THE MAGIC SCHOOL BUS TV PROJECT
Department of Energy Grant #: DE-FG02-92ER75743

FINAL TECHNICAL PERFORMANCE REPORT

SEASON III

TELEVISION PRODUCTION
For Season III, our goal has been to produce 13 new episodes that can optimally benefit from our research and experience in developing this unique series. With a total of 39 episodes, MSB's third season will move the production from a weekly to a daily series, airing Monday to Friday and Sundays on PBS.

As we delivered the 13 Season II episodes to PBS during fall of 1995, we also completed 13 more scripts for Season III production. During the remaining portion of Season III, these 13 scripts are being animated and prepared for delivery to PBS for an October 7th, 1996 launch date.

Based on staggered phases of production used since the project's inception, the development of science topics and show scripting for Season IV occurs at the same time that Season III shows are in animation and post-production. Thus, topics for Season IV shows are being selected, and science research and scripting have also begun during this time period. Both the National Science Foundation and PBS have made a commitment to Season IV, and a proposal has been submitted to Microsoft for consideration.

ADVISORY BOARD AND SCIENCE TOPIC MEETINGS
On February 2, 1996, the MSB Advisory Board met to review Season II finished shows, Season III scripts, Season III/IV outreach and evaluation plans, and Season IV show topics. Among the many ideas discussed were: looking for opportunities to increase the presence of female and minority role models on the show; bringing back Carlos's younger brother Mikey (who was very well received by all); introducing a new character who communicates through signing; and exploring new ways to use the shows to safely encourage children to engage in hands-on activities as a follow-up to viewing.

To further inform the development of our next phase of science topics, a science topic workshop involving leading scientists and educators was held the end of February. During this meeting, we further explored age-appropriate science topics for Season IV that help to fill out and extend our existing library. A list of topics under consideration along with attendees is attached.
DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.
RESEARCH AND EVALUATION
Research conducted by Arc Consulting on Season I episodes was completed during this time period. An Executive Summary is enclosed.

Another research study, conducted by Research Communications Ltd., focuses on summative evaluation and examines the range of impacts MSB has on the target audience viewing multiple shows in a naturalistic, home setting. This small scale, pilot study includes 45 parent/child pairs in four cities selected for their geographic spread. Children were encouraged to view 13 Season II MSB episodes during a two-week period. Extensive interviews prior to and after viewing took place in the homes.

To inform the design of this study, we convened a small group of researchers specializing in television research and science education for young children. They included: ETS's Ted Chittenden, PhD, and Gita Wilder, PhD; Dr. Matthew Schneps, Director/Executive Producer, Science Media Group, Harvard-Smithsonian Center for Astrophysics; and Ellen Wartella, PhD, Dean, College of Communications, University of Texas, Austin. With this group, we explored new methods for gaining insight into how children construct science knowledge from their exposure to viewing MSB. Based on this meeting, we developed a technique in which children were exposed to a poster featuring a natural environment and were provided cut-outs of Ms. Frizzle, the bus, and the characters and asked to design their own MSB story. To augment what children reported on their own, parents kept a log in which they recorded any behavior observed as a result of viewing.

An executive summary will be forwarded upon completion of the data analysis.

OUTREACH
Season II kicked off with the distribution of 450,000 MSB Activity Guides to youth group leaders, teachers, and museums. Museums received Season II activity guides based on the new episodes to help them continue their participation. In addition, the series continues to receive ongoing promotion via Scholastic's network of publications (e.g., Super Science Red, Storyworks, Instructor et al) and through the press; the continuation of partnerships with eight youth-serving organizations, and linkages with PBS stations, on-line services, schools, and museums. The Season III guide, currently being completed, will be disseminated along similar lines.

Just as we maintain the existing vehicles in support of the series, we have also instituted some new activities, outlined below. Note that our science team works closely to review each of these domains as needed.

Family Print. In the fall of 1995, we completed development and distribution of 8,000 family workshop kits to partner youth-serving organizations. The kit includes a plan for organizing the event, a series of flexible science activities that utilize simple materials, and take-home materials for parents. We have selected evaluation sites that will provide feedback not only on the ease of use and effectiveness of the materials but also on the impact of reaching families in this manner.
MSB Web Site. In addition to the ongoing science chats between the MSB science staff and children and teachers on the Scholastic Network, we have kicked off a new MSB Web Site designed to reach children and families at home. In addition to information about the television project, the Web Site features MSB puzzles, games, science factoids, and even an area to display children's MSB artwork on-line. To access the Web Site, go to http://www.scholastic.com/MagicSchoolBus.

PROMOTION
Traveling MSB. A real traveling MSB is now touring the country, visiting museums, malls, stores, and schools. With headlines like "The Magic School Bus entertains and teaches," press and public reception of the bus has been overwhelmingly positive. One 6-year-old on board the bus is quoted as saying: "This is too much fun. It's got a lot of science stuff on it!"

The bus stops in as many as 5 different locations in a month, with attendance ranging from 200 - 500 participants. Booked for three weeks at Universal Studios in Florida and other exciting venues, the bus has already been boarded by 250,000 children. Note that the television show plays on the bus along with all the other activities and our family take-home, hands-on science activities from the Season I and II guides are distributed to participants.

Promotions. Efforts to reach large numbers of children and families in non-school settings continues to be critically important to maintaining awareness of the series among viewers. During the summer of 1995, we had a promotion partnership with Dial Soap.

In the winter of 1995, Denny's 1,500 restaurants promoted MSB on tray liners with tune-in messages. And starting August of 1996, Dairy Queen's 5,000 stores will feature a MSB promotion with four premiums and television advertising support. This promotion will continue through November, giving Season III an additional boost.

CARRIAGE AND RATINGS
We are pleased to report that MSB is currently on over 300 PBS stations reaching 97% of US TV Households. The most popular scheduling of the series is on Sundays, although this year we have seen a notable increase in plays on Saturday morning as well. Stations generally schedule the series two to three times a week.

During the Nielsen week of 3/25/96, MSB achieved an Average Audience rating of 2.4 and a cume of 2.9, reaching as many as 2.7 million viewers. In its second season, MSB continues to be THE MOST POPULAR SCHOOL-AGED CHILDREN'S show on PBS and among the top three children's shows for 2 to 5-year-olds on PBS. In addition, MSB wins weekends over all PBS children's shows.
AWARDS
Awards for The Magic School Bus continue to come in and now total 14. Those received to date are listed below:

- Daytime Emmy Award for “Outstanding Performer in an Animated Series” to Lily Tomlin
- National Educational Media Network Gold Apple, TV and Cable Broadcast
- National Education Association Award for Advancement of Learning Through Broadcasting
- 6 CINE Golden Eagle Awards
- Environmental Media Association Award
- Parents’ Choice Gold Medal
- 2 Parents’ Choice Video Awards
- Parents’ Choice National Television Hall of Fame Classic Award

BROADCAST STRATEGY
In Season III, all 39 MSB episodes will be fed during multiple time periods Monday to Friday as a daily show and on Sundays. PBS will feed our holiday show on recycling on 12/25/96, in prime time, at 8:00 p.m.

CONCLUSION
We are pleased to report that the MSB TV Project is on schedule and on budget in all domains and continues to hold its place “at the head of the class” in quality children’s television. In our second season we have sustained and extended the momentum begun in our premiere year.

As we look forward to the launch of Season III, we are planning to make optimal use of the switch to a daily show and will continue to create special promotional opportunities to ensure press attention and excellent scheduling by PBS stations. In this way, we hope to build on the program’s current reach with children and families and extend it even further. At the same time, we are pursuing the development and financing of our next season of episodes to ensure the long-term success of this breakthrough children’s science series.
THE MAGIC SCHOOL BUS
RESEARCH FINDINGS

Executive Summary

PRESENTED TO:
SCHOLASTIC PRODUCTIONS, INC.

BY
ARC CONSULTING LLC

OCTOBER, 1995
AN ASSESSMENT OF FOUR MAGIC SCHOOL BUS PROGRAMS ON CHILDREN'S SCIENCE LEARNING

Executive Summary

ARC Consulting was retained to conduct research on four new MSB episodes. Research was designed to focus on the product’s appeal to viewers and its educational effectiveness in three areas: (1) science content (what information the children learn from the show and how they learn it); science process (children’s ability to recognize that the MSB characters take an active approach to learning); and science behavior (the impact of MSB programming on children’s attitudes toward learning and science).

The primary goal of the research was to provide insight into “how” and “why” the program supports science learning among elementary school children. This involved an analysis of two distinct levels of scientific learning: (1) the ability to retain and articulate basic scientific facts and principles, from simple descriptions of data and events to more complex and abstract scientific concepts and principles; and (2) a more general, less-detail-oriented comprehension of the basic ideas explored in each episode.

The program’s success in achieving this level of “big picture” learning was measured by qualitative research consisting of focus group discussions in which viewers were probed concerning their level of comprehension and allowed to expand upon their questionnaire responses.

The results of these two levels of research — and the two types of learning they were designed to examine — were then compared to determine the extent to which general science learning is achieved in response to the episodes, even when certain elements of the basic scientific data are too complex for young viewers to fully comprehend or articulate.

Methodology

Approximately 90 school children were recruited to participate in the study. Participants were divided equally among the first, second and third grades with each grade being drawn from an elementary school in a different geographic area (New York, California, and New Jersey). Schools were selected to represent the diverse racial and ethnic populations in the particular area in which the students attended school, according to available census data. Students in each classroom were equally divided between girls and boys.
While student groups were not recruited on the basis of their past exposure to MSB products or programming, none of the schools had previously used the MSB videotapes in their classrooms.

At each location, research was conducted on four consecutive school days, with each student viewing the following four MSB episodes: The Magic School Bus Meets the Rot Squad; The Magic School Bus Inside Ralphie; The Magic School Bus Gets Eaten; and The Magic School Bus Kicks Up a Storm.

Each student completed a pre-viewing quantitative survey which asked about prior exposure to MSB and assessed general science knowledge in each of the four science areas that would be covered by the episodes included in the research over the course of the study.

On each of the four days, immediately after viewing the MSB episode, students responded to a questionnaire which featured multiple choice questions about the science content covered in the episode, and elicited their attitudes toward the episode and characters.

Each day, after the quantitative survey was finished, half the students participated in focus group discussions. Each student participated in two focus group discussions which were scheduled on alternate days. By the completion of the study, all participants had completed four questionnaires and participated in two focus groups.

The balance of quantitative (pre- and post-test questionnaires) and qualitative (focus group discussions and observed viewing) research was designed to measure the relationship between objective learning (the participants’ ability to correctly identify basic science facts and principles in the questionnaire) and the students’ more general grasp of the “big ideas” presented in the episodes.

**Highlights**

**Factors That May Influence Respondents**

In a pre-test survey and interviews, teachers and school administrators were asked to identify those factors that may influence children’s attitudes and receptivity to science learning prior to their participation in the MSB study. This research revealed that children’s learning from The Magic School Bus episodes and their reactions to them are influenced by: (1) exposure to MSB, (2) attitudes toward MSB, (3) science knowledge, and (4) attitudes toward learning.
Prior Exposure to MSB

Most students were familiar with The Magic School Bus — either through viewing the show on television or reading the books. Almost three quarters of the students (71%) had previously watched MSB on television. On average, girls had seen MSB three times and boys had seen it two times. An additional three quarters of the students (72%) had previously read MSB books. Between 40% and 60% of the participants reported having some prior exposure to the episodes viewed in this research.

Prior Attitudes Toward MSB

The vast majority of children who had already viewed MSB television programming prior to the research had very positive attitudes toward MSB. Over eight-in-ten children (84%) who had seen MSB on TV reported that they liked it “a lot.” Over eight-in-ten children (84%) who had read MSB books also reported that they liked them “a lot.”

Prior Science Knowledge

Interviews with teachers and principals in participating schools, pre-test questionnaires and focus group discussions were used to determine the participants’ prior exposure to and knowledge of basic scientific concepts and principles.

- First grade students had no previous classroom exposure to the science content of the episodes used in the study.
- Second grade students reported previous exposure to a number of general scientific concepts and principles, including a basic knowledge of the human body and some limited knowledge about weather.
- Third grade students had some specific exposure to three of the content areas treated in the episodes used in the study, including decomposition, germs/illness, and food chains.

Prior Attitudes Toward Learning

Participants identified many key activities that they considered to be “good ways to learn.” About three quarters of the participants agreed that traditional ways of learning (such as reading a book or going to school) were good. Between 50% and 60% agreed that active ways of learning were good, including: asking questions, doing experiments, and exploring. The same percentage of children also endorsed a variety of out-of-classroom learning activities, such as: going to a museum and talking with their parents about science. Only one third thought talking with friends was a good way to learn.
Enjoyment

The program allows children to enter at their own level of science knowledge and plot comprehension. When asked to rate each episode immediately after viewing it, 94% to 99% of the children in the study said that they liked it "a lot," and the show was equally appealing to children in all three grade levels.

- In addition to providing science content that the children can enjoy and follow, the show has a compelling narrative style that appeals to them and captures their attention.

- Although some of the younger children are often not prepared to fully comprehend all of the science information conveyed in the episodes, group observation and discussions revealed that they can still enjoy the narrative content and overall style of the programs without feeling frustrated.

Attention, Engagement and Entertainment

Researchers observed and recorded the children's behavior while they viewed the show. Group observations consistently revealed that children at all grade levels were very attentive to, engaged in, and entertained by the show.

- Throughout the episodes, children in all age groups were active, participatory viewers, who manifested their enthusiasm by laughing, singing, clapping their hands, and pointing at and talking to the characters on the screen.

Reactions to Fantasy and Adventure

Children responded positively to the use of fantasy and adventure in the show and had little trouble distinguishing between fantasy and reality while viewing the episodes.

- When asked what part of the show they liked the most, the children often described the segments that included action, adventure and fantastic events.

- Many children liked the idea of shrinking and said they wished they could shrink.

- Many children liked the magical nature of the bus, especially its ability to change shapes, turn into things, and go to unusual places, such as inside the log, inside the body and underwater.
Reactions to Music

Group observation revealed that all the children in the study responded positively to the use of music in the show. The majority of children sang along and clapped their hands to the theme song after the initial viewing. The music often maintained the momentum of the show, and focused and enhanced the children’s response to critical points in the story.

Reactions to Humor

Group observation revealed that children responded positively to the humor in the show. As with their overall understanding of the show, each of the children enjoyed the humor in MSB at their own level of receptivity and understanding.

- Children in all grade levels laughed frequently while viewing the episodes.
- While younger children did not laugh at some of the humorous elements of the story, their attention was not disturbed and they did not seem frustrated when characters on the screen laughed at something they didn’t understand.
- In the focus groups, the children indicated that they liked certain characters — such as Carlos, Liz, Arnold and Ms. Frizzle — specifically because they were funny.

Character Appeal

Children reported that they liked the characters who exhibited traits that they personally admired or that allowed the characters to play an important role in the episodes.

- Wanda and Keesha were the characters most often mentioned by girls in all age groups.
- Ralphie, Tim and Carlos were the characters most often cited by boys.
- Both boys and girls indicated that they would like to be like Liz because she was so funny.

Ms. Frizzle

Ms. Frizzle was the character who received the highest rating among children from all age groups. Nine-out-of-ten children indicated in the post-test questionnaires that they liked her “a lot.” In the focus group discussions, students reported that they enjoyed the way
Ms. Frizzle helped kids learn and that she made learning fun. Children in all age groups said that they would like being in Ms. Frizzle's class.

Arnold

Arnold's appeal was consistently lower than any of the other lead characters in the episodes (between 55% and 63%). As a group, the children exhibited a wide range of responses — from a strong identification with his intelligence to distaste for his "nerdy" appearance and behavior.

Responses to Individual Episodes

- "Inside Ralphie" and "Rot Squad" were both thoroughly entertaining and easily comprehensible to children in all grades. The majority of children remained intently focused on the episodes throughout the program, and were eager to identify and discuss with researchers the elements of the episode that they found most exciting.

- Group observation revealed that "Gets Eaten" held children's attention less effectively than the other episodes. First graders were fidgety and impatient throughout the episode. When asked to describe their responses to the show, first graders had less to say about the episode than any other show in the study.

- Children displayed occasional discomfort and impatience during the viewing of "Kicks Up a Storm," but, unlike "Gets Eaten," they were much more eager to discuss the exciting elements of the episode during the focus groups.

Story and Plot Comprehension

Children in all age groups had little problem following the story or the basic elements of the plot in the episodes they viewed during the study. In their responses during the focus group discussions immediately following the episodes, the majority of participants demonstrated both that they were able to understand and follow the major aspects of the plots, including the destination and activities of the class portrayed in the episodes; and easily distinguish between the use of fantasy and reality in the story line.

Where the Class Went and Why

In the focus group discussions, the children talked freely about both their own experience of out-of-class "field trips" and the more spectacular adventures undertaken by the
children in the MSB episodes. Participants were able to describe correctly where the class went on the field trip and to explain why they went.

Science Learning Based on Exposure to the Show

An examination of participants' responses to the pre- and post-test questionnaires revealed that children's knowledge of basic science information increased after viewing the episodes.

- Children in all age groups reported that they felt they had learned "a lot" from viewing the episodes. In the post-test questionnaire, approximately nine-out-of-ten children said they'd learned "a lot" about the science topics covered in the episodes. In the focus group discussions, children consistently reinforced these findings with their excitement about what they learned from the show and their eagerness to share their newly acquired knowledge with the researchers.

- In the post-test questionnaires, children in all age groups expressed satisfaction with their level of understanding, consistently indicating that the episodes were either "too easy" (48-57%) or "just right" (42-47%) for their needs. Less than 5% of all participants indicated in the questionnaires that any of the episodes were too hard for them to understand.

How the Children Learned

Based on observations of the children's viewing behavior and responses to focus group discussions, three factors seemed to have contributed to the children's high comfort level with the programs, as well as the high level of science learning and comprehension of the show revealed in the questionnaires and focus group discussions.

- Repetition of science facts and big science ideas — Children exhibited the highest level of recall for those facts and concepts that were repeated throughout the episodes;

- A close tie between science information and the plot — Children exhibited a high level of retention and understanding of ideas and concepts that were closely tied to the dramatic and visual elements of the episodes;

- Simplicity — Children were most likely to retain and comprehend information consisting of no more than three basic facts or details; and

- Connection with their own experience — Participants were particularly
receptive to ideas and activities that were similar to or had relevance for their day-to-day experience.

Awareness and Reactions to Active Learning

The majority of the children reacted positively to the use of active, participatory learning techniques in the show, such as field trips, experiments and exploring nature with their friends. Children in all grade levels had positive reactions to the way the characters in the show learned.

- Virtually all the children (98%-99%) thought the characters really liked learning about the topics covered in the episodes.

- Almost all the children (95%-98%) liked the ways the characters learned about the topics.

- Second and third grade students attributed positive qualities to the characters whom they recognized as active learners. Concerning the character, Keesha, one participant observed: “She used her brain to figure out what she should do (about the project). She tries to figure out how scum and tuna are connected.”

Ways to Learn

Over the course of the study, children increased their understanding of and openness to specific ways of learning about the world and how it works to include activities and resources that they had not previously considered.

- The biggest increases were shown for active and less traditional ways of learning, including: exploring, doing experiments, asking questions and talking with friends.

- Children in all grades viewed “taking chances, making mistakes and getting messy” as a way the characters learned.

- A substantially smaller increase was noted for traditional ways of learning, such as going to school and reading a book (which had started out with high endorsement as good ways to learn and in some cases actually experienced a decrease in their approval ratings after a viewing of the episodes).

- In addition to the styles of learning discussed above, children reported playing Magic School Bus games outside the study and the classroom. Many of the children reported playing games with their friends and
creating new games and experiments similar to the ones they had seen on television.

• These findings seem to indicate that the ideas and attitudes toward learning introduced in MSB continues to stimulate many children’s imaginations after the viewing experience has ended.

Science Content by Episode

MSB MEETS THE ROT SQUAD

• Children in all grades (from 85% to 93%) were able to identify a number of basic, visually concrete facts after viewing the episode, such as: woodpeckers eat bugs (88%) and a rotting log has lots of living things in it (93%).

• Fewer than half the first graders understood somewhat more difficult concepts, such as: logs rot because mushrooms and bugs eat them, and rot is nature recycling itself.

• Upon probing, children in all three grades were able to state that insects and mushrooms lived in the log, with only the older children able to articulate that log’s inhabitants contribute to its decomposition.

• First graders were unclear as to whether or not rot was useful. This confusion reflects the difficulty that children at this grade level have understanding and articulating the details of such concepts as “process,” “environment” and “ecosystem.” Almost all second and third graders, however, understood that rot was useful because it provided nutrients for the soil.

• When questioned in the focus groups, children in all three grades remembered other things on the show that were rotting, but had difficulty generalizing what they had learned about the rotting logs to the other decomposing objects that they were able to identify.

• Second and third grade children discussed both the details of the show (a rotting log turns to soil, lots of things live in a rotting log, there were other rotting things on the show) and the broad conclusions (rot is useful, you should leave nature alone).

MSB Inside Ralphie

• In the post-test multiple choice questionnaires, more than three-fourths of the students in each grade (from 88%-95%) correctly identified a number of basic, visually concrete statements from the episode:
• Most participants had a great deal of difficulty understanding how white blood cells know when to “gobble up” germs.

• The largest discrepancy among age groups was in response to the statement, “Bacteria are a kind of germ” — correctly identified by all third graders and only 50% of first graders. Eighty percent of the second graders were able to correctly identify the statement.

• In focus group discussions of MSB Inside Ralphie, children in all grades routinely used language and visual images from the show to describe what they had learned (“green stuff,” “gobbled them up,” etc). This use of language and imagery from the episode to describe scientific data demonstrates that children used the show to learn.

• When asked in the focus groups to describe what the characters on the show learned, children in all grades displayed a basic understanding of how germs and white blood cells affect one’s health. Children in all three grades knew, when asked, that germs made Ralphie sick and that they were destroying Ralphie’s throat cells. Children in all grades discussed antibodies without being asked about them. The children also recognized that antibodies were part of the battle to help Ralphie get better.

MSB GETS EATEN

• MSB “Gets Eaten” presented the greatest discrepancy between the quantitative and qualitative findings. While children in all age groups experienced difficulty identifying the correct statement in the multiple choice questions, the focus group discussions revealed a significant, if fragmented, grasp of the basic concept of food chains.

• In response to the post-test questionnaires, more than half of all students in all age groups were able to identify a number of basic, visually concrete facts about the food chain, but less than half were able to identify more complex facts and principles, such as “all food chains begin with plants” and “green scum and grass are both plants.”

• Although only third graders could reconstruct the entire food chain, children in all age groups demonstrated at least some understanding of a food chain, describing the fact that some animals eat plants or that big things sometimes eat little things. With additional probing, however, children in all grades revealed an understanding that it would be harmful if something changed in the basic food chain.

• An examination of the discrepancies between the comparatively low level
of accuracy in the quantitative survey and the higher levels of general learning displayed in the focus groups reveals that children are learning important scientific information in spite of their "incorrect" responses to the questions in the quantitative survey. When probed in the focus groups, many of them, especially among the older students, are able to report facts and make connections that they were unable to reveal in the post-test questionnaire.

MSB Kicks Up A Storm

- "Kicks Up a Storm" was not quite as difficult to understand as "Gets Eaten," but not as easy to understand as the first two episodes. According to the post-test questionnaires, more than 90% of children in all grade levels understand that "Rain comes from clouds" and "Raindrops start out as snow or ice" — the two questions that involved visually displayed details.

- Younger participants had more trouble, however, with the more abstract issues and the lesson that involved applying scientific information to one's own experience ("If you were in a cloud, you would be cold and wet").

- The children had much greater difficulty understanding how wind was made. The majority in all grades agreed with the incorrect statement that "wind is made by a combination of air and water." Surprisingly, none of the first and second graders answered the question correctly, while only 4% of the third graders correctly identified the statement. Participants were confused as to whether wind was caused by warm or cold air rising, or by clouds. In addition, the majority of first graders agreed, incorrectly, that "weather is the same everywhere," while more than three quarters of the older students knew that weather is not the same everywhere.

- In focus group discussions of MSB Kicks Up a Storm, children in all grades were able to correctly identify the basic ingredients of weather. However, children were unable to articulate how these ingredients combined together and resulted in different types of weather.

- When probed, several of the children in the second and third grade groups were able to describe how wind is created, in spite of the findings in the quantitative research indicating that none of the second graders and only 4% of the third graders understood this concept.
Many children said that heat, air and water were the basic elements in a thunderstorm, although only a few knew that how they mixed together was an important part of creating a thunderstorm.

The consistently high level of correct responses in the post-test questionnaire to rudimentary scientific observations (clouds produce rain, rain originates as ice crystals or snow) and the comparatively high level of comprehension of more difficult and abstract concepts (the composition and definition of weather) among all age groups demonstrate that children were able to learn the basic building blocks about weather from an initial viewing. More complex concepts, however, such as the composition and cause of wind and thunderstorms, appear to be too difficult for even the older students to comprehend or articulate from viewing a single episode.

These findings seem to indicate our overall findings that: (1) children, especially in the lower grade levels, are most responsive to information and concepts that they can associate with the dramatic and visual elements in the program; and (2) questionnaires and other strictly quantitative research tools are an inadequate measure for scientific learning from MSB programming.

Major Findings

- MSB is an effective and entertaining vehicle for teaching children about science and active learning. Children in all age groups enjoyed the episodes and said they made learning fun.

- Both the density of science information and the presentation of the plot, characters and other narrative elements were appropriate for all the grade levels involved in the study. The majority of children in all age groups reported little or no frustration or confusion about either the content or the style of the episodes. This age-appropriate balance of science information and appealing narrative elements is crucial to the show’s ability to achieve its goal of educating and entertaining children.

- Children were able to comprehend and articulate those scientific facts and principles which were: (1) repeatedly frequently throughout the episode; (2) explained and illustrated both in the dialogue for the episodes and visual and dramatic elements of the programming; (3) limited to three or fewer details for them to remember; and (4) most directly related to their own experience.
• Younger children, in particular, were most likely to retain and understand facts and concepts when they were able to associate them with language and visual and dramatic images from the episodes, such as white blood cells “gobbling up” germs to protect the body from disease.

• Over the course of study, children expanded their understanding of and openness to active, participatory styles of learning. Many children imitated the activities of the show’s characters in their after-school play or invented games or experiments like the ones on the show.

• Though quantitative research is crucial for determining the program’s success in increasing children’s basic scientific knowledge, it is not an exhaustive measure for how science learning occurs. Qualitative research can be used to demonstrate that general science learning takes places even when children are not prepared to retain and interpret more complex concepts and information explored in some of the episodes.
13 All-New Adventures Aboard Scholastic's The Magic School Bus®

Season Three Episodes

Ms. Frizzle says, "Bee Ready for Anything!"

#301
THE MAGIC SCHOOL BUS®
In a Beehive
Topic: Honeybees

When Tim delivers the last of the season's honey to his grandfather's customers, the jars get broken. Tim's solution is simple: get more honey from some bees. But Ms. Frizzle sweetens the idea by turning her class into bees and showing them a beehive up close and personal. When a bear steals the bees' hard-earned supply of honey, the bee-kids discover one last field of nectar-filled flowers. How will the bee-kids communicate this information to the bees in time for them to harvest enough honey before the flowers are killed by the impending frost? Season Three premiere episode!

#302
THE MAGIC SCHOOL BUS®
In the Arctic
Topic: Heat

"Where did the hot go?" wonders Arnold when he finds that his hot cocoa has cooled. In response, Ms. Frizzle whisk the class to the Arctic! What's the freezing Arctic got to do with heat? While the kids try to find out, the bus's engine freezes and the bus floats away on an ice floe with Ralphie and Phoebe inside! As the bus moves away, so does the heat from everyone's body. How can Ms. Frizzle's kids insulate their body to keep the heat in? Can they rescue Ralphie and Phoebe before they all become the Ice Cube Kids?

#303
THE MAGIC SCHOOL BUS®
Spins a Web
Topic: Spiders

What do you do when a 50-foot praying mantis menaces your town? Run like the wind...unless you're in Ms. Frizzle's class and she's taken you on a field trip inside a 1950s sci-fi film. The movie's main character, the power-mad General Araneus (Ed Asner) is determined to destroy the mantis, but Phoebe wants to trap it and save it! Shrinking to the size of real spiders, the kids discover how spiders construct a variety of silky snares, making them world-champion trappers. Can the kids save the mantis—and stop Araneus before it's too late?

#304
THE MAGIC SCHOOL BUS®
Under Construction
Topic: Structures

Two inches tall, and trapped in a bathroom at Wanda's house, the kids have to get out before Wanda's mother (Rosalind Chao) discovers them. Gathering building materials such as spiky hair curlers, sticky Band-Aids, dental floss, and Q-tips, the kids use what they've learned about structures to construct a series of towers and bridges across the bathroom to an open window! They get across the toilet OK—but will they get past the alligator in the bathtub?
THE MAGIC SCHOOL BUS®
Gets a Bright Idea
Topic: Light
After the illuminating light show at Walkerville’s old theatre, Arnold’s bossy cousin Janet claims she could put on a much better show. Nobody believes her until Janet and Arnold mysteriously disappear. Ms. Frizzle leads her class into the darkened theatre to look for them. To shed some light on the problem, the kids become beams of light. Then, to their great shock, they see Arnold’s ghostly image floating high above the empty stage! Is the theatre haunted? Is this just one of Janet’s tricks? Or have they all been “Frizzled”?

THE MAGIC SCHOOL BUS®
Shows and Tells
Topic: Archaeology
It’s the International Show-and-Tell Competition and Arnold and DA are representing Ms. Frizzle’s class. Arnold brings a webbed hoop, left behind by his great-aunt Arizona Joan, the famous archaeologist, but he has no idea what it is! Using clues from the hoop and Joan’s journal, the kids make educated guesses about its uses. To test their hypotheses, Ms. Frizzle turns the bus into a “Supposatron,” a magical device designed to evaluate guesses. Can the kids solve the puzzle before Arnold and DA take the stage? With Alex Trebek as the “Sportscaster.”

THE MAGIC SCHOOL BUS®
Makes a Rainbow
Topic: Color
The class finds Ms. Frizzle inside her closet—playing pinball! But this is no ordinary pinball machine. Created by the Friz herself, it’s played with light pulses, not steel balls. Ms. Frizzle is down to her last game. If she doesn’t light up the six colors of the rainbow and win the game, she’ll lose the machine. To help her, the kids shrink and go inside the game. With time and the light pulses running out, the kids must discover the secrets of color—before the principal, Mr. Ruhle (Paul Winfield), discovers them!

THE MAGIC SCHOOL BUS®
Goes Upstream
Topic: Migration
Ralphie wants to catch salmon to serve at the annual school picnic, but he can’t find any at his favorite fishing spot. Where could all the salmon have gone? The kids are soon “Frizzled” inside a salmon bus that has an uncontrollable urge to head upriver. “Wait!” Ralphie cries. “We’ll be late for the picnic!” But the salmon bus won’t stop. Using its sense of taste and smell, it swims the long journey to a shallow freshwater stream miles away. Why has the bus, which thinks it’s a salmon, gone to all this trouble?

THE MAGIC SCHOOL BUS®
Works Out
Topic: Circulation
At this year’s Teacherathalon, Ms. Frizzle squares off with Mr. Sinew (Dan Marino), a muscle-bound gym teacher. Sinew easily wins the first of the three events. Thinking there’s a problem, the kids go inside Ms. Frizzle to check her out. The bus takes them through her lungs to the bloodstream, where they get pumped through her heart to her calf muscle. But when Frizzle’s leg muscle collapses from the strain of winning the second event, the kids discover that her red blood cells can’t get oxygen to her muscles fast enough! Can the kids help Frizzle recover in time to win the final race?

THE MAGIC SCHOOL BUS®
Gets Planted
Topic: Photosynthesis
Phoebe tries to grow a vine for the school play, Jack and the Beanstalk. But her plant is more like a bean sprout than a beanstalk! With the opening curtain only moments away, Ms. Frizzle turns Phoebe into a real plant. But Phoebe finds she doesn’t know how to grow; her leaves curl up from stage fright and she’s starving! With time running out, the bus and the kids shrink and travel into a nearby plant to do research. They discover its leaves are its own private food factory. With this information, the kids rush back to help Phoebe grow into the star of the show!
#311 THE MAGIC SCHOOL BUS® in the Rain Forest

**Topic: Rain-Forest Ecology**

The kids rent a rain-forest cocoa tree as an Earth Day present for Ms. Frizzle. But when the harvest arrives, there’s only one shriveled cocoa bean and a note from Inspector 42 (Matt Frewer) reporting that, for reasons unknown, the tree isn’t producing beans! DA and Tim become detectives as Ms. Frizzle takes the class to the rain forest to meet the impeccable inspector, who keeps a tidy, mud-free cocoa grove. What has Inspector 42 done to the rain forest’s intricate web of life that is keeping the tree from making pods?

#312 THE MAGIC SCHOOL BUS® Rocks and Rolls

**Topic: Water Erosion**

To celebrate the founding of Walkerville, Ms. Frizzle's class sculpts a stone likeness of its founding father, Captain Walker. But as they add the finishing touches, the statue tumbles down the mountain. Ms. Frizzle turns the bus into a giant boulder and the kids into rock kids. They bump down the mountain in a desperate attempt to save the statue. By the time they reach the celebration at the base of the mountain, they’ve been pushed, tossed, sandared, polished, and eroded by water—as has the statue, now the size of a soccer ball. The kids are sure they’ve let everyone down—until they look back at the mountain for the surprise of their lives!

With Jessica Walter as “Ashley Walker-Club-Dupree.”

---

**Holiday Special**

Airs Dec. 25th, 1996 8:00 p.m.

---

#313 THE MAGIC SCHOOL BUS® Holiday Special

**Topic: Recycling**

It’s the last day of school before the winter holidays and Wanda plans to see the Nutcracker ballet. But during a trip to a recycling plant that belongs to Murph (Dolly Parton), the toy soldier she needs to get into the theater accidentally gets recycled! Devastated, Wanda wishes for a world without recycling. Ms. Frizzle activates the bus's un-recycler, taking the class and Murph on a song-filled field trip. The importance of recycling hits home when the bus's magic unrecycles everything in Walkerville—including the bus itself, as it too was made from recycled objects! Will the kids find a way to reconstruct the bus in time for Wanda to get back to see the Nutcracker? (Dolly Parton sings an original song plus four special carols written by Peter Lurye, composer of the rollicking MAGIC SCHOOL BUS theme song.)
Arnold’s dad; Dana Elcar as Phoebe’s dad; and Edward James Olmos as Carlos’s dad.

#205
THE MAGIC SCHOOL BUS®
Butterfly and the Bog Beast
Topic: Butterflies
The class needs a new mascot for its soccer team. Phoebe suggests butterflies, but everyone thinks they’re wimpy—until The Friz flutters in!

#206
THE MAGIC SCHOOL BUS®
Wet All Over
Topic: Water
The Friz takes the class on a wild ride through the water cycle.

#207
THE MAGIC SCHOOL BUS®
in a Pickle
Topic: Microbes
Keesha and the class return from vacation to find her prize cucumber has turned into a pickle! Could the Mike Robe gang be to blame?

#208
THE MAGIC SCHOOL BUS®
Revving Up
Topic: Engines
The school district’s Vehicle Maintenance Inspector, Junkett (Sherman Hemsley), is about to condemn the Magic School Bus!

#209
THE MAGIC SCHOOL BUS®
Taking Flight
Topic: Flight
Shrunk inside Tim’s model airplane, the class goes on a high-flying field trip to find out how things fly.

#210
THE MAGIC SCHOOL BUS®
Getting Energized
Topic: Energy
The class is ready to plug in their “Double-Trouble Wheel of Wonder” at the town carnival when they discover all the electrical outlets are taken.

#211
THE MAGIC SCHOOL BUS®
Out of This World
Topic: Space Rocks
When Dorothy Ann warns the kids that there’s an asteroid headed straight for their school, Ms. Frizzle arranges a field trip into space. With Swoosie Kurtz as Dorothy Ann’s mom.

#212
THE MAGIC SCHOOL BUS®
Cold Feet
Topic: Warm-/Cold-Blooded
Liz has gone off to a mysterious place called “Herp Haven.” Thinking she’s in trouble, the class rushes to Herp Haven, where they turn into reptiles. With Michael York as Herpst.

#213
THE MAGIC SCHOOL BUS®
Ups and Downs
Topic: Floating and Sinking
There’s a monster in Walkerville Lake! Wanda wants to be the first one underwater, but Gerri Poveri (Cindy Williams), a TV reporter whose ratings are sinking, wants Wanda out of the way.
#101
THE MAGIC SCHOOL BUS®
Gets Lost in Space
*Topic: The Solar System*
Arnold’s know-it-all cousin Janet drives the kids crazy when she joins Ms. Frizzle’s class on a field trip and gets them lost in outer space!

#102
THE MAGIC SCHOOL BUS®
For Lunch
*Topic: Digestion*
Arnold’s so excited he doesn’t have to go on a field trip! But when he accidentally swallows his miniaturized class, he becomes the field trip!

#103
THE MAGIC SCHOOL BUS®
Inside Ralphie
*Topic: Germs*
Ralphie is crushed when a fever keeps him home from school the day he’s scheduled to host an FNN (Frizzle News Network) television broadcast on health. With Tyne Daly as Ralphie’s mom.

#104
THE MAGIC SCHOOL BUS®
Gets Eaten
*Topic: The Food Chain*
Arnold and Keisha are in trouble when they forget to bring in their assignment on “two things that go together.”

#105
THE MAGIC SCHOOL BUS®
Hops Home
*Topic: Habitat*
When Wanda’s pet frog, Bella, jumps out an open window, Ms. Frizzle shrinks the bus into a mechanical frog and takes her now-tiny class on a hop-along adventure.

#106
THE MAGIC SCHOOL BUS®
Meets the Rot Squad
*Topic: Decomposition*
It’s “Accidental Science Project” day and the class has brought in marvelously rotten entries from the back of their refrigerators. With Ed Begley, Jr., as Larry Log-Away.

#107
THE MAGIC SCHOOL BUS®
All Dried Up
*Topic: Desert Adaptation*
Always the caring soul, Phoebe goes on a crusade to save the animals and plants of the desert—and discovers how well they take care of themselves.

#108
THE MAGIC SCHOOL BUS®
in the Haunted House
*Topic: Sound*
The class is thrilled about its upcoming concert at the Sound Museum—until they discover the spooky mansion is more of a thrill than they bargained for. With Carol Channing as Cornelia C. Contraalto.

#109
THE MAGIC SCHOOL BUS®
Gets Ready, Set, Dough
*Topic: Kitchen Chemistry*
It’s Ms. Frizzle’s birthday, and a field trip to the bakery seems perfect—until the bus’s shrinkscope goes on the fritz and the class gets baked in a cake! With Dom DeLuise as the baker.

#110
THE MAGIC SCHOOL BUS®
Plays Ball
*Topic: Forces*
Ms. Frizzle combines Dorothy Ann’s physics and Ralphie’s baseball into a “Frictionless Baseball Game.”

#111
THE MAGIC SCHOOL BUS®
Goes to Seed
*Topic: Seeds*
The class’s garden is going to be featured on the cover of PLANT IT! magazine. But Phoebe’s garden plot is glaringly empty. With Bobby Benson as Mr. Seedplot.

#112
THE MAGIC SCHOOL BUS®
Gets Ants in Its Pants
*Topic: Ants*
The Magic School Bus goes into show business when Keisha directs a movie about social animals for the school science fair.

#113
THE MAGIC SCHOOL BUS®
Kicks Up a Storm
*Topic: Weather*
The Friz transforms the bus into a weathermobile and—in a wild ride through the skies—Ralphie becomes the meteorological superhero of his dreams.
SEASON IV PROPOSED TOPICS & SCIENCE TOPICS WORKSHOP ATTENDEES
EGGS

Science Idea: Reproduction
Subject: Life Sciences/Human Biology

BIG IDEA:

Baby chicks grow inside, then hatch from chicken eggs only when two tiny incomplete parts -- one from a rooster and one from a hen -- first join together inside the hen.

ORGANIZING PRINCIPLES:

A. A chick begins, not as an egg, but as a tiny, incomplete part (an ovum) deep inside the hen. The ovum cannot grow into a chick until it is joined by another incomplete part (a sperm) that comes from a rooster.

B. When a sperm joins an ovum inside the hen, the two combine into a single life package that divides again and again, growing larger and more complicated.

C. Now called an embryo, the new life package needs special food and protection for growth which the hen provides before squeezing it out of her body inside an egg.

D. Fed by the food inside the egg and kept warm by the hen in the nest, the embryo develops and grows until a fully formed chick pecks its way out to face life on its own.

SHORELINE

Science Idea: How organisms interact in ecosystems
Subject: Life Sciences

THE BIG IDEA:

In spite of pounding waves and shifting tides, most shoreline animals will fight for a 'piece of the rock' because their food comes to them in the water.

ORGANIZING PRINCIPLES:

A. In spite of pounding waves and shifting tides, some animals at the ocean’s edge search for a spot to latch onto, and will even fight to keep it!

B. High on the rocks, midway, or low down in the water, these animals choose places for homes based on how much of the pounding and shifting they can cope with.

C. But coping with pounding waves and shifting tides is worth the trouble, since animals that live at the ocean’s edge are built for the stress -- and their food comes to them in the water!
BIG IDEA:

North, South, East and West are fixed directions that never change which we can use as signposts to help us find our way even if we get turned around or lost.

ORGANIZING PRINCIPLES:

A. We often use landmarks -- uncommon objects that can be seen from a distance -- as signposts that show us which way to travel to reach a place.

B. Sometimes we can’t find landmarks that show us which way to travel to reach a place. Then we need an invisible sense of direction -- a clear idea about which way to travel so that we can set a course to reach our destination.

C. North, South, East, and West are fixed directions that never change. Even though they are invisible, when we find them, they give us a sense of direction. We can use them as signposts to show us which way to travel to reach our destination.

D. To get to where we want to go, we first have to set our course -- note the direction in which we need to travel to reach our destination. Then find North, South, East or West, and use that direction as a fixed signpost to adjust our course as we travel so that we don’t get turned around or lost.
WETLANDS

Natural systems in ecology
Humans in the ecosystem

THE BIG IDEA:

Low-lying, swampy, shallow places that ooze with mud and stink from rotting vegetation aren’t nuisances. They are wetlands that actively work around the clock, helping our environment by controlling floods, feeding and sheltering animals, and cleaning and filtering water.

ORGANIZING PRINCIPLES:

A. Wetlands -- low areas with shallow water -- store rising flood waters, thereby reducing their impact.

B. Grasses, reeds, shrubs and trees thrive in the wetlands’ shallow water, giving food, shelter, and breeding grounds to water-loving animals.

C. Because plant roots and stems slow the flow of water through a wetland, they filter and trap debris and sediments. They actually help purify the water by giving tiny plants and animals time to feed on nitrates and other human pollutants that would otherwise pass on through.

D. If we fill in a wetland to reclaim "useless" land, flood waters will erode and carry away valuable topsoil. Wetland animals lose their habitat, making their populations drop; and polluted waters flow un-cleaned down rivers and into the ocean.
The Magic School Bus
Science Topics Brainstorming Session
568 Broadway, 9th floor
New York, New York 10012
February 28-29, 1996

Participants:
Betty Davidson, Exhibit Planner, Museum of Science, Boston, MA
Eddie Goldstein, Holstein Design, Superior, CO
Les Kaufman, Ph.D., Associate Professor, Boston University Marine Program, Department of Biology, Boston University, Boston, MA
Matthew H. Schneps, Ph.D., Director, Science Media Group, Science Education Department, Harvard-Smithsonian Center for Astrophysics, Cambridge, MA
Mary-Ann Feller, Grade 2 teacher, New York, NY

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.