates to the excitement of the ride.

Investigation Purpose: Fourth and fifth grade responses to the investigation's purpose were very similar. Across both grades, the largest number of viewers (39%) said it was about g's or gravity, such as "*How many* g*'s are in different parts of the roller coaster," "how many g's there is on a roller coaster,"* and "*It was about two boys who liked speed and wanted to see which part of the roller coaster got the most* g*'s and only two parts were high* g*'s."* A quarter (24%) identified the purpose as being to identify which part of the roller coaster was the most fun or exciting. Some of theses comments included, "*Seeing which part of the roller coaster was the most exciting"* and "*This investigation is about a roller coaster and how they move and the roller coaster's speed. It's also about what makes a roller coaster fun."* In some cases, their responses combined

the goal of seeing what part is most fun, with the investigation of g's. "*The investigation was about which part of a ride was most exciting. They measured it in* g*'s."* One fifth (21%) said it was about speed and 15% gave very general responses about it being about roller coasters. And in a few cases, they noted the role of personal opinion in determining what part is the most fun. For instance, one fifth grader said, "*How many* g*'s there were on the rides but then they realized it wasn't about* g*'s."*

Knowledge Gained: What was most striking about these responses in contrast to those of other questions was the great diversity of responses. They ranged from simplistic responses defining g's or making a statement about what makes a roller coaster fun, to a wide array of attempts to show relationships between g's, acceleration, speed, direction, and/or enjoyment. The accuracy of responses varied, and many were too general to assess whether viewers understood the concepts presented. Because of the diversity of responses and difficulty in assessing the accuracy of many of them, the description below provides an overview of the range of responses. These responses suggest most of all the complexity of the information presented in this segment and the varying abilities of the viewers to make sense of it.

Some of the more basic statements included, *"I learned that lots of things are fun about roller coasters," "I learned about what g's were and how many g's turns and going down hills would take,"* and *"I learned that g's are big on roller coasters. Also I learned what g's were."* Some offered accurate descriptions of the effects of the *g*'s: "*I learned what* g*'s are and why you always get butterflies in your stomach when you go down on a ride."* In a few cases, these simple statements were not accurate. For instance, "*I learned that g's represent how fast you are going."*

Others grappled with the concepts and relationships presented suggesting varying degrees of understanding. Some focused on the relationship of g's and speed, for instance, "*I learned that if you're going really fast, there may not be a lot of* g*'s."* Others introduced direction and acceleration, for instance, "*I learned that accelerating doesn't give you as much* g*'s as when you drop suddenly or jerk to the left or to the right."*

Many others tried to explain what they learned about what makes a roller coaster fun. Some noted their learning about the lack of importance of speed, for instance, "*When it comes to roller coasters speed doesn't make it more exciting."* Others tried to understand the role of speed and were not entirely accurate in their assessments, for example: "*Some parts of roller coasters make you feel like you are going fast even if you are not"* and "*Going down a big drop in a roller coaster doesn't make you go faster."* Yet others looked at the role of g's or gravity, arriving at varying conclusions. For instance, while one said, *"the amount of gravity makes the roller coaster more fun,"* another stated, "*I learned that gravity may not be the reason for the roller coasters being so much fun."*

In some cases viewers tried to sort out which parts of the roller coaster produce the most g's. For instance, several tried to relate g's to the tops or bottoms of the hills, and it was often difficult to tell whether they were referring to specific segments of the roller coaster, or whether they were making general statements about the effect of altitude on gravity. For instance, *"the higher you go the more gravity."* Others did not understand the relationship of g's to changing directions, for instance, *"it is not all about g's, it is about twists and turns,"* and in many cases it was apparent that viewers did not have a clear understanding of what a "g" is.

Some focused on the segment's conclusion that individual preference plays a part in determining which part of the roller coaster is most fun. For instance, viewers wrote "*It's not all about* g*'s—*

it's about what kind of acceleration you like—banking 180, hilltop, bottom of the hill, top of the hill," and *"I learned that when you say which part is the best it's more a matter of opinion."*

Investigation Replication: Fifty-seven percent of the viewers said they could imagine taking part in a similar investigation. Almost every positive response mentioned enjoying roller coasters, for example, "*Yes, I could because it's fun and also it's more hands on and active"* and "*It looks amazingly fun."* Viewers who could not imagine participating in a similar activity responded predominately with a fear of heights, or a dislike of roller coasters such as, "*No because I hate roller coasters."* Others were not interested in the activity because "*I'd be having too much fun on the roller coaster to remember to check the thing,"* acknowledging the sheer physical pleasure of riding a roller coaster.

Sail On

Story: Two boys debate whose sailboat is faster—a single-hulled lido or a double-hulled catamaran.

Investigation: Visiting the "Big Lab" exhibit at the California Science Center, the boys race several different model sailboats in a large tank and use their findings to determine the most efficient sailboat design. They also analyze the design of the boats and measure how much of the hull is in contact with the water, as a measure of drag. Their investigation culminates in a live action sail boat race in their full-size sailboats.

Investigation Purpose: Fourth and fifth graders' sense of the investigation's purpose were similar; most described it as about determining which of two sailboats was faster. One fourth grader said, "*The investigation was about which boat would go faster…"* Fifth graders used the key terms of catamaran and lido in their responses more often than the fourth graders did, for example, a fifth grader said, "*This investigation was about finding out which boat—the lido or the catamaran—would go faster and why."*

The remaining responses included either very basic descriptions of the investigation as about sailing, or were more complex, and noted the variables affecting speed, such as "*the different effects weight and wind had on boats."*

Knowledge Gained: The fourth grade responses varied considerably. Most offered simple responses about the impact of speed, which ranged from those who said they learned which boat went faster; to others who noted they learned "*that speed isn't everything."* Other responses included usage of the specific terms mentioned in the video, i.e., *weight, drag,* and *sails*. For example, "*Some boats go faster depending on the drag, weight, and sail."* A few viewers gave more details about the relationship of the terms and speed, e.g., "*I learned that the more water the boat drags, the boat goes slower."* A final group of viewers focused on the two types of sailboats; viewers most frequently discussed the speed difference between the boats while turning. One said, "*I learned that the catamaran was slower at turning."*

Fifth grade responses were similar to the fourth grade responses but made more explicit connections between the relationship of speed and sailboat design. Rather than just stating which boat was faster, fifth graders elaborated, for example, "*I learned that more weight makes the boat slower."*

Fifth graders frequently used the terms *weight*, *drag*, and *turning ability* in their responses. One said, "*I learned that although the catamaran was faster and weighed less, the lido won because it had better turnage."* The fifth graders also expanded on the differences between the boats and the impact those differences had on the race's outcome. For example, one fifth grader explained,

"*A lido has one hull and a catamaran has two hulls, the more water the boat touches, the slower the boat goes."* A couple of fifth grade students also addressed the difference in boats traveling upwind, for example, "*I learned that the lido went faster upwind than the catamaran."*

Investigation Replication: Forty-two percent of the viewers expressed interest in conducting a similar investigation. Fourth and fifth grade responses, mentioning enjoying sailing and that the activity seemed fun, ranged from short answers, "*I like sailing,"* to longer ones such as, "*it looks like fun and I always wanted to go on a boat."* Some viewers said their interest stemmed from how the investigation was explained and the active way the boys solved the question, for example, "*It is hands on and it is measuring and using tactics. I like these kinds of experiments"* and *"I could because they explain everything perfectly."*

Just over half of the viewers said they were not interested in taking part in a similar activity, for reasons ranging from a lack of interest in sailing or a lack of necessary resources, i.e., sailboats.

Dinosaur Dig

Story: In *Dinosaur Dig*, two girls visit the Fort Worth Museum of Science and History, where they are fascinated with the dinosaurs and other creatures that once lived in the Dallas-Fort Worth area.

Investigation: After touring a model of a dig site in the museum, they go on a field expedition to a real dig site, where they gather microfossils. They return to the museum and analyze the microfossils, identifying the variety of other creatures that co-existed with the dinosaurs.

Investigation Purpose: Both fourth and fifth graders described the investigation's purposes similarly; almost all included the words *microfossils, bones*, and *dinosaurs*. Their responses ranged from basic explanations such as, "*finding microfossils,"* to more detailed purposes, "*The investigation was about digging shark teeth and fish teeth and also crocodile bones. Then looking into a microscope to see what they are."* Some detailed responses added that the investigation occurs in Texas, and that two girls led the investigation, for instance, "*This investigation was about finding dinosaur bones in Texas"* and *"Two girls go to a museum and look for microfossils."* More fifth graders mentioned identifying the microfossils, for example, "*This investigation was about finding and identifying microfossils."* Notably missing from these responses was a description of the investigation in terms of the relationship between these fossils and the search for evidence of creatures that live alongside dinosaurs.

Knowledge Gained: The fourth graders reported learning that microfossils exist—"*I learned about microfossils"*—and described the general physical characteristics of the microfossils found during the investigation, such as color and size. One viewer said, "*I learned that fossils are normally a darker color than their surroundings."* Many fourth graders commented on the size of microfossils with statements like, "*Microfossils are fossils you need a microscope to see."* A few fourth graders explained why dinosaur and fish bones were found in the same place; for example, "*There could be a lot of dinosaur and crocodile and fish microfossils anywhere and dinosaurs might have fallen in the water when they died."* A few explicitly made the connection between identifying animals through microfossils, for example, "*I learned about small bones and which dinosaur it matched."* Eight fourth graders said that they did not learn anything from this investigation, although one noted problems with the DVD, which might have contributed to this.

In general, almost every fifth grader commented on learning about microfossils, bones, or dinosaurs, for example, "*Bones can become rocks over years, also there are many different ways to find a measurement of where the bones are at."* A few discussed the purpose of the datum pole in the museum exhibit: "*I learned that a datum [pole] was used to measure the exact point*

of the bone or fossil." More fifth graders made the connection from the microfossil to identifying the original animal; as one noted, "*Microfossils are small bones from fish, lizards, and dinosaurs. The microfossils that they found were animals that lived near water or in water. They found fish and other animal bones (teeth).*"

Investigation Replication: Forty-one percent of the viewers expressed interest in conducting a similar investigation, mostly through interest in fossils and dinosaurs or the pleasure of finding fossils. "*I have always been interested in dinosaurs,*" one said, while others spoke of enjoying "*digging things up and examining things too.*" A few viewers expressed interest in both topics, as this fifth grader stated, "*I could see myself doing an investigation like this because I like to dig and I enjoy learning about different fossils.*"

The strongest rationale for those uninterested in pursuing a similar investigation was a stated lack of interest in dinosaurs or in going to a dig site. A fourth grader said, "*I couldn't see myself doing that…I am not interested in dinosaurs and fossils.*" Another trend in responses that showed little interest in a similar activity was that the viewers didn't live in an area where this activity was feasible, for example, a fifth grader noted, "*There are not any sites to dig at where I live.*"

This investigation had the largest percentage (8%) of indecision about participating in a similar investigation. Responses showing uncertainty about a similar activity ranged from, "*maybe*" to "*Maybe but do not like dinosaurs but I do like digging for things.*"

Light and Color

Story: In *Light and Color,* five science club members take up a challenge a teacher has given them: create an art project without paint.

Investigation: The young scientists visit the Exploratorium's "Light and Color" exhibit, learn about the properties of light, and use what they have learned to create an interactive art project.

Investigation Purpose: Almost every fourth and fifth grade viewer described the purpose of this investigation as either making art without using paint or using light and color to make art, such as "*It was about some kids trying to make an art project without paint.*" There was very little variety in how viewers described these two themes. A few provided additional detail, such as "*The investigation was about seeing how to mix, bounce, and bend light and also how to make a light room.*"

Knowledge Gained: Four and fifth graders' responses to what they learned from the investigation were similar. Most responded that light can be manipulated, and used the terms introduced in the segment—*bend, mix,* and *bounce.* For example, one viewer said, "*I learned you can mix, bend and bounce light.*" Another common trend was remarking on one of the activities conducted by the investigators in the museum. One viewer said, "*I learned that if you put blue and red together with lights you get a purple background not a purple shadow.*" Another said, "*I learned how you make a vision without a solid screen.*" Most responses about the activities mentioned the screen with various lights and the shadows made by the lights. More fourth graders discussed learning how to create rainbows by bending light, for example, "*If they move the paper away the rainbow gets bigger.*"

Some viewers provided more complex answers such as, "*I learned that you can mix and bend light. If you have a white long sheet and colored lights your shadow turns into that color. I also learned certain colors you mix with paint do not mix the same with light.*" Another said, "*You can mix light color so they become new colors. You can bounce light and bend light and you can*

make a rainbow." Eight viewers (three fourth graders, five fifth graders) said they did not learn anything from this investigation.

Investigation Replication: Fifty-three percent of the viewers showed interest in pursuing a similar investigation either because it was fun, or they enjoyed either art or science. Most implied that they would recreate this activity because it looked like fun. For example, "*I could see myself doing it because it would seem fun doing rooms that can have rainbows and other cool stuff,"* and "*I could because it was exciting, simple, and they did a very good job making the exhibit."* Others said they would replicate this activity because they enjoyed science. Some of these comments included "*I could because I like doing science very much,"* and "*I could see myself doing an experiment like this because I love science and I love experimenting with light and color."* A final group of responses, indicated interest in the project because of an enjoyment of art, for example, "*I could because I'm really into art and people say I'm really good at it."*

Reasons given for a lack of interest in conducting the activity included not liking science, lack of interest in the activity or the topic, e.g. "*It looked boring."* A couple of students who were interested in repeating the activity on their own said that materials would restrict them from replicating the investigation, "*It would be hard to get all the stuff, but it looked incredibly fun."*

Cactus/Home Prickly Home

Story: A young visitor at the Arizona-Sonora Desert Museum asks two docents (a girl and a boy) whether the homes birds build in holes in Saguaro cacti all face in the same direction. The docents promise to find out the answer.

Investigation: The two docents gather data on the direction of holes in several saguaro cacti on the museum grounds, and make a chart of the number of holes found in each compass direction. Their results indicate that birds build their nests on the north side of the cacti in the shade, or on west side where the prevailing breezes come from, and hypothesize that the birds are seeking cooler nesting sites.

Investigation Purpose: Most fourth grade viewers described this investigation as related to cacti or birds, sometimes as simply as "*Cactus and cactus holes.*" Others provided more thorough answers mentioning cacti and the relationship to the bird holes, such as "*The investigation was about finding which direction has the most holes in the cactus*," and, "*It was about holes in cactuses in Arizona and what side of the cactus the holes were on.*" While most fourth graders incorporated the words *cacti*/*cactus*, *holes* and *birds* in their responses, only a small group included specific vocabulary such as *saguaro* and *Sonoran Desert*.

Most fifth graders described the connection between the holes in the Saguaro cacti and birds, for example, "*The investigation was about cactus and birds and how they live in the cactus. And also what side they mostly live on. They mostly live on north and west. They also live on east and south.*" In contrast to the fourth graders, the older students tended to incorporated vocabulary specific to this investigation such as *saguaro* and *Sonora*, for example, "*This investigation was about the Sonoran desert and if birds normally make their holes on one side of a Saguaro cactus.*" Another detailed response added that, "*Arizona-Sonora museum, two kids help in a museum."*

Knowledge Gained: Students were remarkably consistent in both the content and the phrasing of their answers to this question. Slightly more than one-half of the fourth and fifth graders, reproducing language in the segment verbatim, said that the holes in the cacti were predominately located on the north and west sides. Most also provided some detail as to why the holes were positioned in those directions. A fifth grader said, "*I learned that most of the holes*

were on the north and the west. They are there because that is the more comfortable and cooler side of the cactus." A fourth grader said, "*I learned that more holes are on the west and north because the shade on the north and breeze on the west*." The responses that included the direction were almost all accurate; although a few responses located the holes on the east side.

In addition to learning about the holes in the cactus, viewers commonly mentioned learning about the wildlife in the desert, chiefly about the birds and/or woodpeckers. Some of these responses included, "*I learned what Saguaro holes were. Also I learned about many different types of birds and animals,*" "*I learned that there are all kinds of different animals in the desert. It's not just a piece of dry land*," and "*I learned that a lot of animals live in the desert like a woodpecker and a coyote and a type of pig.*" Three viewers added a phrase about not taking anything out of the desert: "*It's illegal to bring animals or plants out of the desert.*"

Investigation replication: Forty-one percent of the viewers expressed interest in participating in a similar activity, supplying a range of reasons, from enjoying the outdoors and science to being curious. The most common answers were a love for animals, enjoying the outdoors and that the investigation seemed fun. A fifth grader said, "*I could see myself doing an investigation like this because I love science and enjoy learning about things like this."* Another viewer said, "*I could see myself doing this because I am curious."* One viewer noted that the investigation's thoroughness would make it easy to replicate: "*I had a picture of what was going on because it gave all the right details."*

More than half of the fourth and fifth graders could not imagine participating in a similar investigation. Two trends were noticeable in their responses: most said either that they did not like the desert (the heat) or live close to a desert. As a fifth grader explained, "*I couldn't because I am not a big fan of the desert."* A small group of viewers said they wouldn't be interested due to disliking cacti, for example, "*I don't see myself doing this because I would not like being that close to cactus."*

Summary

For each investigation segment viewed, viewers were asked to relate in their own words the purpose of the investigation and what they learned, as a means of assessing in broad terms the clarity of the science investigations—including both the purpose of the investigation and content.

Purpose: Overall, children in the study were easily able to articulate the purpose of the investigations. In most cases, viewer responses were very consistent in how they articulated the purpose of the investigation, suggesting that it had been clearly stated. In the case of *Dinosaur Dig*, however, responses tended to describe the methodology – finding microfossils – rather describe the larger investigation about which creatures lived alongside dinosaurs.

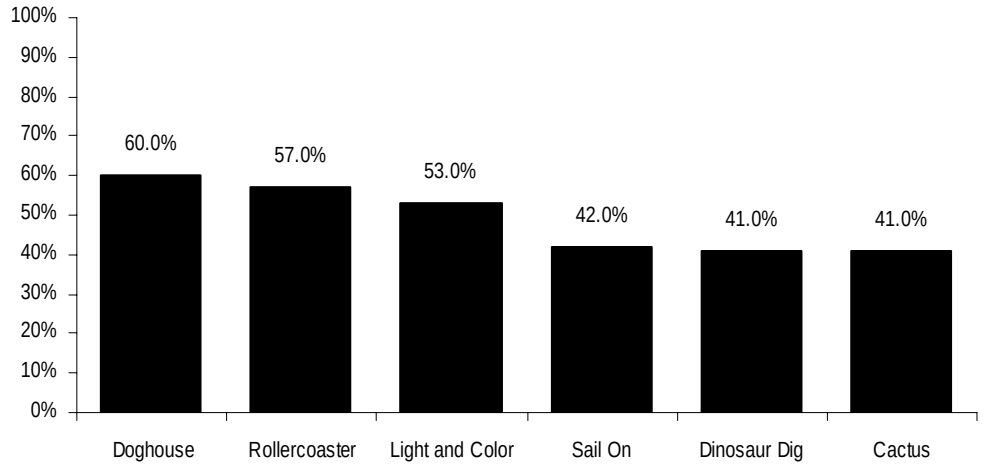
Learning: The complexity of the investigations varied considerably as did the degree to which students were able to accurately relate information about the investigations. Because of the open-ended nature of the questions, it was often easier to assess appreciation of general concepts and processes than specific science facts. Nevertheless, results suggested that most students clearly understood both the methodologies employed in the investigations and conclusions reached e.g. accurately relating the position of cactus holes in *Cactus* or the importance of color or an evaporative cooler for building a cooler doghouse in *Doghouse*.

Sail On and *Roller Coaster* presented the most complex investigations. The information presented in *Sail On* was easily comprehensible by most students, who were able to accurately relate the importance of at least one variable on the speed of the sailboats. The roller coaster segment introduced viewers to the physics of roller coasters—including concepts such as

velocity, acceleration, the force of gravity—and were the most advanced ideas presented in the six segments. These concepts were difficult for many students to understand, and this segment produced the greatest number of inaccurate statements. It was nevertheless notable that at least some students were able to accurately relate learning about "g's". Also striking were the responses that suggested that some of the students were able to follow the complex path of the investigation, which moved from an initial examination of "g's," to the lack of correspondence between speed and "g's," and a conclusion that related the physics to the investigators' enjoyment of different parts of the roller coaster.

Interest in replicating investigations: Viewers' desire to repeat the experiments varied significantly across the six segments, as indicated in Figure 4 below.

Figure 4: Desire to Replicate Investigations at Home (All Participants)



The ranking of segments in terms of interest in replicating them at home matches the order in which viewers ranked the appeal of the segments (see next section). Comments suggest that the accessibility of environments or resources was a concern for both students who were and were not interested in conducting the investigation.

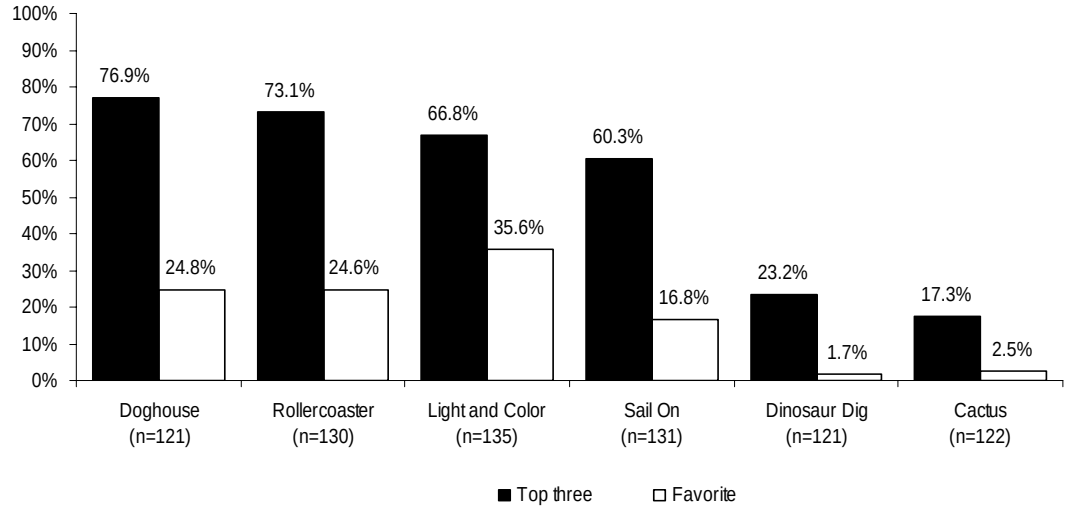
Investigation Ranking: Appeal

Participants were asked to rank the six investigations they watched in order of those they liked most (1) to those they liked least (6). For each investigation the percentages of respondents who gave a ranking of 1-3 were combined to rank them more easily.

All Respondents: *Doghouse*, *Roller Coaster*, and *Light and Color* were the three most popular investigations. They had both the highest numbers of viewers who selected one of them as their favorite, and the highest cumulative percentages of viewers who selected one of them as among their top three favorites. Although a relatively smaller number of viewers selected *Sail On* as their favorite, it was nevertheless popular, as indicated by the large number of viewers who placed it as among their top three.

Figure 5 shows the overall ranking of segments, presented in order of their rank among the top three favorites. This ordering of the segments—*Doghouse* first and *Cactus* last—is followed in all charts to allow for easy comparison of subgroups with the whole set of viewers.

Figure 5: Segment Ranking (All Participants)



Ranking by Gender: Girls strongly preferred *Doghouse* and *Light and Color*; 93% and 82% chose these episodes as among their three favorites, and 39% and 47% chose one of them as their favorite. *Roller Coaster* and *Sail On* also figured heavily among the top three episodes girls selected, but fewer than 10% of chose either as their favorite episode. Figure 6 shows girls' responses.

Boys' favorites were less clearly divided than the girls'. Boys nevertheless strongly favored *Roller Coaster*, followed by *Sail On*; 83% and 71% placed these segments among their top three. Boys also indicated they enjoyed *Doghouse* and *Light and Color*. Figure 7 shows boys' responses.

Figure 6: Segment Ranking (Girls)

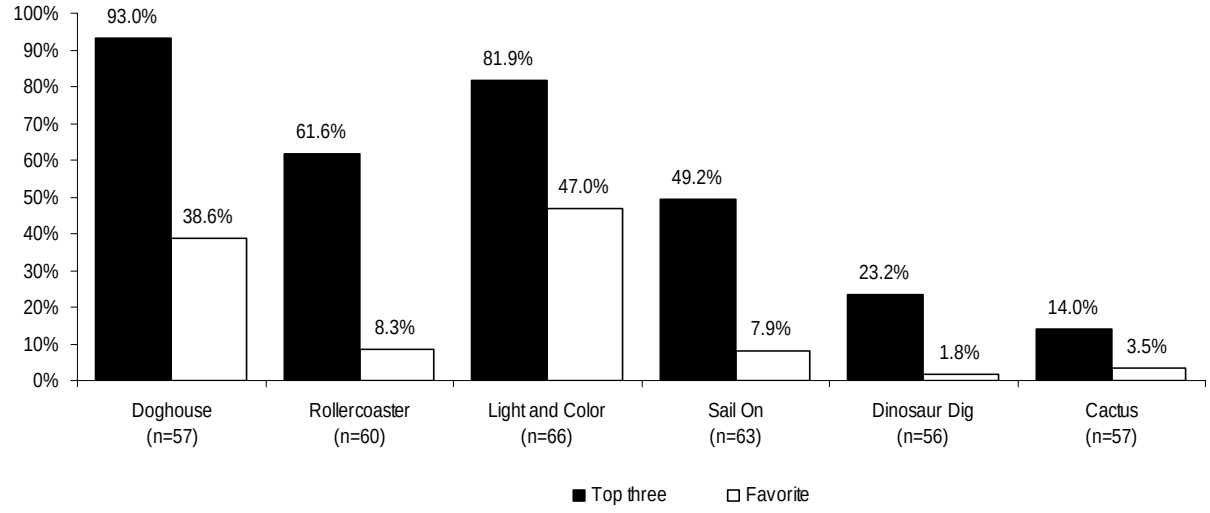
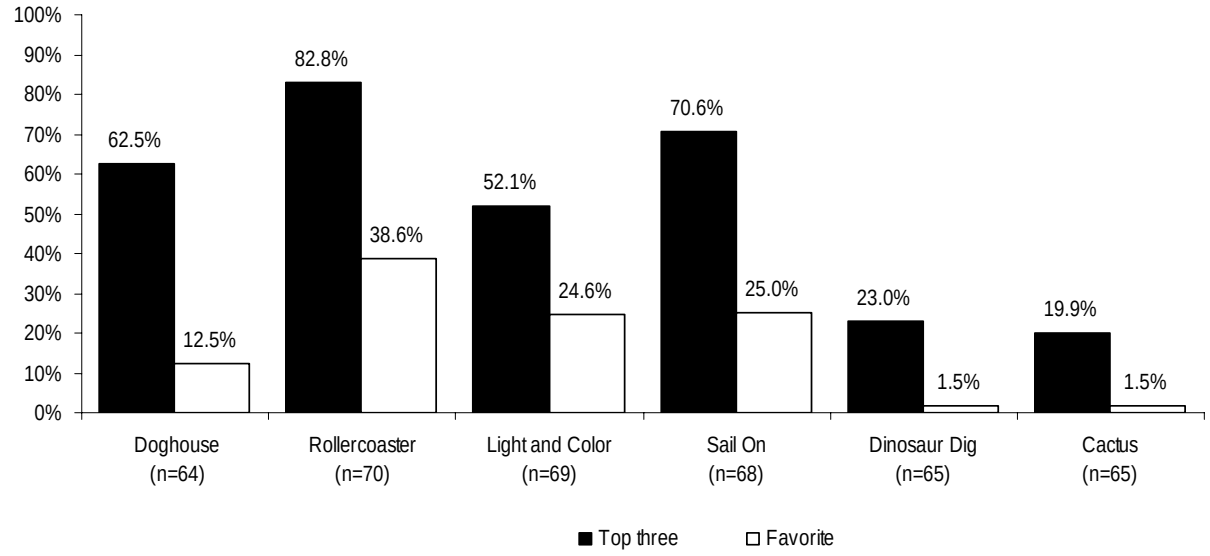


Figure 7: Segment Ranking (Boys)



Grade Level: While *Light and Color* was popular in both grades, more fifth than fourth graders named *Doghouse* as their first choice; *Roller Coaster* was more popular with the younger viewers. In both cases, there was an approximately 20% difference between fourth and fifth graders in choosing one of these as their favorite.

Fourth graders ranked *Doghouse*, *Roller Coaster*, *Light and Color*, and *Sail On* almost equally among their top three; 68% to 72% of the students placed one of them among their top three favorites. Fourth graders chose *Light and Color* and *Roller Coaster* most often as favorites. See Figure 8.

Looking at top three favorites, fifth grade preferences mirrored the ranking for the entire group. *Doghouse* and *Light and Color* were most often rated as favorites, followed by *Sail On* and *Roller Coaster*. See Figure 9.

Figure 8: Segment Ranking (4th graders)

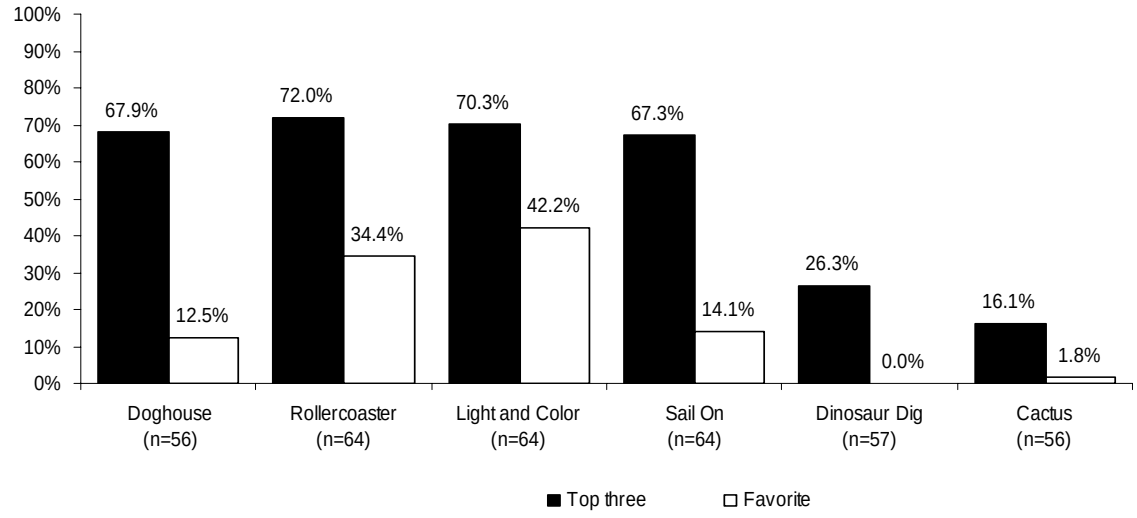
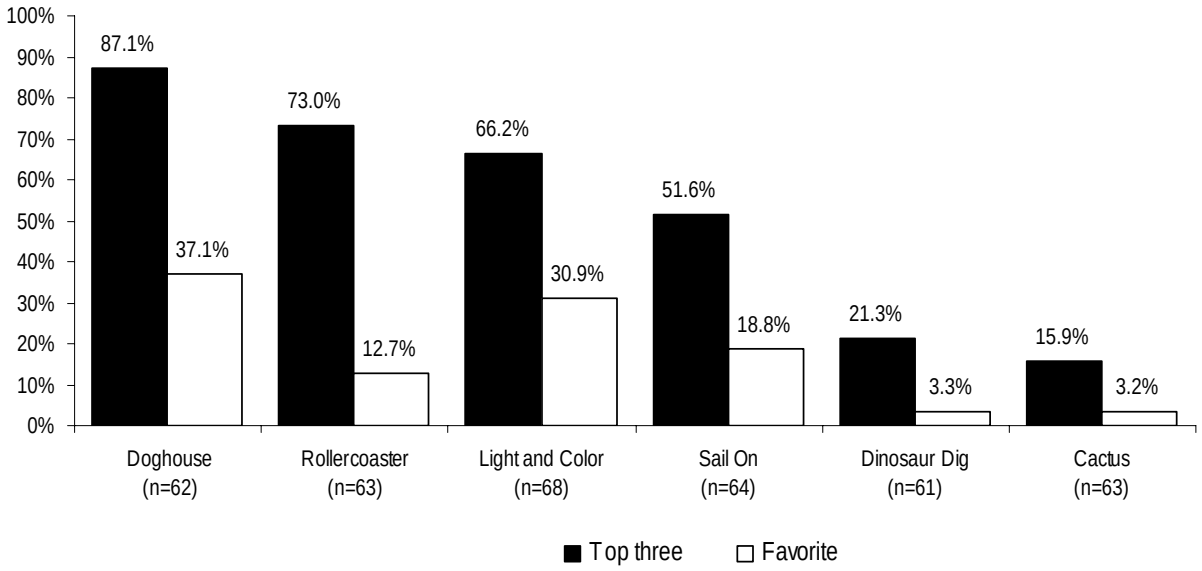


Figure 9: Segment Ranking (5th Graders)



Focus Group Responses

In their initial comments, viewers stated that they enjoyed the way *DragonflyTV* shows that you can combine fun things while learning new things. Their comments on which episodes they enjoyed most closely followed the survey results. In discussions, they showed the greatest enthusiasm for *Doghouse*, *Light and Color*, *Roller Coaster*, and *Sail On*. Many laughed at the talking animals in *Cactus*, though some said they did not like this. They were thrilled by *Roller Coaster*, and many asked to see it again.

Investigations: Most viewers agreed that the most realistic investigations were *Doghouse* and *Light and Color*. Regarding *Doghouse*, they easily related to both the dog and the practicality of the project, while they found *Light and Color* accessible because it was an assignment given by a teacher. Several viewers also said they liked it because they enjoyed art projects.

Most viewers in the focus groups enjoyed the *Roller Coaster* segment and felt it was realistic that children would go on a roller coaster, but some noted that conducting measurements was less believable. As one viewer stated, he would be "too busy having fun." Most viewers enjoyed *Sail On* and felt that the segment made sense because the exhibit at the science center was clearly set up to do the experiment shown.

Only a small number of viewers found the *Dinosaur* investigation appealing, largely because they enjoyed "digging" and "archaeology." *Cactus* was also less popular, however, a few viewers said they enjoyed the investigation because they like nature or "learning about animals."

Components of Inquiry: Viewers enjoyed the clear depictions of trial and error investigations in *Sail On* and *Light and Color*. Observation of children's attentiveness during viewing suggested that they were following the *Sail On* trials closely, laughing each time the lido went astray in its course or lost a race. The viewers also enjoyed the experimentation with colored light that produced the colored shadows shown in *Light and Color*. A few children noted that collecting data and graphing were less appealing, and not seen as something children would actually do. Most nevertheless remained engaged throughout these parts of the segments.

Focus on the Children: Many viewers found it unrealistic that the children were shown doing the activities in science centers with neither other visitors nor adults around. They also found it less credible that the children never asked for information or help from either science center staff or from parents. One viewer noted that the children came and went from the science centers and never paid to get in.

Clarity: The fast pace of *DragonflyTV* and the constant music track did not seem to prevent viewers from understanding and conveying the segment content. However, when the video cut between different locations, some viewers were confused. For example, a few children thought that the lab in *Dinosaur Dig* where the girls were working was in one of their homes. Others found the very fast cross-cutting style of *Roller Coaster* difficult to follow, and others felt the information was sometimes presented too quickly.

Children understood the storylines and to a large extent, the science presented, in all six segments. However, in a few cases, concepts or methodological details that were not extensively explained in the body of the segment left at least some viewers with questions. For instance, in the *Cactus* segment, viewers weren't sure why the children were doing the investigation, what the circles were for, and why they made them the size they did. Likewise, children asked what makes light bounce after watching *Light and Color,* and what a "g" is in *Roller Coaster.*

A common concern viewers raised was that some of the child presenters mumbled, particularly in *Sail On* and *Cactus*, making the story difficult to understand.

Significantly, there were few questions about processes or ideas when they were repeated a number of times in the course of the segment.

Student Investigators: Viewers often expressed strong preferences for certain of the children featured in the segments. They enjoyed those who were the most natural and did not appear to be acting. They did not like the investigators who seemed overly enthusiastic or corny. In general, the favorite children were those in *Doghouse*, *Light and Color*, and in some cases *Sail On*, or *Roller Coaster*. They found the investigators in *Dinosaur* and *Cactus* less believable. Many viewers liked that *Light and Color* featured a group of children with a mix of boys and girls.

Comments from several viewers suggest they liked seeing the children cooperate, share tasks, and treat each other nicely. Responses to whether they enjoyed the competition in *Sail On* were mixed; some felt the competition added to the story, while others did not. Viewers had similarly mixed feelings about the individual preferences concerning the roller coaster ride in *Roller Coaster.* In general, viewers did not like the teasing between children, though there were mixed reviews of a scene where one investigator called another "dork."

Most viewers liked the profiles of children at the beginning of segments, such as in *Doghouse*, but did not like it when they interrupted the story, particularly in *Dinosaur Dig*.

Generally, the girls in *Dinosaur Dig* were the least favorite child investigators, described as not "acting normally," not focused, and "too enthusiastic."

Viewers liked the children in *Light and Color* because they stayed focused and on topic (with the exception of the profiles in the middle of the story) and they did lots of energetic activities. They did not like instances when the investigators got off track, as the children did in *Dinosaur Dig*.

In several classes, viewers mentioned a preference for investigators who look their age, noting that some, such as the boy in *Cactus*, were too old.

B. Attitudes about Science Centers and Science Projects

Because one of the goals of the *DragonflyTV GPS* series is to enhance children's appreciation of the value of science museum experiences and of conducting science projects, the study employed a number of strategies to measure changes as a result of viewing. Children completed pre- and post-test survey questions concerning their attitudes towards science centers and projects and were asked about their interest in conducting science projects on both their surveys and in discussions.

Data related to these questions are presented below. When appropriate, pre/post data is organized to highlight changes, thus individual variables are ordered (from left to right) on each graph from greatest positive change to least.

Describing Science Museums

Changes in Children's Selections of Words Describing Science Museums

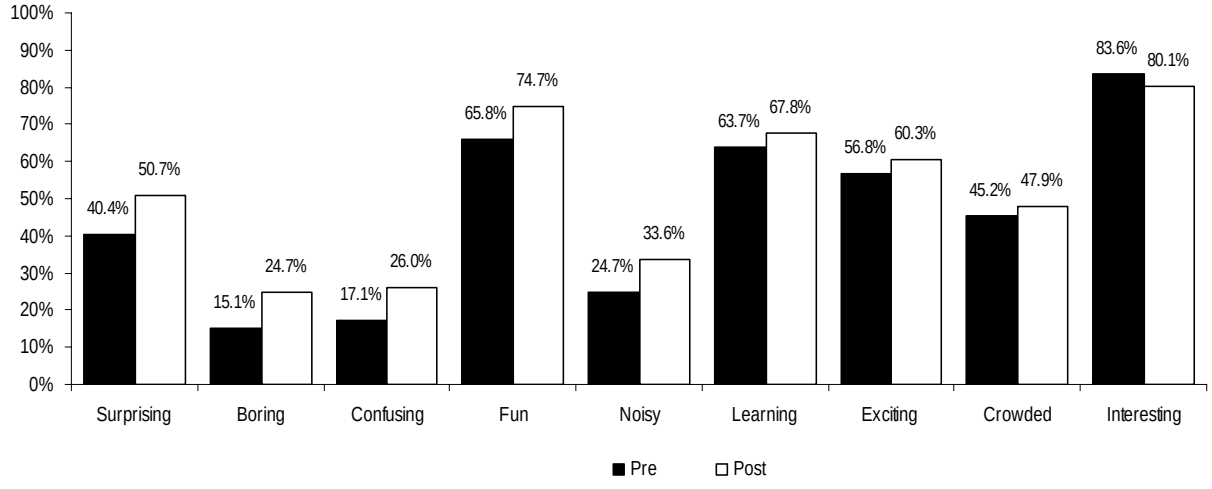
Viewers were asked to check all of the words or phrases that they associate with science museums.

Pre-Viewing Surveys: On pre-viewing surveys, more than 50% of viewers selected *interesting*, *fun*, *learning*, and *exciting* to describe science museums. Between 25% and 50% chose *crowded*, and *surprising.* Fewer than 25% chose *noisy*, *confusing*, and *boring* to describe museums.

Pre-Post Changes: In the post-surveys, a larger number of viewers chose *surprising* (+10%,) *boring* (+10%), *fun* (+9%), *noisy* (+9%), *confusing* (+9%), *learning* (+4%), *exciting* (4%), *crowded* (3%). Fewer viewers selected interesting (change of -4%).

See Figure 10 for complete responses.

Figure 10: Words Describing Science Museums (Pre and Post-Viewing Responses) (n=143)



Usefulness of Science Information

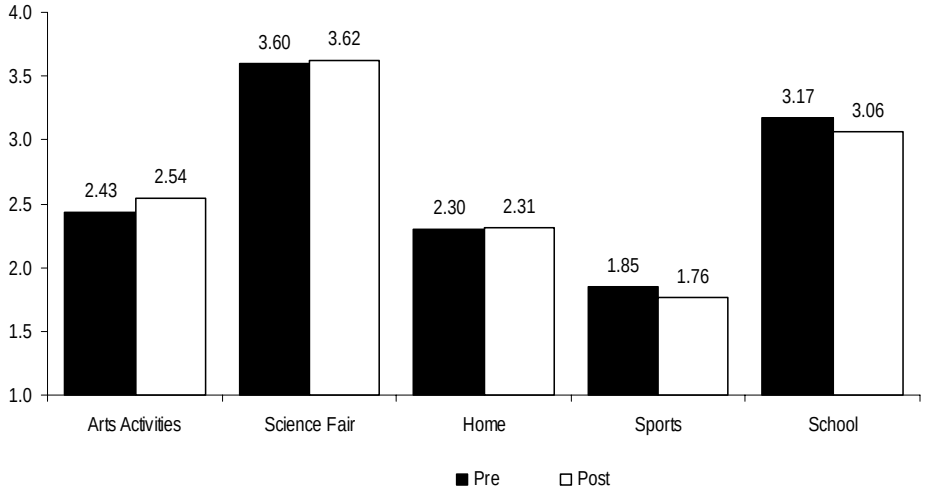
Viewers were asked to rate the usefulness of information from science centers on a scale from one to four, in which 1=not at all useful, 2=a little bit useful, 3=useful, and 4=very useful.

Pre-test Perceptions: Viewers saw science center information as most valuable (between very useful and useful) for *science fair activities*, followed by *school.* Science center information was rated as between a little bit useful and useful in regard to *arts activities* and *home*. Viewers rated the value of the information for *sports* as between not useful at all and a little bit useful.

Pre-Post Changes: Small positive changes in the ratings of the usefulness of information at science centers were seen in the value of their application to *arts activities* (mean + 1.1). These changes were greatest in the responses of girls and of fifth graders. The perception of decreasing value of science center information is seen in the value of science centers for doing school work (mean – 1.1). Extremely small changes were seen in the value of the information in other areas.

Figure 11 presents the results, ordered from greatest positive change to greatest negative change.

Figure 11: Usefulness of Science Center Information (Pre and Post-Viewing Responses)
(n=143)



Companions for Science Center Visits

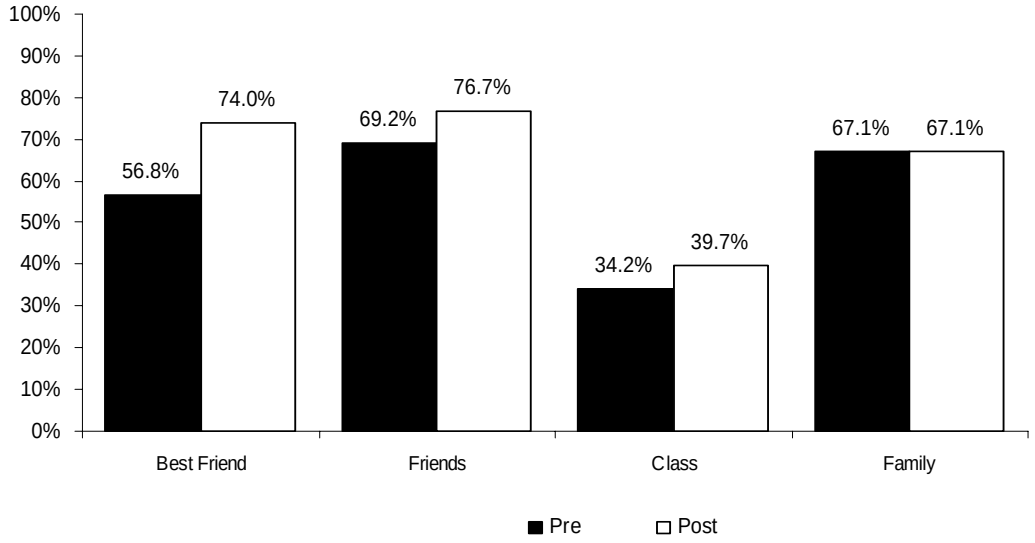
Viewers were asked to name the people with whom they would like to visit a science center.

Pre Responses: Viewers said they would prefer companions in the following order: friends, family, best friend, and class.

Pre-Post Changes: The greatest change was an increase in responses naming friends or best friends as science center companions. Positive responses for taking a best friend increased more than 10% among all viewers, and both boys and fourth graders showed a more than 10% increase in preferring to bring friends. There was little change in the percentage who selected class, or other children, and no change in the numbers who would go with family.

See Figure 12 for complete responses.

Figure 12: Companions for Science Center Visits (Pre- and Post-Viewing Responses) (n=144)



Target Ages of Science Centers

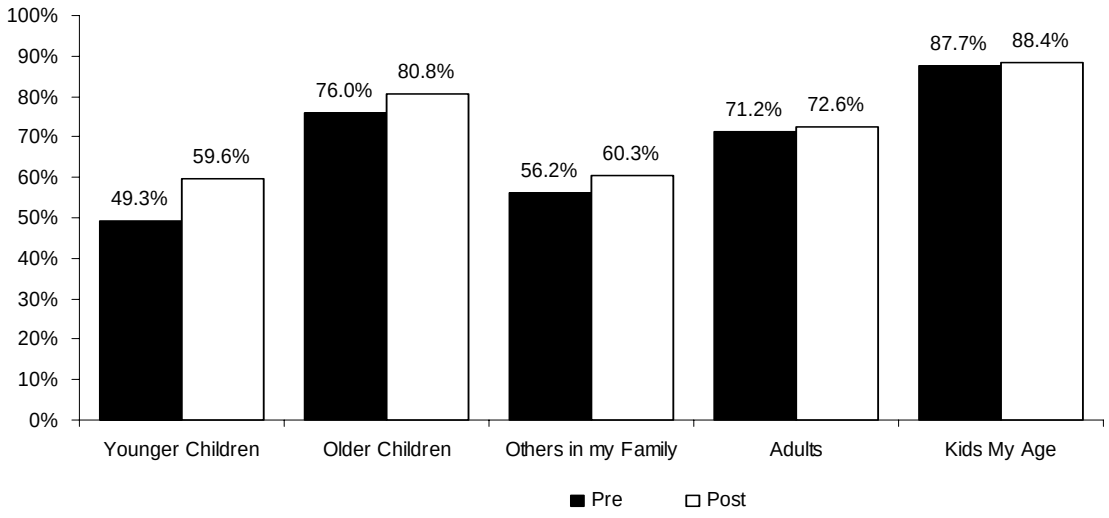
Viewers were asked to state which groups of people science centers were geared for.

Pre-test Responses: More than three-quarters of viewers felt that science centers target children their age (88%) or older children (76%), followed by 71% who felt science centers were for adults, 56% for "others in my family", and 49% for younger children.

Pre-Post Change: The greatest change was a greater than 10% increase, especially among fifth graders, in seeing science centers as targeting **younger children**.

See Figure 13 for complete responses.

Figure 13: Target Ages of Science Centers (Pre- and Post-Viewing Responses) (n=143)



Excitement Ratings

Viewers were asked to rate how exciting they felt their next visit to a science center would be on a scale from 1=not exciting, 2=a little bit exciting, 3=exciting, and 4=very exciting.

On both pre- and post-viewing surveys the mean response was 2.9, or just under exciting. There was very little change from pre- to post-viewing responses.

Anticipating Museum Visits

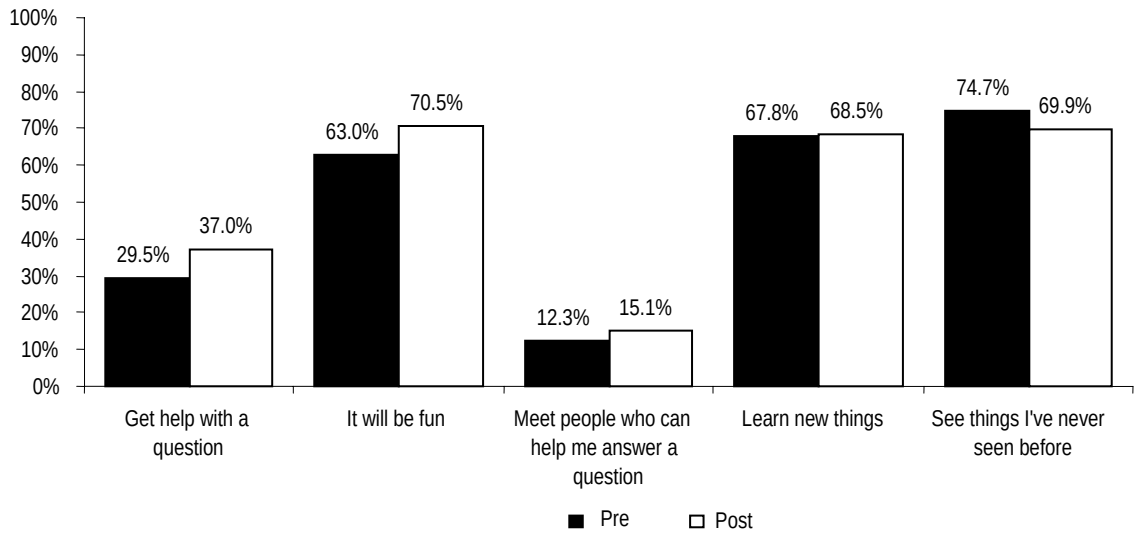
Viewers were asked what they looked forward to about their next visit to a science museum, and to check selections from a list.

Pre-viewing results: Viewers looked most forward to "seeing things I've never seen before" (75%), "learning new things" (68%), "it will be fun" (63%), "getting help with a question" (30%), and "meeting people who can help me answer a question" (12%).

Pre-Post Changes: The greatest change, 8%, was seen in anticipating "getting help with a question" while "it will be fun" increased 7%, and "meeting people who can help me answer a question" increased 3%.

See figure 14.

Figure 14: Anticipating Museum Visits (Pre- and Post-Viewing Responses) (n=145)



Attitudes about Science Projects

Another *DFTV* goal is to interest children in doing their own science projects and experiments at home. The following questions addressed children's attitudes towards science projects in general and their interest in replicating the experiments seen on *DFTV* at home.

Science Projects

Viewers were asked to choose all the words or phrases from a set list which they felt best described doing a science experiment or project.

Pre-viewing Results: The greatest number of viewers described science experiments as: "can be done with friends" (79%), "fun" (72%), "can be done indoors" (69%), "can be done outdoors" (67%), and "can be done outside of school" (65%).

About half of the viewers described science experiments as "for kids my age" (56%), or "hard" (49%).

Less than half chose one of the following phrases: "can be done alone" (40%), "need materials I don't have" (39%), "confusing" (34%), "more for older kids" (32%), "easy" (24%), "boring" (16%), and "more for younger kids" (5%).

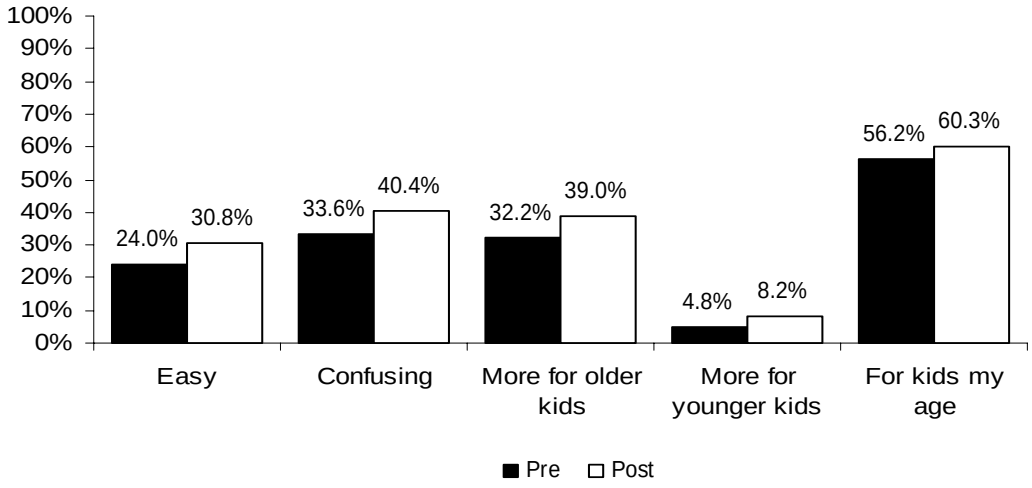
Pre-Post Change: The greatest changes in attitudes about science projects were in "needing materials I don't have" (increase of 18%), "can do it alone" (13%), "boring" (13%), and "hard" (10%).

The data showed smaller increases in the numbers of viewers who characterized science projects as "confusing" (7.2%); "easy" (6.8%); "for older children" (6.8%); "for my age" (4.1%); "indoors" (4.1%); "outside of school" (3.4%), "for younger kids" (3.4%); and "outdoors" (0.7%).

The numbers of viewers who characterized science projects as "fun" decreased (-4.8%), as did "involving friends" (-1.4%)

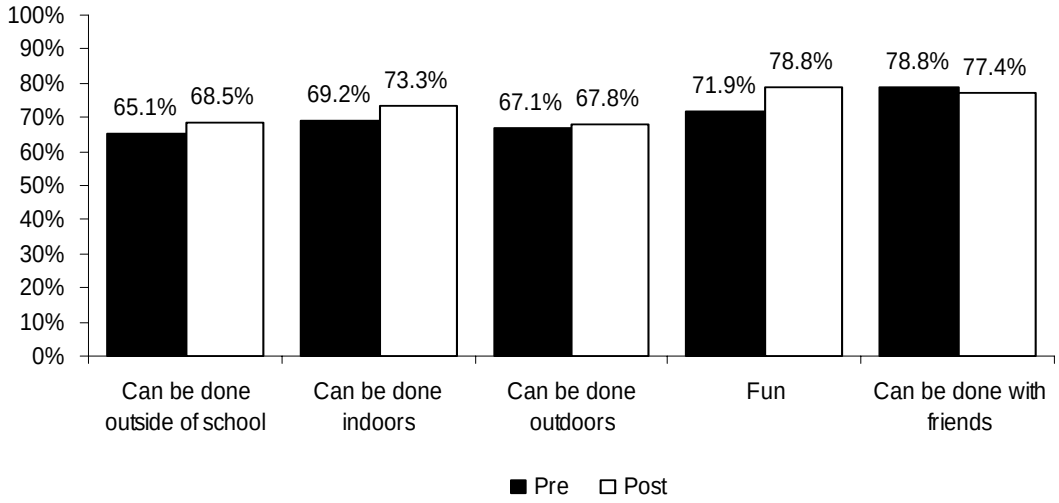
Figure 15 below shows the results; the science project characterizations have been ordered from the greatest positive change in pre-post responses to the least.

Figure 15: Descriptions of Science Projects (Pre- and post-viewing responses) (n=145)



(Continued on next page)

Figure 15: Descriptions of Science Projects (Continued)
(n=145)



Conducting Investigations at Home

Although viewers expressed interest in replicating the experiments seen on *DFTV*, ranging from 40% to 60% (see Figure 4), in discussions, many expressed concerns that they would not have the resources to conduct these investigations at home. They also felt that parental permission would be an obstacle to doing such activities at home.

Further, viewers were very concrete in even imagining what kinds of investigations they might want to do. For instance, many said they would not do the investigation in *Cactus* because they do not live near a desert, and could not do the sailing study because they do not have a boat. Although encouraged in discussions to do so, most of the fourth and fifth graders in this study were not inclined to consider ways in which the activities could be adapted to available resources.

SUMMARY AND DISCUSSION

Introduction

This evaluation was designed as the first step of an iterative process for assessing the features and characteristics of science television programs that impact learning. The study began with the development of a set of characteristics derived from an analysis of the segments' structure and content. Data was then collected from children to aid in articulating which of these characteristics appeared to be significant to their experiences—in terms of appeal and learning—of the segments. Data on children's learning was gathered to provide an understanding of viewers' overall grasp of the segments' content, as a means of reflecting on the clarity and complexity of the segments. Generally, as noted in the Segment Analysis, children were able to describe much of the science content and the process in all six segments. However, because the segments varied widely in terms of the topic areas, complexity of science concepts and investigation steps, details of data collection, and conceptual framing of the investigation, no attempt was made to correlate learning with the different segment characteristics. The ability of students to describe the content roughly matched the degree to which the content had been emphasized or repeated in the segment. When complex content was presented, it was particularly important to examine variables individually and repeat the ideas.

This final section of the report contains three parts. The first part provides a summary of children's responses to the six segments they viewed. The second part presents the features and characteristics which emerged as significant for children's learning. These include both story elements and science investigation elements. For analytical purposes, they are treated individually, but ideally, these story and science components should be closely woven within a segment. The third part provides a summary of the findings related to the show's impact on perceptions of science centers and science investigations.

Children's Responses to the Segments

The six segments were chosen because they presented different combinations of features and attributes representative of the techniques employed in the *DragonflyTV* series. While some topics were clearly of greater appeal to students, all six segments had elements of interest to at least some of the students. Each of the six segments is presented below and includes a summary of the science investigation and when appropriate, some of the features of the segment for which it was chosen for the study. This description is followed by a summary of viewer responses to the appeal of the segment and an overview of viewer comprehension of the science investigation and content.

Doghouse: Motivated by an engineering challenge, this investigation deals with two main ideas, the relationship between the color of an object and how quickly it heats up, and how an evaporative or swamp cooler works to cool a doghouse. The first occurs in the science center where two girls experiment with different colored houses and temperature changes, and the content is reinforced through a short dramatic play with a stuffed animal. Then the girls learn about the construction of a swamp cooler. The segment continues in a backyard, where they construct a light-colored doghouse with a swamp cooler and confirm that the temperature inside is reduced following these improvements. The segment concludes with the girls showing the completed doghouse to their neighbors (and to their dog!).

Doghouse was a very popular segment overall. The largest number of viewers (77%) placed it among their top three selections. It was especially popular with the girls: 39% named *Doghouse*

as their favorite segment, and 93% placed it in their top three. Fifth graders ranked it more highly than fourth graders. It was also the highest rated (60%) in terms of a desire to replicate the investigation.

Viewers found this investigation very accessible; they could follow the connection between the Arizona climate and the desire to build a cooler doghouse. They also identified with the desire to make a pet more comfortable, and noted that they love dogs and helping them. Viewers grasped the motivation for the project easily and could describe accurately the information presented about the relationship between color and temperature and about a swamp cooler's value in lowering the temperature of a doghouse. A few reflected on the accessibility of such an experiment, or observed they would enjoy doing a similar project. In discussion, students said they liked the child investigators.

Roller Coaster: In *Roller Coaster* two boys declare their love of roller coasters, and wonder why some parts of a roller coaster are more exciting than others. At the science center they learn about *g*'s and learn to use an accelerometer to measures *g*'s. They try the accelerometer in a roller coaster simulator, and then take it on a real roller coaster. They measure g's in a number of different places on the roller coaster to see if there is a correlation between g's and enjoyment. They learn that "change of direction" is another way of experiencing high g's, and that speed is not the most crucial factor in creating excitement. They conclude that high acceleration – corresponding to a high number of *g*'s – are what make roller coasters exciting. However, they conclude that which part of the roller coaster is most exciting is also affected by personal opinion.

Roller Coaster received the largest number of "favorite" ratings (39%) by boys, and was a close second to *Doghouse* for the entire group: 73% placed it among their top three. It received the second largest number of "favorite" ratings by fourth graders, second only to *Light and Color*; a much smaller number of fifth graders selected it as their favorite segment. Fifty-seven percent of the viewers said they could imagine participating in a similar investigation, many noting that they enjoyed roller coasters or thought it would be fun.

Viewers were drawn to the excitement of the roller coaster and even to the museum's simulator. They felt the investigation had a believable premise because roller coasters are enjoyable, although some noted that they would be having too much fun to actually collect the data. This segment presented the most advanced concepts of the six segments, including abstract concepts of velocity, acceleration, and the force of gravity. Children were able to describe the purpose of the investigation variously as which part of the roller coaster had the most *g*'s or was the most exciting. A significant number of viewers accurately related something they had learned about the relationships between *g*'s, acceleration, speed, and excitement on a roller coaster, while others were left somewhat confused. For some viewers the very active editing style detracted from its clarity.

Light and Color: In *Light and Color*, five students in a science club are challenged to create an art project without using any paint. The students visit a museum where they explore exhibits which allow them to experiment with three properties of light – bending (refracting), bouncing (reflecting) and mixing. The children then conduct their own trial and error investigations, reproducing what they learned about the properties of light, in order to build an art installation in a classroom. The investigation is ultimately an engineering challenge, based on models seen in the museum, rather than an investigation involving data collection. It was also unique among the six segments tested in featuring five student investigators rather than two.

Light and Color was third in the ranking of top three segments by all viewers, and 36% chose it as their top favorite. It was more popular among girls, almost half (47%) of whom chose it as their favorite. It was somewhat more popular among fourth graders than fifth graders. Fifty-three percent of all viewers expressed interest in pursuing a similar investigation because of its overall fun and ease, their enjoyment of science, and their love of art.

Viewers found this segment believable because it was motivated by an assignment, and they seemed to identify with the group of investigators. Responses about the investigation's purpose were nearly unanimous: it was to make an art project. Viewers accurately named the three properties of light explored and some noted specific things they learned, such as how the mixing of light is different than mixing pigments.

Sail On: This investigation was probably the most straightforward in design. Two boys who enjoy sailing wonder whose sailboat – a single-hulled lido or a catamaran – is faster. A science center exhibit allows them to design and race model boats, which they do, changing one variable at a time. In the final sequence they apply what they have learned to a race in real boats. They discover that while factors of hull and sail design predict one boat would win, another factor, maneuverability, ultimately decides the winner.

While this segment ranked fourth among the viewers' top and top three choices, viewers enjoyed it, especially the boys, who chose it as the second favorite both individually and among their top three. Forty-two percent of viewers said they would like to do this investigation either because they liked sailing or have never been and would like to go sailing.

Viewers described the investigation's purpose as determining which of the two sailboats was faster. Many were able to accurately articulate the different variables tested and/or to relate something about the relationship between weight, drag or sail area to speed, or between the boat's ability to turn and its speed. Viewers were neutral about the children in this investigation, but they expressed mixed feelings about the competition between them; some enjoyed it but others did not. Viewers were completely absorbed in following the boat races after each modification, and enjoyed watching each trial. They felt this story made sense and was realistic because the science center exhibit was set up to do the experimentation portrayed.

Dinosaur Dig: At a dinosaur exhibit, two girls learn about the dinosaurs and other animals that once lived in their region. They learn about microfossils and decide to see what kinds of fossils they can find. In a museum exhibit, they learn how scientists conduct paleontology fieldwork. They then gather microfossils at a remote dig site and bring them back to the lab for identification. Using a key provided by the museum, they identify their fossils. Their investigation reveals that many other creatures lived alongside the dinosaurs and they hypothesize about the co-existence of terrestrial and marine fossils.

Only a couple of viewers picked *Dinosaur Dig* as their favorite, and just under a quarter (23%) placed it among their top three segments. Differences by age or gender in this segment's appeal were negligible. Forty-one percent of the viewers expressed interest in conducting a similar investigation, explaining that they were interested in fossils or dinosaurs or enjoyed the process of finding fossils. The main reason viewers gave for a lack of interest in this investigation was not practical, as it was in many of the others, but that the topic did not interest them.

Viewers described this investigation as being about finding and identifying microfossils. Their responses included learning some very basic facts such as noting the existence of microfossils, learning about their general physical characteristics such as color and size, and learning that you need a microscope to see them or about how a datum pole works. Some noted that dinosaurs and fish fossils were found in the same place and talked about why this might be so. A few viewers said they enjoyed this segment because they enjoyed digging for things. Viewers did not like the brief profile of the girls that was inserted into the middle of the segment because it interrupted the flow of the investigation. Viewers were less enthusiastic about the children in this investigation, whom they described as not acting normally, not focused, and too enthusiastic.

Cactus: In *Cactus*, a young visitor asks two museum docents whether the nests birds build in Saguaro cacti all face in the same direction. The docents—a boy and a girl—go into the desert, looking for bird holes in several saguaro, and record the direction they face. The docents also observe local fauna and look for other clues about bird behavior. The docents report their findings back to the visitor, offering a hypothesis that the birds build nests on the sides of the cactus that are coolest.

This was one of the least favorite segments. Only a couple of viewers selected it as their favorite; however, 41% said they would enjoy participating in a similar activity. The most common reasons for this were a love of animals, enjoying the outdoors, and that the investigation seemed fun. Those who said they were not interested gave reasons such as not living near a desert or not liking the desert.

Viewers described this investigation simply as being about cactus and cactus holes or about finding which direction the holes were in. Responses about what viewers had learned were remarkably consistent in both content and choice of language; viewers learned the holes were on the north and west side of the cactus. Most viewers also explained why this was so in environmental terms. Although viewers were clear about what the investigators were observing and the results of their data collection, viewers found some details of the data collection confusing. The animals were a highlight of this segment and many viewers noted that they learned about wildlife in the desert. These investigators were also not appealing; the boy seemed "too old," and some viewers noted that the he mumbled and was hard to understand.

Characteristics and Features Impacting Learning

Analysis of children's responses to the segments and discussions between *DFTV* project principals and RMC Researchers led to further refinement of the key features and characteristics which may impact learning in Children's Science Television.[3] These features have been grouped in terms of: 1) Storytelling, and 2) Science Content, though recognizing that these features are typically interwoven in a single story.

Storytelling

DFTV inquiry segments feature real kids doing real science. In each segment, two or more children engage in an investigation which is shaped by their own interests and motivations. Segments vary in the context provided for the inquiry, the characters of the children, and other storytelling characteristics including visual appeal of segments and the dramatic arc that shapes

[3] The original characteristics used to select segments for study included inquiry content, inquiry design, interactivity, teamwork versus competition, background science content, accessibility of materials, character development and depth of the introduction to science centers.

their investigation. The table below (Figure 16) details the strengths and weakness of each segment and findings related to features of storytelling in the *DFTV* segments.

The conclusions of this analysis are presented in bulleted form below.

Story Set-Up

- Story set-up provides a means of establishing the relevance of science content.
- Stories involving familiar activities and situations were seen as more credible than others.

Dramatic Arc

- A clear progression of activities and final pay-off (in the form of a product or final test) contributed to segment strength.

Visual Appeal

- "Big action" footage such as the roller coaster was enjoyed by viewers. Also engaging were interesting visuals (such as in *Light and Color*) and animals. Sail boat races provided dramatic appeal.
- Cutting between locations was difficult for some viewers to follow.

Child Investigators

- Acting "naturally" and not overly enthusiastic or corny contributed to the appeal of characters.
- Investigators who stayed "on topic" and got along well with and cooperated with one another were more appealing than those who did not.
- Viewers were interested in finding out about the children featured on the show, but when those scenes were too disconnected from the thread of the inquiry, they were disruptive rather than informative.

Figure 16
Storytelling Features (by DFTV Segment)

FEATURES	Doghouse	Light and Color	Sailing	Roller Coaster	Dinosaur Dig	Cactus	Conclusion
Story Set-Up	Girls are interested in creating an air-conditioned house for their dog.	Science club members are given an art assignment.	Boys love to sail and are interested in which sailboat is faster.	Boys love speed and roller coasters and are interested in what part is most fun.	Girls are at the museum enjoying the exhibit and learning about dinosaurs.	Inquiry question is posed by a visitor. No context provided for how this question was formulated.	Story set-up provides a means of establishing the relevance of science content. Stories involving familiar activities and settings were seen as more credible than others.
Dramatic Arc	Challenge established at beginning of segment drives investigation. Climaxes with completion of dog house and presentation to neighborhood.	Challenge of creating art project established at beginning. Completed project provides pay-off.	Each model boat test builds understanding and culminates with final sailboat race. Races provide drama and observable tests.	Investigating roller coaster begins strong but some viewers confused by ending or found conclusion that personal opinion effects outcome disappointing.	Drama arises from museum visit; not highly compelling. Main questions presented very quickly. Children identify fossils of animals that lived alongside dinosaurs.	Investigators are challenged by another child's question. Pay-off of returning an answer is not high.	Clear progression and a final pay-off in the form of a completed project or test were positive attributes of segments. Sail boat races provided dramatic appeal.
Visual Appeal	Vicarious enjoyment of nurturing dog	Visually interesting colors and lights	Visual interest in sailboats and races.	Vicarious appeal of roller coaster and simulator. Editing style was distracting for some viewers.	Low excitement and appeal. Microfossil images had low appeal.	Desert animals provide appeal. However these are tangential to science investigation.	"Big action" footage (roller coaster), animals, aesthetically pleasing images (lights and colors) all added visual appeal. Cutting between locations was difficult for some viewers to follow.
Child Investigators	Child investigators appealing. Good, positive energy. Seen as among most credible.	Viewers enjoyed mixed group of investigators. Seen as among most credible.	Viewers neutral about characters. Mixed reviews of competition between the boys.	Viewers neutral about characters.	Least favorite child investigators, described as not "acting normally," not focused, and "too enthusiastic." Personal profiles seen as distracting.	Less appealing characters. Boy seen as too old and criticized for mumbling.	Acting "naturally" and not overly enthusiastic or corny contributed to the appeal of characters. Investigators who stayed "on topic" and got along well with and cooperated with one another were more appealing than those who did not. Viewers were interested in finding out about the children featured on the show, but when those scenes were too disconnected from the thread of the inquiry, they were disruptive rather than informative.

Science Content

In the ideal *DFTV* model, each investigation includes an inquiry question, hypothesis, data collection method, analysis and next question. Segments varied in both the clarity of these components and the emphasis placed on them. In addition, investigations involved different levels of conceptual complexity, steps of the investigation, and variables investigated. The table below (Figure 17) details the strengths and weakness of each segment and concludes with positive attributes as suggested by the data.

The conclusions of this analysis are presented in bulleted form below.

Inquiry Type

- Engineering segments were most appealing, while the observational segments were the least appealing

Topic

- Some topics may be inherently more appealing to children
- Less appealing topics may benefit from the incorporation of storytelling elements that appear in the most popular segments.
- More abstract topics require greater scaffolding of the science content to help viewers understand the relevance and significance of the inquiry

Integration of Story and Science Investigation

- Story set-up providing a hook for viewers should be closely intertwined with the science content.
- Significance of the investigation should be established as part of the set-up (prior to data collection) to drive investigation.

Clarity and Complexity of Science Content

- Richer science content may positively impact engagement.
- Underlying concepts should be clearly presented and paced to enhance understanding.
- Repetition of concepts, test results and investigator's observations through restatement provide greater clarity.
- Challenging ideas and content require sufficient screen time to handle them adequately.

Methodology and Data Collection

- Clarity and appeal of data collection may be improved by clear sequencing of individual variables, real-time investigator responses during data collection, and opportunities for direct observation by viewer.
- Extensive detail on data collection that is not tied to results or significance may detract from segment.
- Summary of results needs adequate emphasis to communicate the science.

Figure 17
Science Features (by DFTV Segment)

FEATURES	Doghouse	Light and Color	Sailing	Roller Coaster	Dinosaur Dig	Cactus	Conclusion
Inquiry Type	Engineering	Engineering	Experimental	Experimental	Observational	Observational	Engineering segments were most appealing; Observational least appealing.
Topic	Viewers related to the dog and the idea of taking care of the dog; many also said they liked building things.	Viewers related to the idea that child investigators were pursuing an assignment, and some said they liked art.	Some children said they liked sailing, but it did not provide as strong a hook as other topics.	Most viewers were excited by the roller coaster vicariously enjoyed the roller coaster rides.	Although a few viewers said they liked dinosaurs, digging or "archaeology", there was not a strong connection to this topic. Extensive time spent on gathering and sorting fossils was not engaging.	Viewers connected to the animals in the segment, but there was no strong connection to the investigation of bird behavior.	Some topics may be inherently more appealing to children More abstract topics require greater scaffolding of the science content to help viewers understand the relevance and significance of the inquiry
Integration Of Story and Science Investigation	Engineering challenge provides framework for motivating investigation of heat and color, and of evaporative cooling.	Engineering challenge (art project) motivates exploration of properties of light (bending, mixing, refracting).	Love for sailing and friendly competition leads to questions about the impact of boat design (hull area, sail size and weight) on sailboat speed and on turnage.	Love for speed and roller coasters leads to questions about what makes them fun. Speed, direction, and acceleration are considered and "g's" used as unit of measure	Interest in local dinosaurs leads to search for microfossils. Segment addresses coexistence of dinosaurs and sea creatures as suggested by fossil record, only weakly established.	Visitors' question leads to exploration of direction of bird holes. Significance of data collection (relationship of data collection to environment) is not explored until the conclusion of the segment.	Story set-up providing hook for viewers should be closely intertwined with the science content. Significance of the investigation should be established as part of the set-up (prior to data collection) to drive investigation.

(continued on next page)

Figure 17 (continued)
Science Features (by DFTV Segment)

FEATURES	Doghouse	Light and Color	Sailing	Roller Coaster	Dinosaur Dig	Cactus	Conclusion
Clarity and Complexity of Science Content	Effect of color on temperature clearly explained and reinforced; details of swamp cooler presented quickly, but clearly. Understanding of latter did not impact satisfaction in seeing completed doghouse.	Three properties of light explained and explored. Some confusion, but the names of the properties were reinforced, adding to the clarity.	Investigation of sailboat speed examined in terms of three variables, very clearly presented	Most advanced content, includes investigation of three variables, with complex relationship to unit of measure "g", not always clear	Very basic science content presented. Learning characterized by simplistic statements about microfossils	Basic science content presented. Learning characterized by simple statements of observation results, i.e. direction of bird holes	Richer science content may positively impact engagement. Underlying concepts should be clearly presented. Repetition of concepts, test results and investigator's observations through restatement provide greater clarity. Challenging ideas and content require sufficient screen time to handle them adequately.
Methodology and Data Collection	Very clear sequencing of activities. Data collection easy to follow and results of tests in museum reinforced through mini-story	Clear sequencing of investigation of three properties of light. Viewers can assess for themselves outcomes of tests, e.g. mixing light to create colored shadows.	Sequential exploration of different characteristics of boats, each tested and easily observed by viewers.	Multiple variables tested in quick succession without opportunity to reflect from one test/part of roller coaster to the next.	Much of the segment spent preparing for and visiting dig site. Brief analysis at end did not emphasize correlations between micro and macro fossils.	Generally clear data collection process which is repeated with little variation. Data analysis was left until after all observations had been made.	Clarity and appeal of data collection may be improved by clear sequencing of individual variables, real-time investigator responses during data collection, and opportunities for direct observation by viewer. Extensive detail on data collection that is not tied to results or significance may detract from segment. Summary of results needs adequate emphasis to communicate the science.

Attitudes about Science Centers and Science Projects

The children participants in this study held positive attitudes towards science centers and museums and viewing *DragonflyTV* did not significantly change their attitudes. The most striking change was an increased number of children who indicated an interest in bringing friends along on their next trip to a science museum. This may be a direct response to having pairs of children – friends – working together on investigations modeled in the television episodes. Viewers also indicated an increase in seeing science centers as geared to younger children. Small increases were seen in how they viewed upcoming science center visits, with the greatest changes in seeing science centers as places to "get help with a question" and "have fun."

Attitudes towards the use and value of science center information also remained largely constant, with the exception of an increased perception of the value of science for art projects. Small increases were seen in the selection of a wide range of descriptions for science projects including both "easy" and "confusing;" "more for older kids," "more for younger kids" and "for kids my age;" and can be done "outside of school," "indoors," and "outdoors," and in seeing them as "fun"

Students were generally positive about replicating the science investigations they saw modeled on television. Reasons for wanting to replicate a particular activity were generally related to a specific interest in or enjoyment of a topic or activity. Obstacles given for not pursuing such projects at home were often related to a lack of materials or to a lack of permission from parents.

Conclusion

The *DFTV Going Places in Science* Child Study suggests several key factors that contribute to a successful *DFTV* segment. Chief is the construction of the inquiry, including framing an inquiry within a relevant and clear question and presenting that inquiry through a clear sequencing of individual variables. *DFTV* commits to presenting the details of such full inquiries, incorporating basic vocabulary and scientific concepts in a consistently fast-paced, music-driven style. Viewers in the study were consistently attentive to the segments, and were able to repeat the content for all of the segments tested, even those that viewers later identified as less appealing or of less relevance.

The study demonstrated that several factors can heighten the appeal of segments. These included learning that more abstract science concepts and less-familiar environments can benefit from additional scaffolding so that viewers can relate the new information to what they already know. Where the content is less familiar, the segments may improve with a more generous explanation of the "why" in addition to the "how" of the inquiry. Other factors that can enhance a segment's appeal include a dramatic story arc, opportunities to observe experiments as they unfold or to observe unfamiliar phenomena such as animals, and a likeable group of child investigators who interact well with each other.

Appendices

Appendix A: Segments Characteristics and Grid

Segment Analysis

Segment Characteristics Grid

DragonflyTV Child Study
Potential Characteristics of Successful Science TV

Introduction

DragonflyTV Going Places in Science was developed with two science education goals in mind. The first goal addresses increasing children's interest in and ability to conduct scientific inquiries. The second goal is to present science centers as a destination for children.

The Child Study component of the DFTV-GPS Summative Evaluation focuses on identifying key characteristics of a segment that a) encourage replication or extension of an inquiry, and b) increase a child's interest in visiting a science center.

These questions will be addressed through two phases of study. In the first phase, a textual analysis of segments was conducted to identify potential characteristics of successful science television. In the second phase, these characteristics will be tested with children to better understanding their importance from the perspective of the end-user. The information below presents results of this first phase.

Segment Analysis

The Segment Analysis phase of the DragonflyTV Child Study focused on identifying a set of characteristics of the segments which may contribute to a story's success. Characteristics were identified through textual analysis of the video segments and transcripts. Each characteristic is described below, with bullets explaining the variations of this characteristic as found in different segments. Selected segments are listed as examples of the characteristic variations.

1. Inquiry Content

Do certain content areas afford greater appeal than others to children; or do different children relate to different topics? Are the questions posed by the children relevant to viewers?

- speed or sport, e.g. *Rollercoaster, Sail On, Ice Scream*
- natural history/wonder about environment, e.g. *Bogged Down, Something Fishy, Biodiversity, Earthquakes*
- practical, found in *In the Doghouse*
- artistic, in *Light and Color*

2. Inquiry Design

Does the kind of investigation have an impact on children's interest level and on their perceptions of learning science? Do children learn more from one kind of inquiry than another?

- Experimental/Trial and Error investigations, including *Roller Coaster, Batter Up!, Sail On, Pump Up the Volume, Ice Scream, In the Doghouse, Light and Color*
- Observational inquiries, including *Bogged Down , Dino-Mite!, Something Fishy, The Nose Knows, Biodiversity, Home Prickly Home, Quake Zones*

3. Interactivity

Does the type of interactivity depicted on screen have an impact on the appeal of the segment? Does the familiarity of the activity matter? Note that a single segment may include more than one kind of interactivity.

- physically demanding activities and/or whole body play such as the inquiries emerging from a sport in *Ice Scream, Rollercoaster,* and *Batter Up!*
- senses of smell and touch such as *Bogged Down* and *The Nose Knows*
- emotive elements such as *In the Doghouse*
- sound is strong in *Pump Up the Volume*
- visual wonder or is a component of the field work and observational pieces such as *Home Prickly Home, Biodiversity,* and *Something Fishy*; and also of *Light and Color*.

4. Teamwork vs. Competition

Does the relationship of the children to each other in the context of the inquiry have an impact on the appeal or level of engagement?

- In most of the segments, two or more children work as a team, e.g. *Light and Color, Quake Zones* and most others
- In a few segments, children either take different positions, or are competitive with one another. These include selecting different sections of a roller coaster ride to test (*Roller Coaster*); preferences for different bats or sailboats (*Batter Up!, Sail On*). In the latter cases, the preferences result in a competitive element to the children's relationships and to the investigation.
- The mentoring relationship of docents and younger child is another variation on children's relationships and is a feature of *Home Prickly Home*.

5. Source and Accessibility of Background Science Content

Does revealing the source of background information and/or the accessibility of such information have an impact on children's perceptions of their ability to replicate and/or create their own inquiries?

- One of the key ideas of DFTV is that children lead the investigation, and the presence of adults and information provided is largely erased. Is this believable?
- Information provided by the host, e.g. *Roller Coaster*
- is read by children off museum panels, *Dinosaur, Pump Up the Volume, In the Doghouse, Quake Zones*
- is presented as information the child already knows, *Bogged Down , Sail On,*
- children as docents, *Home Prickly Home*

6. Accessibility of Materials

Does the accessibility of materials used in the inquiry impact children's desire to conduct their own inquiries or suggest barriers to doing so?

- Use of tools, such as the accelerometer, e.g. *Roller Coaster*
- Availability of materials for the experiment, e.g. *In the Doghouse, Pump Up the Volume*
- Accessibility of activities such as *Ice Scream*
- Familiarity of environment, e.g. *Home Prickly Home*

7. Character Development

Does development of the children's characters, either as related directly to the science inquiry, or in other areas, add to the appeal and engagement of viewers? Does the depth of involvement children have in an activity or content area impact the believability or interest of the segment?

- Children have strong commitment to the activity, and their relationship to it is developed, *Ice Scream, Sail On, Pump Up the Volume*
- development of children's other interests e.g. *Dino-Mite!, Biodiversity, In the Doghouse*

8. Introduction to Science Centers

Does how the science center is introduced and the kinds of activities portrayed matter in the perception of the value of the science center and whether children would want to visit?

- Includes kids' narrative on value and meaning of science center, *Biodiversity*
- Visit to museum driven by need, *In the Doghouse*

Segment Characteristics

Science Center, Story	Inquiry Question, Relevance to Kids; Development of Inquiry	Level of Activity; Active, Hands-on; Engagement of senses	comparative or competitive component vs. cooperation	Experimental vs. Observational	Accessibility of materials:	Accessibility of background information and science concepts	Real Children; Length of background profiles; authenticity of kids; gender and #	Museum Intro and Depiction	Other
501: Carnegie Science Center: *Roller Coaster Design*	What's the easiest way for a kid to go really, really fast? What's the most exciting part of the ride? Brainstrorm.How do we measure change in direction and/or speed? Accelerometer. They never actually say that they are going to measure G's.	High level of energy and engagement. Riding rollercoasters.	Each boy selects favorite parts of the roller coaster. Not different hypotheses.	Experimental and quantitative: Measure G's on roller coaster at different points of the ride;	Roller coaster, accelerometer (you can make one yourself); Described by host.	Concept of "G" ; Complicated, multistep inquiry. How clear is dev't from measuring G's to "it's not about the big G's, its about changes in speed and direction?	2 boys; 39 sec intro focused entirely on speed and roller coasters	Exhibits where you test your performance… Then use simulator to measure Gs.	
501: Carnegie Museum of Science and History: *Bogged Down*	Girls describe bog and peat moss. Bogs preserve things from the past. What is and isn't preserved?	Slogging around in bogs.	No differences in girls attitudes shown.	Brief experiment about absorption of moss and dirt. Main inquiry is experimental and qualitative. Look at items buried in three different sites, at two points in time.		Girls provide background info about bogs, preservation and how sphagnum moss absorbs water. And not just water, but also anaerobic environment and moss as natural antibiotic.	2 girls; 8 second intro; then girls explain what a Bog is.	Visit Bog exhibit and brainstorm about why and what is preserved.	
502: Science Place *Batter Up!*	Very simple: where is the sweet spot? Test different spots and calculated distance. Essentially did the same experiment twice - once in museum and once on baseball field	Hitting baseballs	Different preferences for wooden and aluminum bats.	experimental and quantitative: Measure distance ball travels with different bats, and sweet spot and not.	baseball bat and measure	thin content: host explains that the bat vibrates; less vibration at sweet spot	2 boys; 17 second intro; "we both like to play sports…"	Exhibit lets you test different bats and see which point hits the ball the furthest. Used the exhibit in the main investigation.	
502: Fort Worth *Dino-Mite!*	Not clear what the question is. What is it like to do paleontological fieldwork? What kinds of fossils are there? Identifying fossils.	digging, filtering soil,	work together	replicating field work process and identifying fossils; quantifying aquatic fossils and hyphothesizing about environmental changes that would result in both dino and aquatic fossils in one place	electron microscope	Kids explain: datum and field work; and that "fossils are bones and stuff from millions of years ago that were covered up by earth and dirt, and then..sort of turned into rock. Microfossils… Clear that some of this is being read.	Randy and Ashley (2 girls) introduce themselves in context of exhibit; they often sound like they are reading; they describe each others' personalities and dancing partway through segment	Learn about field work through exhibit. Museum has things for measuring…	
503: Aquarium of the Pacific *Something Fishy: California Fish*	Have seen different kinds of mouths; wonder if fish in the bay also have different kinds of mouths; then ask how fish eat (food above, below, or right in front) and if correlation with mouth type	going out on boat and leaving traps	work together	observational; quantifying sample and charted fish collected and mouth direction	go out on boat; snorkeling in fish tank	pretty accessible, 3 kinds of fish and mouths; boat crew helped us identify different kinds of fish; leap in story from direction of mouth to diversity as means of reducing competition between species	Milan and Harison (2 girls)	Girls walking around aquarium, looking at fish, imitating, ray tank and feeding rays	
503:California Science Center *Sail On: Sailboat Design*	Starts right off with question and competing hypotheses. Who will win? Who is faster, who turns more efficiently?; Then says, 'we got the idea for our race from the CSC…."	first test sailing with model boats in science center; then repeat modified experiment with real boats	Catamaran versus lido	Experimental: first trial and error designing boats with different hulls and sails and weights and drag; racing and measuring time	building models is accessible; concepts and measures accessible	kids introduce the background info like what is drag; feels authentic in their own words	Brian and Max: Starts out with boys sailing and into themselves;	Got idea for the race at the CSC" leads into SC sequence. Show's very different, active segments. Then lab for different sailboats…	
504: SMM *Pump Up the Volume: Music and Sound*	Experience of diverse music in film. Play their own music. Then, questions about why some things made low pitched sounds and others high pitched.	playing with science center experiment gallery	work together	Experimental; learn longer tube makes lower pitch, length determines pitch; material and diameter don't matter	tubes in the garage	Science center experiment gallery has basics of experiment and breaks down vibration, tube length and sound.	Maxine and Hannah; shows them playing music, talk about when they started.	Open with Maxine and Hannah have just seen Stomp. Clips from film. Then go to SMM Experiment gallery.	initial question stated, about why some things high and others make low pitch is not answered by the experiment; The experiment is about the different materials and diameters of the tubes; the question is answered by the exhibit and length of the tubes

Segment Characteristics

Science Center, Story	Inquiry Question, Relevance to Kids; Development of Inquiry	Level of Activity; Active, Hands-on; Engagement of senses	comparative or competitive component vs. cooperation	Experimental vs. Observational	Accessibility of materials:	Accessibility of background information and science concepts	Real Children; Length of background profiles; authenticity of kids; gender and #	Museum Intro and Depiction	Other
504: Bakken Museum ***Body Electricity***	Wanted to find out about how prosthetic arm works.	Shows kids playing with different exhibits.	focus on Riley, but with friend	Experimental	science center exhibit focused				
504: Minn Zoo ***The Nose Knows: Animal Scent***	Couldn't agree on what's most important about how animals use smells	interact with exhibit, then test smells on their favorite animals (wolf and lions)	disagree	Observing animal behavior and comparing two animals; codifying responses in terms of what they learned at the exhibit	(could replicate with housepets)	learned from exhibit that animals use scent for recognizing each other, marking where they live; but for interpretation of their results they bring in various info e.g. about alpha male lion, that comes out of nowhere	Nick and Paige - like gross things	Open with kids plahying in the Animal Grossology exhibit	
505: NY Hall of Science ***Ice Scream: Luge***	Arises directly out of kids sport experiences	high level of activity both in depiciton in science center and doing luge	cooperate	How pushes effect speed. Do measurements at NY Hall of Science. Repeat experiment on luge track.		very thin explanation of why differences in speed; mention of gravity, friction, but not well discussed	Kids introduce themselves and ask "Guess what our favorite activity is?" so science is intro'd through them: intro of kids is right at top; they introduce luging and then more about themselves; their interest drives them to the NY Hall of Science	girls interacting with big motion exhibits; then in playground trying slides. Cut back and forth between luge and slids.	
505: Bronx Zoo ***Biodiversity***	where animals live and adaptation	Moving around zoo; visually interesting; they dance around.	cooperate	Observe and code observations; where animals live in terms of layers of rainforest. Draw map and put animals in and see how they have adapted to it. Kids discussing observations		Kids explain different layers of the rainforest. Doesn't sound like they are reading. Not clear where they learned information about the different animals.	See Jessica and Stanley looking through binoculars; their names in graphics on screen (don't introduce themselves); then J starts talking about loving animals and you see her with animals in different places; boy says it too; Then he introduces the Bronx Zoo. Later on Stanley says he has just moved to NYC, so Jessica plays tour guide. Later they talk about which animals they liked.	Boy says "I love the Bronx Zoo because they have so many animals you don't usually get to see. Then he says how many times he has gone.	
506: AZ Sci Center ***In the Doghouse: Doghouse Design***	Dog needs house with air conditioning. How can they do it?	Use exhibit to learn about temperature and light/dark colored houses;	build it together	experiment with exhibit and colored houses; then temperatures of dog house with and without cooler	diverse materials pulled out of garage	host explains that dark colors absorb heat; Use museum exhibit to look at cooler and model for what they will build	Alex and Anna introduce themselves and their dog Rupert. They like biking, making up songs, (see them playing piano), watching movies, talking… Describe Rupert.	Realize they need to do research for their dog home makeover, which is what takes them to AZ Science Center. Then see edits of them checking out exhibits.	take off on home makeovers; very cute b&w film using stuffed animal reinforces idea of dark and light houses
506: AZ-Sonora Desert ***Home Prickly Home: Cactus***	esoteric; but a younger child asks questions of the older kids (docents); Are the holes in the saguaros always on the same side?	walking thorugh envirnoment	investigate together	field work; gathering descriptive data; recording direction of holes	compass	The kids are museum docents so they know a lot about the environment. Though at times they sound like they are reading, or you wonder where the info comes from.	Host introduces the two kids as docents; mock western with the two kids; girl and boy; Mark and Alex: Lots about the environment and why they like it; nothing about their relationship	The kids introduce the museum as the best place to learn about the desert. And then they give tour of the animals, etc.	
507: Lawrence Hall of Science ***Quake Zones: Earthquakes***	We wondered what causes earthquakes. Museum has outdoor exhibits that show what happens in an earthquake.	walking around the city measuring slip strike along two faults	investigate together	field work; measuring slip strikeand compare data	walking around city; measure with tape measure	Girls provide definitions of earthquake etc; sound like they are reading; Later girls provide more explanation that is clearly tied to musuem; at other places obviously being fed lines	Claire and Nisha introduce themselves; "we live in the san francisco bay area"; one girl says, did you know that the highway collapsed here?	Girls go to Hall of Science to learn about earthquakes; playing with exhibits	
507: Exploratorium ***Light and color***	Challenge to make an art project using no paint.	playing in exhibits	team work	figure out how to make a purple light; lots of trial and error	lights, prisms, etc	one kid mentions light; kids explin light concepts, but they don't really explain; said they learned a lot of stuff at the museum (bounce, bend, mix light)	kids introduce themselves; they all met in science club; some express liking science and or art. Later one girl talks about the traits of others.		

Characteristics of Segments Selected for Study

Science Center, Story	Inquiry Question, Relevance to Kids; Development of Inquiry	Experimental vs. Observational	Complexity of Inquiry	Level of Activity	comparative or competitive vs. cooperation	Unusual materials	source and accessibility of science background/content	Real Children; Length of background profiles; authenticity of kids; gender and #	Museum Intro and Depiction	Other
503:California Science Center *Sail On: Sailboat Design*	Yes, emerges from kids' experiences: Which boat goes faster?	experimental; multiple step trial and error designing boats	builds from trial and error in museum	physical activity	competitive - catamaran vs. lido	sailing - elite activity	kids introduce background info; feels authentic in their own words	2 boys; love sailing		
506: AZ Sci Center *In the Doghouse: Doghouse Design*	Yes, emerges from kids' experiences; practical: How can I air condition the dog house?	experimental;	exhibit and at home offer different stages	affect - pet	cooperative	materials in garage	host explains dark colors absorb heat; museum exhibit provides model for invention	2 girls and dog; introduce themselves and other interests		take off on reality show; also sequence with stuffed dog
506: AZ-Sonora Desert *Home Prickly Home: Cactus*	very esoteric; but motif of child asking other children; Are all the holes on the same sides of the cactus, and why? Why would you want to know this?	field work; descriptive data is quantified	gather data on position of holes; unclear where explanatory info comes from	visual - exotic plants and animals	cooperative	compass	Kids are museum docents, though at times they sound like they are reading	girl and boy docents; nothing about their relationship		
507: Exploratorium *Light and color*	challenge by teacher; invention	trial and error; invention	3 properties of light; don't build together	visual - aesthetic	cooperative	lights, prisms	kids explain light concepts	group of kids in science club		
501: Carnegie Science Center: *Roller Coaster Design*	Yes, emerges from kids' experiences	experimental and quantitative	complicated, multistep inquiry from speed to acceleration to changes in speed and direction	physical activity	competitive - each boy selects favorite parts of the roller coaster	build your own accelerometer	Concept of Gs introduced by host	2 boys; interest in roller coaster	exhibit where you test your performance	
502: Fort Worth Dino-Mite!: *Dinosaurs*	never clear what the inquiry is -- what kinds of animals lived with the dinosaurs?	replicating field work process; identifying fossils; quantifying and hypothesizing about environmental change		visual interest - scale; field work experience	cooperative	microscopes	kids explain key ideas; clear that it is being read	2 girls; intro touches on personalities; dancing		

Appendix B: Instruments

Pre- and Post-Viewing Surveys
Segment Surveys
Focus Group Questions

DragonflyTV Pre-Viewing Survey

Your name _____

Grade (Circle One): **4th 5th** Gender (Circle One): **female male**

For each question below, select ALL the answers that apply.

1. **Circle ALL** the words you associate with science museums.

Fun	**Boring**	**Crowded**
Noisy	**Interesting**	**Exciting**
Learning	**Confusing**	**Surprising**

2. **Circle ONE** number for each question to show how useful you think the information you learn in a science museum is for the different parts of your life.

	Very Useful	**Useful**	**A little bit useful**	**Not Useful**
a. in school?	**4**	**3**	**2**	**1**
b. at home?	**4**	**3**	**2**	**1**
c. sports?	**4**	**3**	**2**	**1**
d. arts activities?	**4**	**3**	**2**	**1**
e. in a science fair project?	**4**	**3**	**2**	**1**

3. **Circle ALL** of the groups of people you would like to go with on a visit to a science center.

My family	**My best friend**
A group of friends	**My class**

4. **Circle ALL** of the ages of people you think science centers are for.

older children	**younger children**	**adults**
kids my age	**others in my family**	

5. **Circle ONE** number to show how exciting you think your next visit to your local science museum will be.

Very exciting	Exciting	A little bit exciting	Not exciting
4	**3**	**2**	**1**

6. **Circle ALL** of the things you look forward to most about your next visit to a science museum.

   I can get some help answering a question I have.

   It will be fun.

   I can learn new things.

   I can meet people who can help me answer questions.

   I'll see things I've never seen before.

   Other:

   _____

   _____

7. **Circle ALL** of the words that describe doing a science experiment or a science project.

Can be done alone	**Can be done with friends**
Fun	**Easy**
Hard	**Confusing**
Boring	**More for older kids**
More for younger kids	**For kids my age**
Need materials I don't have	**Can be done outside of school**
Can be done outdoors	**Can be done indoors**

8. **Circle YES or NO:** Have you ever seen DragonflyTV on your public television station before? **yes** **no**

THANK YOU FOR YOUR HELP!

DragonflyTV Post-Viewing Survey

Your name _____

Grade (Circle One): **4th 5th** Gender (Circle One): **female male**

1. **Circle ALL** the words you associate with science museums.

Fun	**Boring**	**Crowded**
Noisy	**Interesting**	**Exciting**
Learning	**Confusing**	**Surprising**

2. **Circle ONE** number for each question to show how useful you think the information you learn in a science museum is for the different parts of your life.

	Very Useful	**Useful**	**A little bit useful**	**Not Useful**
a. in school?	**4**	**3**	**2**	**1**
b. at home?	**4**	**3**	**2**	**1**
c. sports?	**4**	**3**	**2**	**1**
d. arts activities?	**4**	**3**	**2**	**1**
e. in a science fair project?	**4**	**3**	**2**	**1**

3. **Circle ALL** of the groups of people you would like to go with on a visit to a science center.

My family	**My best friend**
A group of friends	**My class**

4. **Circle ALL** of the ages of people you think science centers are for.

older children	**younger children**	**adults**
kids my age	**others in my family**	

5. **Circle ONE** number to show how exciting you think your next visit to your local science museum will be.

Very exciting	Exciting	A little bit exciting	Not exciting
4	**3**	**2**	**1**

6. **Circle ALL** of the things you look forward to most about your next visit to a science museum.

I can get some help answering a question I have.

It will be fun.

I can learn new things.

I can meet people who can help me answer questions.

I'll see things I've never seen before.

Other: _____

_____

7. **Circle ALL** of the words that describe doing a science experiment or a science project.

Can be done alone	**Can be done with friends**
Fun	**Easy**
Hard	**Confusing**
Boring	**More for older kids**
More for younger kids	**For kids my age**
Need materials I don't have	**Can be done outside of school**
Can be done outdoors	**Can be done indoors**

8. **Label each story with a number from 1 to 6.** Place a number 1 next to the story you liked the MOST, a number 2 to the story that was your second favorite, down to 6 for the story you liked the LEAST.

___ Cactus/Home Prickly Home	**____ Rollercoaster**
___ In the Doghouse	**____ Dinosaur Dig**
___ Sail On/Sailing	**____ Light and Color**

THANK YOU FOR YOUR HELP!

Segment Survey

Name:_____ **Grade:_____**
Circle the story you are viewing.

In the Doghouse	**Sailing**
Rollercoaster	**Dinosaur Dig**
Cactus/Home Prickly Home	**Light and Color**

1. What was this investigation about?

2. What did you learn from the investigation?

3. Could you see yourself doing an investigation like this? Why or why not?

Focus Group Discussion Questions

Have students relate their answers to ALL three segments screened that day.

1. What did you like most about the stories you just watched?

2. What did you like least about the stories you just watched?

3. Did you have a favorite story? Why was this one your favorite?

4. Did you like the kids in the shows?
   - Which kids did you like the most? Why?

   - Which kids did you like the least? Why?

5. Did you believe the kids would really do all the activities shown in the shows?

6. Which story did you learn the most from? Why?
   - Which story did you learn the *most science* from? Why?

7. Did you find any of the stories confusing? Which ones and why?

8. If you went to a science museum, would you like to do similar things to what the kids in the show were doing?
   - What would you most like to do?

9. Do you think you would do any of the things they did outside of the museum?
   - What might prevent you from trying one of these project or experiments on your own?

10. Do you think if you went to a science museum, you would try something you learned at home? *[Facilitators, please note if trying a science project at home that is inspired by a museum visit seems to be a new idea for the children.]*

Appendix C: Quantitative Data

I. DragonflyTV Pre-Viewing and Post-Viewing Survey Data

1. Circle ALL the words you associate with science museums.

Question 1a – Fun

	Pre-Survey			Post-Survey		
	n	frequency	%	n	frequency	%
All	143	96	65.8%	146	109	74.7%
Female	69	49	71%	69	52	75.4%
Male	74	47	63.5%	77	57	74.0%
4th Grade	67	40	59.7%	69	47	68.1%
5th Grade	72	52	72.2%	73	60	82.2%

Question 1b – Noisy

	Pre-Survey			Post-Survey		
	n	frequency	%	n	frequency	%
All	143	36	24.7%	146	49	33.6%
Female	69	14	20.3%	69	24	34.8%
Male	74	22	29.7%	77	25	32.5%
4th Grade	67	14	20.9%	69	20	29.0%
5th Grade	72	21	29.2%	73	27	37.0%

Question 1c– Learning

	Pre-Survey			Post-Survey		
	n	frequency	%	n	frequency	%
All	143	93	63.7%	146	99	67.8%
Female	69	53	76.8%	69	53	76.8%
Male	74	40	54.1%	77	46	59.7%
4th Grade	67	36	53.7%	69	44	63.8%
5th Grade	72	53	73.6%	73	53	72.6%

Question 1d – Boring

	Pre-Survey			Post-Survey		
	n	frequency	%	n	frequency	%
All	143	22	15.1	146	36	24.7%
Female	69	12	17.4%	69	15	21.7%
Male	74	10	13.5%	77	21	27.3%
4th Grade	67	13	19.4%	69	20	29.0%
5th Grade	72	9	12.5%	73	15	20.5%

Question 1e – Interesting

	Pre-Survey			Post-Survey		
	n	frequency	%	n	frequency	%
All	143	122	83.6%	146	117	80.1%
Female	69	62	89.9%	69	65	94.2%
Male	74	60	81.1%	77	52	67.5%
4th Grade	67	54	80.6%	69	52	75.4%
5th Grade	72	64	88.9%	73	63	86.3%

Question 1f – Confusing

	Pre-Survey			Post-Survey		
	n	frequency	%	n	frequency	%
All	143	25	17.1%	146	38	26.0%
Female	69	12	17.4%	69	19	27.5%
Male	74	13	17.6%	77	19	24.7%
4th Grade	67	11	16.4%	69	12	17.4%
5th Grade	72	14	19.4%	73	25	34.2%

Question 1g – Crowded

	Pre-Survey			Post-Survey		
	n	frequency	%	n	frequency	%
All	143	66	45.2%	146	70	47.9%
Female	69	33	47.8%	69	30	43.5%
Male	74	33	44.6%	77	40	51.9%
4th Grade	67	24	35.8%	69	31	44.9%
5th Grade	72	39	54.2%	73	37	50.7%

Question 1h – Exciting

	Pre-survey			Post-survey		
	n	frequency	%	n	frequency	%
All	143	83	56.8%	146	88	60.3%
Female	69	46	66.7%	69	48	69.6%
Male	74	37	50.0%	77	40	51.9%
4th Grade	67	36	53.7%	69	37	53.6%
5th Grade	72	43	59.7%	73	49	67.1%

Question 1i – Surprising

	Pre-Survey			Post-Survey		
	n	frequency	%	n	frequency	%
All	143	59	40.4	146	74	50.7%
Female	69	33	47.8%	69	39	56.5%
Male	74	26	35.1%	77	35	45.5%
4th Grade	67	22	32.8%	69	29	42.0%
5th Grade	72	36	50.0%	73	43	58.9%

2. Circle ONE number for each question to show how useful you think the information you learn in a science museum is for the different parts of your life.

2a – Usefulness of Information
Overall Pre & Post Survey

	Pre-Survey			Post-Survey		
	n	mean	sd	n	mean	sd
School	143	3.17	.754	146	3.06	.911
Home	142	2.30	.883	145	2.31	.947
Sports	140	1.85	1.052	145	1.76	.945
Arts Activities	142	2.43	.926	143	2.54	.910
Science Fair	141	3.60	.845	142	3.62	.779

2b – Usefulness of Information
Gender Pre & Post Survey

	Female						Male					
	Pre-Survey			Post-Survey			Pre-Survey			Post-Survey		
	n	mean	sd	n	mean	sd	n	mean	sd	n	mean	sd
School	70	3.39	.621	69	3.22	.820	73	2.97	.816	77	2.92	.970
Home	69	2.46	.778	68	2.44	.870	73	2.15	.953	77	2.19	1.001
Sports	68	1.84.	1.031	68	1.87	.976	72	1.86	1.079	77	1.66	.912
Arts Activities	69	2.48	.917	67	2.82	.815	73	2.38	.937	76	2.29	.921
Science Fair	67	3.75	.612	66	3.76	.609	74	3.46	.996	76	3.50	.887

2c – Usefulness of Information
Grade Pre & Post Survey

	4th Grade						5th Grade					
	Pre-Survey			Post-Survey			Pre-Survey			Post-Survey		
	n	mean	sd	n	mean	sd	n	mean	sd	n	mean	sd
School	70	3.11	.753	69	3.01	.899	70	3.21	.759	73	3.11	.906
Home	70	2.23	.920	69	2.25	1.035	69	2.36	.840	72	2.38	.846
Sports	68	1.81	1.011	69	1.67	.902	69	1.88	1.078	72	1.89	.987
Arts Activities	70	2.43	.941	68	2.50	.855	69	2.43	.915	71	2.56	.952
Science Fair	70	3.54	.928	69	3.65	.764	68	3.65	.768	69	3.61	.752

3. Circle ALL of the groups of people you would like to go with on a visit to a science center.

3a - Family

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	144	98	67.1%	146	98	67.1%
Female	70	48	68.6%	69	49	71.0%
Male	74	50	67.6%	77	49	63.6%
4th Grade	70	44	62.9%	69	48	69.6%
5th Grade	70	50	71.4%	73	48	65.8%

3b – Friends

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	144	101	69.2%	146	112	76.7%
Female	70	56	80.0%	69	57	82.6%
Male	74	45	60.8%	77	55	71.4%
4th Grade	70	44	62.9%	69	52	75.4%
5th Grade	70	55	78.6%	73	56	76.7%

3c – Best Friend

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	144	83	56.8%	146	108	74.0%
Female	70	48	68.6%	69	55	79.7%
Male	74	35	47.3%	77	53	68.8%
4th Grade	70	32	45.7%	69	43	62.3%
5th Grade	70	47	67.1%	73	61	83.6%

3d – Class

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequenc	%
All	144	50	34.2%	146	58	39.7%
Female	70	24	34.3%	69	27	39.1%
Male	74	26	35.1%	77	31	40.3%
4th Grade	70	22	31.4%	69	22	31.9%
5th Grade	70	25	35.7%	73	34	46.6%

4. Circle ALL of the ages of people you think science centers are for.

4a – Older Children

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	143	111	76.0%	146	118	80.8%
Female	69	57	82.6%	69	59	85.5%
Male	74	54	73.0%	77	59	76.6%
4th Grade	69	54	78.3%	69	56	81.2%
5th Grade	70	54	77.1%	73	59	80.8%

4b – Kids My Age

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	143	128	87.7%	146	129	88.4%
Female	69	64	92.8%	69	62	89.9%
Male	74	64	86.5%	77	67	87.0%
4th Grade	69	63	91.3%	69	61	88.4%
5th Grade	70	61	87.1%	73	65	89.0%

4c – Younger Children

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	143	72	49.3%	146	87	59.6%
Female	69	40	58.0%	69	44	63.8%
Male	74	32	43.2%	77	43	55.8%
4th Grade	69	36	52.2%	69	38	55.1%
5th Grade	70	34	48.6%	73	47	64.4%

4d – Others in My Family

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	143	82	56.2%	146	88	60.3%
Female	69	43	62.3%	69	47	68.1%
Male	74	39	52.7%	77	41	53.2%
4th Grade	69	34	49.3%	69	35	50.7%
5th Grade	70	46	65.7%	73	50	68.5%

4e – Adults

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	143	104	71.2%	146	106	72.6%
Female	69	52	75.4%	69	53	76.8%
Male	74	52	70.3%	77	53	68.8%
4th Grade	69	50	72.5%	69	51	73.9%
5th Grade	70	52	74.3%	73	53	72.6%

5. Circle ONE number to show how exciting you think your next visit to your local science museum will be.

	Pre-Survey			Post-Survey		
	n	mean	sd	n	mean	sd
All	145	2.93	.742	146	2.89	.895
Female	69	3.00	.748	69	3.14	.809
Male	76	2.87	.737	77	2.66	.912
4th Grade	70	2.90	.705	69	2.80	.901
5th Grade	71	2.93	.781	73	2.97	.866

6. Circle ALL of the things you look forward to most about your next visit to a science museum.

6a – Help

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	43	29.5%	146	54	37.0%
Female	69	19	27.5%	69	21	30.4%
Male	76	24	31.6%	77	33	42.9%
4th Grade	69	21	30.4%	69	27	39.1%
5th Grade	72	20	27.8%	73	26	35.6%

6b – Fun

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	92	63.0%	146	103	70.5%
Female	69	47	68.1%	69	50	72.5%
Male	76	45	59.2%	77	53	68.8%
4th Grade	69	40	58.0%	69	47	68.1%
5th Grade	72	49	68.1%	73	54	74.0%

6c – Learn

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	99	67.8%	146	100	68.5%
Female	69	53	76.8%	69	53	76.8%
Male	76	46	60.5%	77	47	61.0%
4th Grade	69	44	63.8%	69	44	63.8%
5th Grade	72	51	70.8%	73	53	72.6%

6d – Meet

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	18	12.3%	146	22	15.1%
Female	69	9	13.0%	69	11	15.9%
Male	76	9	11.8%	77	11	14.3%
4th Grade	69	9	13.0%	69	10	14.5%
5th Grade	72	9	12.5%	73	12	16.4%

6e – See

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	109	74.7%	146	102	69.9%
Female	69	55	79.7%	69	54	78.3%
Male	76	54	71.1%	77	48	62.3%
4th Grade	69	53	76.8%	69	46	66.7%
5th Grade	72	52	72.2%	73	52	71.2%

6f – Other

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	25	17.1%	146	13	8.9%
Female	69	15	21.7%	69	10	14.5%
Male	76	10	13.2%	77	3	3.9%
4th Grade	69	8	11.6%	69	5	7.2%
5th Grade	72	16	22.2%	73	8	11.0%

7. Circle ALL of the words that describe doing a science experiment or a science project.

7a – Alone

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	58	39.7%	146	78	53.4%
Female	69	31	44.9%	69	37	53.6%
Male	76	27	35.5%	77	41	53.2%
4th Grade	70	25	35.7%	69	33	47.8%
5th Grade	71	32	45.1%	73	42	57.5%

7b – Fun

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	105	71.9%	146	98	67.1%
Female	69	54	78.3%	69	50	72.5%
Male	76	51	67.1%	77	48	62.3%
4th Grade	70	50	71.4%	69	44	63.8%
5th Grade	71	52	73.2%	73	53	72.6%

7c – Hard

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	72	49.3%	146	87	59.6%
Female	69	29	42.0%	69	39	56.5%
Male	76	43	56.6%	77	48	62.3%
4th Grade	70	32	45.7%	69	39	56.5%
5th Grade	71	38	53.5%	73	47	64.4%

7d – Boring

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	23	15.8%	146	42	28.8%
Female	69	8	11.6%	69	19	27.5%
Male	76	15	19.7%	77	23	29.9%
4th Grade	70	14	20.0%	69	21	30.4%
5th Grade	71	9	12.7%	73	19	26.0%

7e – Younger

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	7	4.8%	146	12	8.2%
Female	69	5	7.2%	69	8	11.6%
Male	76	2	2.6%	77	4	5.2%
4th Grade	70	2	2.9%	69	8	11.6%
5th Grade	71	5	7.0%	73	4	5.5%

7f – Materials

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	57	39.0%	146	84	57.5%
Female	69	29	42.0%	69	44	63.8%
Male	76	2	2.6%	77	40	51.9%
4th Grade	70	26	37.1%	69	40	58.0%
5th Grade	71	30	42.3%	73	42	57.5%

7g – Outdoors

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	98	67.1%	146	99	67.8%
Female	69	55	79.7%	69	52	75.4%
Male	76	43	56.6%	77	47	61.0%
4th Grade	70	39	55.7%	69	41	59.4%
5th Grade	71	56	78.9%	73	55	75.3%

7h – Friends

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	115	78.8%	146	113	77.4%
Female	69	57	82.6%	69	55	79.7%
Male	76	58	76.3%	77	58	75.3%
4th Grade	70	58	82.9%	69	53	76.8%
5th Grade	71	54	76.1%	73	57	78.1%

7i – Easy

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	35	24.0%	146	45	30.8%
Female	69	17	24.6	69	24	34.8%
Male	76	17	23.7%	77	21	27.3%
4th Grade	70	15	21.4%	69	18	26.1%
5th Grade	71	19	26.8%	73	25	34.2%

7j – Confusing

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	49	33.6%	146	59	40.4%
Female	69	23	33.3%	69	23	33.3%
Male	76	26	34.2%	77	36	46.8%
4th Grade	70	29	41.4%	69	27	39.1%
5th Grade	71	19	26.8%	73	31	42.5%

7k – Older

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	47	32.2%	146	57	39.0%
Female	69	22	31.9%	69	30	43.5%
Male	76	25	32.9%	77	27	35.1%
4th Grade	70	22	31.4%	69	28	40.6%
5th Grade	71	24	33.8%	73	29	39.7%

7l – My Age

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	82	56.2%	146	88	60.3%
Female	69	45	65.2%	69	45	65.2%
Male	76	37	48.7%	77	43	55.8%
4th Grade	70	34	48.6%	69	37	53.6%
5th Grade	71	45	63.4%	73	49	67.1%

7m – Out School

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	95	65.1%	146	100	68.5%
Female	69	51	73.9%	69	54	78.3%
Male	76	44	57.9%	77	46	59.7%
4th Grade	70	41	58.6%	69	44	63.8%
5th Grade	71	52	73.2%	73	53	72.6%

7n – Indoors

	Pre-Survey			Post-Survey		
	n	Frequency	%	n	Frequency	%
All	145	101	69.2%	146	107	73.3%
Female	69	51	73.9%	69	57	82.6%
Male	76	50	65.8%	77	50	64.9%
4th Grade	70	42	60.0%	69	49	71.0%
5th Grade	71	55	77.5%	73	55	75.3%

8. Label each story with a number from 1 to 6. Place a number 1 next to the story you liked the MOST, a number 2 to the story that was your second favorite, down to 6 for the story you liked the LEAST.

	n	% who ranked the episode as among their top three	% who said it was their favorite
Doghouse	121	76.9%	24.8%
Rollercoaster	130	73.1%	24.6%
Light and color	135	66.8%	35.6%
Sail On	131	60.3%	16.8%
Dinosaur Dig	121	23.2%	1.7%
Cactus	122	17.3%	2.5%

Girls:

	n	% who ranked the episode as among their top three	% who said it was their favorite
Doghouse	57	93%	38.6%
Rollercoaster	60	61.6%	8.3%
Light and color	66	81.9%	47.0%
Sail On	63	49.2%	7.9%
Dinosaur Dig	56	23.2%	1.8%
Cactus	57	14%	3.5%

Boys:

	n	% who ranked the episode as among their top three	% who said it was their favorite
Doghouse	64	62.5%	12.5%
Rollercoaster	70	82.8%	38.6%
Light and color	69	52.1%	24.6%
Sail On	68	70.6%	25.0%
Dinosaur Dig	65	23.0%	1.5%
Cactus	65	19.9%	1.5%

4th Grade:

	n	% who ranked the episode as among their top three	% who said it was their favorite
Doghouse	56	67.9%	12.5%
Rollercoaster	64	72%	34.4%
Light and color	64	70.3%	42.2%
Sail On	64	67.3%	14.1%
Dinosaur Dig	57	26.3%	0%
Cactus	56	16.1%	1.8%

5th Grade:

	n	% who ranked the episode as among their top three	% who said it was their favorite
Doghouse	62	87.1%	37.1%
Rollercoaster	63	73%	12.7%
Light and color	68	66.2%	30.9%
Sail On	64	51.6%	18.8%
Dinosaur Dig	61	21.3%	3.3%
Cactus	63	15.9%	3.2%

II. DragonflyTV Segment Survey Data

3. Counts of how many responses indicated students were or were not interested in conducting a similar inquiry at home.

Cactus				
Grade	4	5	Total	%
Yes	23	32	55	41%
No	47	26	73	54.5%
Maybe	2	4	6	4.5%
	72	62	134	100%

Light/Color				
Grade	4	5	Total	%
Yes	30	48	78	53.1%
No	37	25	62	42.2%
Maybe	5	2	7	4.7%
	72	75	147	100%

Dinosaur				
Grade	4	5	Total	%
Yes	19	36	55	41.3%
No	39	28	67	50.4%
Maybe	4	7	11	8.3%
	62	71	133	100%

Rollercoaster				
Grade	4	5	Total	%
Yes	40	41	81	56.6%
No	24	32	56	39.2%
Maybe	4	2	6	4.2%
	68	75	143	100%

Doghouse				
Grade	4	5	Total	%
Yes	30	49	79	60.3%
No	26	16	42	32.1%
Maybe	5	5	10	7.6%
	61	70	131	100%

Sailing				
Grade	4	5	Total	%
Yes	34	28	62	42.4%
No	35	40	75	51.4%
Maybe	2	7	9	6.2%
	71	75	146	100%