

GOODMAN RESEARCH GROUP, INC.
Program Evaluation • Consultation • Market Research

Summative Evaluation of FETCH Season II

PREPARED BY

Rucha Londhe, Ph.D.
Colleen Manning
Irene F. Goodman, Ed.D.

SUBMITTED TO

WGBH Children's Programming

TABLE OF CONTENTS

EXECUTIVE SUMMARY	I
INTRODUCTION	1
METHODS	2
PARTICIPANTS	2
PROCEDURE	3
DATA COLLECTION INSTRUMENTS	3
DATA ANALYSES	4
RESULTS	5
DID THE FETCH SERIES APPEAL TO THE STUDENTS?	5
DO THE STUDENTS SHOW THE DESIRED LEARNING OUTCOMES?	8
CONCLUSIONS	14
RECOMMENDATIONS	15
CONCLUDING STATEMENT	16
APPENDICES	17

EXECUTIVE SUMMARY

FETCH, a children's television series produced by WGBH since 2005, is a competition-based game/reality show for 6-10 year-old children that includes both animation and live action footage. Goodman Research Group, Inc. (GRG), a research firm specializing in the evaluation of educational programs, materials, and services, served as the external evaluator for the FETCH series in Season Two. GRG's evaluation focused on the science and engineering challenges presented in the show, and assessed the influence of the series on children's understanding of science and engineering concepts and processes.

GRG used survey and interview methods to gather pre- and post-viewing data from students; 168 fourth grade students in Massachusetts (n=97) and southern California (n=74) answered science and engineering process and content survey questions before and after watching five FETCH episodes. A five-minute interview was also conducted individually with a sub-sample of 117 students (51 in MA and 66 in CA) to further explore their understanding of the science and engineering concepts and processes featured in FETCH.

KEY FINDINGS

The FETCH series continues to have high appeal for the target audience in its second season.

The majority of students (ranging from 67% to 91%) either "completely loved" or "liked a lot" each episode that they watched. The most common response about what they liked best about the show was that they liked learning science in a fun way.

Students showed overall gains in their knowledge about science concepts and processes after watching FETCH.

Overall, the students showed a significant increase in their scores on the science questions from the pre- to the post-tests. This difference persisted even when the sample was separated out by gender, age, FETCH viewing habits, and state of residence.

FETCH was effective at increasing children's understanding of science concepts.

The students scored significantly higher on all eight science content questions on the post-test than they did on the pre-test. Also, when asked explicitly to list the science ideas that they learned from FETCH, students mentioned, on average, at least one idea related to the questions on the survey.

FETCH was effective at increasing children's application of science concepts.

The students showed significant increase in the scores from pre- to post- test on the science application questions, as well as on the explanations they gave for

their answers. These open-ended explanations clearly indicated an increase in students' application of science concepts related to characteristics of mammals and gravity and friction.

FETCH was moderately effective at increasing children's understanding and application of science processes.

Questions were asked about four science and engineering processes: (1) designing an experiment, (2) controlling variables, (3) brainstorming ideas, and (4) testing and redesigning products. Students improved significantly from pre- to post-tests in their learning about the design of an experiment; they were more likely on the post- tests to describe scientific terms such as making observations, using graphs to measure growth, and using control variables in the experiment. For the other three concepts, there was an upward trend in pre- to post-scores, although the differences were not statistically significant.

Students more readily discussed FETCH science concepts than they did FETCH science processes.

While students were articulate about the science ideas and concepts they learned from FETCH, they had more difficulty discussing science processes.

RECOMMENDATIONS

Focus on science processes during FETCH's next season.

GRG recommends that WGBH continue to focus on science processes as one of the primary themes of the show in the upcoming year. This would include highlighting as explicitly as possible the science processes in each episode, through the use of graphics, diagrams and other visual aids.

Make specific alterations to the show's format, while keeping the basic model intact.

Because students enjoy the format and appear to benefit from the fun way in which science information is presented, GRG recommends that WGBH maintain the basic format of the show. However, the show can be further enhanced by adding a separate section at the end of each episode that reinforces both the science processes (and science concepts) that are highlighted in that episode.

Introduce new science processes to the viewers while also helping them generalize these ideas.

GRG recommends that the content and characters on the show emphasize and demonstrate how science processes can be generalized. For example, if the episode is dealing with the concept of experimentation and various strategies to enhance an experiment, the cast members could be shown engaging in multiple experiments. They could then be shown drawing parallels among the different experiments, which would reinforce the notion of generalizing the concept.

INTRODUCTION

FETCH, a children's television series produced by WGBH since 2005, is a competition-based game/reality show for 6-10 year-old children that includes both animation and live action footage. The show is hosted by a cartoon dog named Ruff Ruffman; six children are involved as competitors in the show each year. In each episode, Ruff assigns these competitors to go out into the world to complete challenges, typically two in each show. One of these two challenges focuses on science or engineering and the other focuses on sports, art, or culture.

Goodman Research Group, Inc. (GRG), a research firm specializing in the evaluation of educational programs, materials, and services, is serving as the external evaluator for FETCH in Season Two. GRG has evaluated the series (results presented in this report) and is evaluating the museum outreach component in Fall 2007. In 2005, GRG conducted a summative evaluation of FETCH Season One that assessed the extent to which children gained science content knowledge and science process skills as a result of watching the show.

GRG's evaluation of FETCH Season Two series focused on the science and engineering challenges presented in the show. It assessed the influence of the series on children's understanding of science process, as well as children's understanding of two of the Season Two content areas: *Human Body* and *Force and Motion*.

The science- and engineering-based challenges in the second season included: (1) science and engineering processes such as designing a solution to a problem, formulating a hypothesis, experimenting, collecting data and drawing conclusions, and (2) science concepts such as gravity, friction, characteristics of mammals, and the human pulse.

In consultation with the staff at WGBH, GRG selected five specific episodes from Season Two for the evaluation research. Below is a brief description of each of these episodes.

Dolphin/Etiquette. The science challenge of this episode was titled "Dolphin" and involved one of the contestants flying to Orlando, Florida and interacting with a dolphin named Calvin at Epcot's "Living Seas." The contestant raced Calvin and observed how dolphins are adapted for living in the water. The episode also focused on the five distinct characteristics of mammals, namely that all mammals nurse their young, have hair, breathe air, don't lay eggs, and are warm blooded.

Soapbox Derby/Dragon Boat. The science challenge in this episode had the contestants involved in a soapbox derby car race. With the help of an expert soapbox racer, they designed, built, and raced their own car. The episode highlighted the science processes of designing, testing, and redesigning, and the science concepts of gravity, drag, and friction.

Doggie Stress Test/Gumbo. The science challenge of this episode asked contestants to find out whether dogs make people more relaxed or more stressed.

They made predictions and designed their own experiment. After recording people's pulse rates before and after playing with the dogs, the contestants realized flaws in their experiment and discussed what could make their experiment better.

Bowling/Snowboarding. In this episode, contestants were asked to build a device that would bowl a strike every time. They met with an engineer who designs bowling equipment to learn about force, speed, and weight. Then they designed, built, tested, and re-built their device.

Brain/Blue Man Group. The science challenge of this episode dealt with conducting an experiment to prove or disprove the saying that humans only use 10% of their brains. With the help of an expert neurologist, the contestants designed experiments to test this myth. They also used an MRI machine to conduct their experiment.

METHODS

GRG used both survey and interview methods to investigate gains in children's understanding of science and engineering process and content, and to determine the show's appeal to students. A pre-post research design was employed wherein students answered science and engineering process and content questions before and after watching five FETCH episodes. A five-minute interview was also conducted individually with a select sample of students to further explore their understanding of FETCH science and engineering process and content. Details about participants, procedures, and data collection instruments are provided below.

PARTICIPANTS

GRG recruited seven 4th grade classroom teachers in two states, Massachusetts and California, to participate with their students in the evaluation of FETCH. Three teachers were recruited from a single school in San Diego, CA and four teachers were recruited from two different schools in Dorchester and Watertown, MA. The total number of students participating in the surveys included 97 from MA and 74 from CA. The sample size for the post interviews was 51 and 66 from MA and CA, respectively. The teachers each received an honorarium for participating in the study.

In terms of the demographic characteristics of the participants, there was an almost equal distribution of boys (49%) and girls (51%). The age range of the participants was 9-11 years, with a little more than half (56%) 10 years olds, 34% 9-year-olds and the remaining 10% 11-year-olds. Not all children chose to answer questions about ethnicity. Out of the 78% who did answer that question, close to a half said that they were Hispanic. Eighty-eight percent of the students reported their race. Table 1 indicates the distribution of the students by their race.

Table 1
Distribution of the students by race

Race*	
American Indian or Alaska Native	6%
Asian	4%
Black or African American	10%
Native Hawaiian or Other Pacific Islander	2%
White	39%
Other	42%

*Multiple responses were possible

PROCEDURE

The teachers involved in the study were contacted by GRG through one of two means: (1) GRG’s Participant Database and (2) email announcements sent to principals. They were provided with a complete outline of the evaluation activities along with the timeline. Once the teachers were recruited, GRG sent consent forms for the teachers to send home to the students’ parents. The letter addressed to the parents solicited permission for their children to participate in the evaluation research, including the surveys and the interview activity. The students brought back the forms signed by their parents.

After GRG received the signed parental consent forms back from the teachers, a GRG researcher went to the schools to administer a pre-survey to the students. The GRG researcher read aloud the pre-survey questions to the class as a whole and the students individually wrote their answers. Over a period of the next three weeks, the students watched five FETCH episodes, two per week. The sequence of the episodes was pre-determined and consistent across all of the classrooms.

At the end of the third week, GRG researchers returned to the schools for post-data collection activities. These involved a post-survey administered in the same manner as the pre-survey. Then the researchers carried out a short individual interview with a limited sample.

DATA COLLECTION INSTRUMENTS

Pre- and post-surveys

The pre-survey included demographic questions, while the post-survey included the series appeal questions. A set of questions that was common to both surveys queried students about their FETCH viewing habits and about their attitudes toward science. The pre- and post-surveys also sought to evaluate the learner outcomes of the FETCH series. They focused on changes in knowledge and application of science and engineering content and science process. Table 2 indicates the various content and process topics that were included in the survey questions. Appendices A and B contains complete information on the surveys.

Post interviews

The interviews, conducted individually with a subset of the students after they had taken the post surveys, included questions to evaluate whether the students attributed the science knowledge gain to FETCH (See Appendix C for the interview protocol). During the interview, the students were specifically asked to comment on what ideas about science they learned from FETCH and if those ideas helped them answer the questions on the survey. The students were also asked what, if anything, on FETCH helped them answer the specific questions on science and engineering processes.

Table 2
Questions on the pre- and the post- survey

Science Area	Topic	# of questions
Science content	Characteristics of mammals	1
	Job of a neurologist	1
	Gravity and drag	1
	Speed, weight, and aim of a bowling ball	1
	Characteristics of human brain	2
	Characteristics of human pulse	2
Application of science content	Characteristics of mammals	1
	Gravity and drag	1
	Speed, weight, and aim of a bowling ball	1
Science & engineering processes	Experimentation	1
	Variables	1
	Brainstorming of ideas	1
	Testing and redesigning of products	1

DATA ANALYSES

Descriptive statistics such as frequencies and percentages are used to describe the demographic data in the present study. For the content questions, scores were calculated based on the correct responses and paired sample t-tests were carried out to evaluate differences in the mean scores before and after viewing of the FETCH episodes.

Rubrics were created for scoring of the open-ended questions on both the surveys and the interview. All the interview responses were coded by a single researcher. See Appendix D for details on the scoring of the open-ended questions on the interview.

RESULTS

The findings of the evaluation study are presented in the form of responses to the following research questions:

Did the FETCH series appeal to the students?

Did the students show the desired learning outcomes?

- o Were changes in students’ knowledge of science concepts observed?
- o Were changes in students’ application of science concepts observed?
- o Were changes in students’ knowledge and application of science and engineering processes observed?
- o Did the students attribute any knowledge gains to the FETCH series?

DID THE FETCH SERIES APPEAL TO THE STUDENTS?

On both the pre- and post-survey, students reported on their FETCH viewing on television. Not surprisingly, the number of students who reported on the post test that they watched FETCH was significantly higher than the number who had watched before the evaluation activity. This number rose from 40% to 66%.

Students rated each FETCH episode they watched at school as part of the research study (using a 5-point rating scale on which 1 indicated “*Didn’t like it at all*” and 5 indicated “*Completely loved it*”). Overall, FETCH had high appeal for its target audience. The number of students who gave either of the two top ratings ranged from 67% to 91% on the five episodes, as seen in Table 3. The mean ratings ranged from 3.8 to 4.6 out of 5.

Most of the students reported that they "completely loved" or "liked a lot" each episode that they watched.

The episode titled “Brain/Blue Man Group” was the favorite among the students, while the “Soapbox Derby/Dragon Boat” episode received the lowest average appeal rating of the five episodes (though students still like it a lot). It is interesting to note that although the “Soapbox Derby/Dragon Boat” episode received lower ratings, students understood and retained the science concepts from the episode (as discussed later in the report).

Table 3
Ratings by students of the FETCH episodes

Name of the episode	Didn’t like it at all	Didn’t like it very much	Sort of liked it	Liked it a lot	Completely loved it
Dolphin/Etiquette (mean = 4.2)	2%	4%	16%	26%	52%
Soapbox Derby/Dragon Boat (mean = 3.8)	3%	6%	24%	35%	32%
Doggie Stress Test/Gumbo (mean = 4.1)	5%	5%	12%	29%	49%
Bowling/Snowboarding (mean = 4.4)	2%	4%	7%	24%	64%
Brain/Blue Man Group (mean = 4.6)	0%	2%	7%	13%	78%

In open-ended questions on the post-survey, the students reported what they liked best and least about FETCH. The most common responses for what the students liked best about FETCH are displayed in Table 4. About 20% of the students mentioned that they liked learning science in a fun way. The students were also enthusiastic about the format of the show (e.g., contest, adventures, and prizes).

Table 4
What students liked best about FETCH

Response	Examples
It is funny/interesting and educational at the same time (N = 30)	<ul style="list-style-type: none"> • What I liked about FETCH is that you learn things, you have fun while you are learning. • What I liked was that it teaches you a lot in a fun way. • It was fun and it taught me about science. • What I like best about FETCH is how they teach you things not in a boring way; they teach you it in a fun way.
Specific episodes (N = 28)	<ul style="list-style-type: none"> • The Blue Man Group because they spray paint with their mouths. • I like the dolphin episode because it was about racing.
Ruff, the theme song, and the characters (N = 25)	<ul style="list-style-type: none"> • The thing I liked about FETCH is that it is very funny and my favorite characters are Ruff Ruffman and Willy... • I like Ruff a lot! He's kind of funny. I also like Blossom the cat.
The adventures, contests, contestants, and the prizes (N = 25)	<ul style="list-style-type: none"> • What I liked best about FETCH were the challenges, races, and competitions. • What I liked best about FETCH was that all the contestants were real people; they weren't just made up characters.
Learned science and math (N = 22)	<ul style="list-style-type: none"> • I like FETCH because it teaches you. • FETCH teaches you about new things every episode. • I like the science information because I love science.
The half-time show (N = 5)	<ul style="list-style-type: none"> • I liked the ½- time quiz show because I feel that I am part of the show. • What I like best about FETCH is the ½ time quiz show because it shows how much we learn and remembered.

When asked what they liked least about FETCH, close to half of the students replied that they liked everything about the show. Some of the students did not like that the show was only 30 minutes and would like longer episodes. Table 5 displays students' responses regarding their least favorite aspect of FETCH.

What students liked most about FETCH was learning science in a fun way.

Table 5
 What students liked least about FETCH

Response	Examples
Nothing, I liked it all (N = 73)	<ul style="list-style-type: none"> • I liked all of it. • There wasn't really anything I didn't like about it.
The commercials (N = 11)	<ul style="list-style-type: none"> • Mostly nothing. The only thing I hate is that it has some commercials.
The characters (Ruff, the grandmother, the cat) (N = 9)	<ul style="list-style-type: none"> • I didn't like blossom the cat! • The way Ruff Ruffman's Grandma talks.
The way the contest is set up and that the contestants lose (N = 7)	<ul style="list-style-type: none"> • ...felt bad when they lost to Spot Spotnick.
The show was too short (N = 7)	<ul style="list-style-type: none"> • It should last more than 30 minutes, probably 1 hour.
Specific episodes such as the etiquette episode (N = 5)	<ul style="list-style-type: none"> • I didn't like the etiquette because it showed stuff that I already know so it was kind of boring.

Students who participated in the interview were also asked at the end of the interview if they had any suggestions to make the show better. More than 60% of them replied that they were happy with the show the way it was and did not suggest any improvements. Suggestions by other students included making the show longer, increasing the number of contestants, changing the format of the show to include all contestants in challenges, and adding more challenges. Some specific quotes from the students were:

“[The show is] really good – [It] needs to be longer.”

“They shouldn't leave some kids behind because they just wait and wait. Maybe all the kids can do one task – so nobody stays behind.”

“[The show should include] more science things, more harder challenges.”

The students also indicated the kinds of challenges they would like to see on FETCH (See Table 6). There were 42 suggestions, with ideas ranging from sports to animals to food to designing or building assorted items.

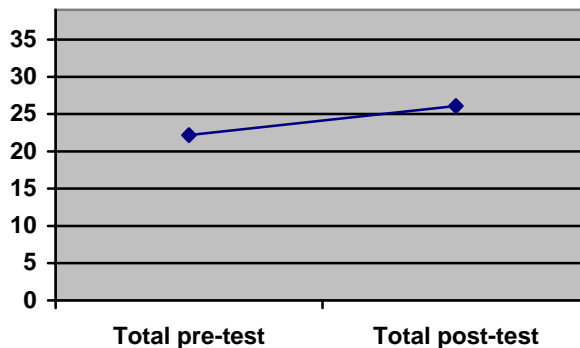
Table 6
Challenges suggested by students

Response	Examples
Sports (N = 12)	<ul style="list-style-type: none"> • Walking in the mountains and seeing more stuff. • Racing in a swimming pool- how fast they are going.
Building things (N = 3)	<ul style="list-style-type: none"> • Building cars, boats, houses.
Weather-oriented (N = 3)	<ul style="list-style-type: none"> • Giant volcano w/ steam coming out. • Something about hurricanes and tornadoes.
Competitions between boys vs. girls (N = 3)	<ul style="list-style-type: none"> • More boys vs. girls challenges. • Boys vs. girls – who is smarter?
Animals (N = 6)	<ul style="list-style-type: none"> • Make dogs do tricks and time how fast they do it. • Test how much faster dogs run than human. • Try to see what kinds of snakes are poisonous. • Reptiles, handling baby alligators/crocodiles.
Food challenges (N = 2)	<ul style="list-style-type: none"> • Create your own food. • Food contests.
Other (N = 13)	<ul style="list-style-type: none"> • Children w/ disabilities- how they get around, what is different in their bodies compared to other people. • Rollercoaster challenge. • Send kids to pencil factory. • Go back in time to see how they lived as pioneers. • Challenge about art.

DO THE STUDENTS SHOW THE DESIRED LEARNING OUTCOMES?

Total pre- and post-scores, composites of all the science and engineering content and process questions, were calculated for each student. The maximum possible score (on pre- or post-) was 39. The mean total score increased at a statistically significant level, from 22.2 on the pre to 26.1 on the post ($p < .01$), as illustrated in Figure 1.

Figure 1
Overall changes in the student mean scores from pre- to post-test



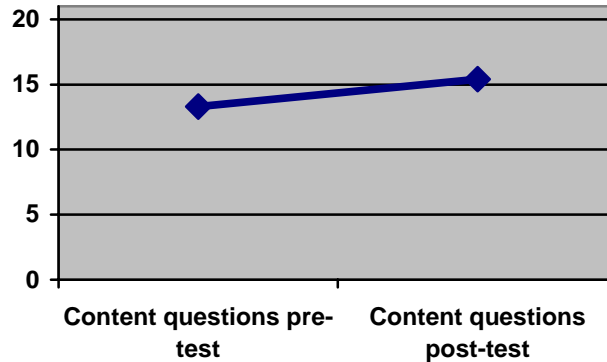
The significant pre-post differences on the total score persisted even when the sample was divided into separate groups by gender, age, FETCH viewing habits, and the state of residence.

Changes in knowledge of science concepts after watching FETCH

Students scored higher on all eight science content questions on the post-test than they did on the pre-test.

To determine students' overall science content knowledge gains after watching FETCH, their total pre scores on the content knowledge questions were compared to their total post scores on the same questions. As illustrated in Figure 2, the mean total content knowledge scores rose from 13.3 to 15.4 (the maximum possible score was 21), which was a statistically significant increase ($p < .01$).

Figure 2
Changes in the student mean scores on the content questions



Once again, the significant pre-post differences on the total content knowledge scores persisted even when analyzed by gender, age, FETCH viewing habits, and the state of residence.

As previously mentioned, the questions on the pre-post survey covered the following science concepts from the FETCH episodes: (1) characteristics of mammals, (2) the job of a neurologist, (3) gravity and drag, (4) speed, weight and aim of a bowling ball, (5) characteristics of the human brain, and (6) characteristics of the human pulse.

Students' knowledge of five out of those six concepts increased at a statistically significant (and practically meaningful) level after watching FETCH. The average percentage increase in correct responses ranged from 11% to 37%, with an average increase of 19%. The results for the knowledge increase for the five concepts are displayed in Table 7.

Table 7
Increases in students' understanding of specific science concepts

	% Correct Pre-Assessment	% Correct Post-Assessment
1. Job of a neurologist	42%	79%*
2. Gravity and drag	38%	64%*
3. Speed, weight, and aim of a bowling ball	29%	41%*
4. Characteristics of human brain – Question 1	71%	88%*
Characteristics of human brain – Question 2	67%	81%*
5. Characteristics of human pulse – Question 1	73%	84%*
Characteristics of human pulse – Question 2	40%	55%*

Number of respondents ranged from 137-171 across questions; *p<.01

The one concept for which there was not a significant increase pertained to characteristics of mammals. Although the change was not statistically significant, the students did demonstrate increased scores from pre- (Mean = 8.7) to post - (Mean = 8.9).

On the post-interview, students were asked to list the various science ideas they learned from FETCH that helped them answer the survey questions. Table 8 indicates the different categories of science ideas the students mentioned. The most commonly mentioned ideas were gravity and friction, followed by various characteristics of the human brain. All the ideas that students mentioned were relevant to the questions on the survey.

Table 8
Science ideas that students mentioned they learned from FETCH

Response	Examples
Friction (N = 20)	<ul style="list-style-type: none"> • Friction stops you from going down a hill.
Gravity and drag (N = 19)	<ul style="list-style-type: none"> • Friction makes things stop and gravity makes you go down faster.
The brain (N = 18)	<ul style="list-style-type: none"> • Brain has many different parts. • Really use 20% or more of brain. • Front of brain is where you do all the thinking.
Mammals (N =13)	<ul style="list-style-type: none"> • People are mammals. • All mammals have to have hair.
Force (N = 12)	<ul style="list-style-type: none"> • Force makes cars go faster.
Dolphins (N = 10)	<ul style="list-style-type: none"> • Dolphins have hair on their noses. • Dolphin is a mammal. • Dolphins are warm-blooded.
Pulse (N = 8)	<ul style="list-style-type: none"> • More than one place to measure pulse.
Who is a neurologist? (N = 3)	<ul style="list-style-type: none"> • Neurologist studies brain.
About science (N = 2)	<ul style="list-style-type: none"> • Science can be fun. • Science is done in different ways. • Science involves working as a team.

Changes in application of science content after watching FETCH

There were three questions on the surveys that tested student's abilities to apply the science concepts they had learned from FETCH. To determine students' overall gains in the application of scientific concepts after watching FETCH, their total pre-scores on these science application questions were compared to their total post-scores on the same set of questions. There was a statistically significant rise in these mean scores from 6.7 to 8 (the maximum possible score was 11), or from 61% to 73% (out of 100%).

After FETCH, students showed improvement in their application of science concepts related to mammals, and gravity and friction.

As with the other knowledge questions, the significant pre-post differences on the total science application scores persisted even analyzed by gender, age, FETCH viewing habits, and the state of residence.

Out of the three questions that asked students to apply content knowledge, students' post-test scores were statistically higher than the pre-scores on two questions – one related to the characteristics of mammals and the other related to speed, weight, and aim of a bowling ball.

It is interesting to note that on the above mentioned questions, the students not only showed significant increase in the scores on the post-test but also showed improved explanations for their answers. Their explanations after FETCH revealed their understanding of science concepts and their ability to apply them.

For example, for the question on speed, weight, and aim of a bowling ball, the students had to pick which one of the two balls (one weighing 3 pounds and one weighing 16 pounds) that rolled at same speed would be more likely to make a strike. After choosing their answer, they then had to explain why they chose it. Analyses of their explanations indicated that significantly more students wrote the correct explanation (at the same speed, the *heavier* ball is more likely to make a strike) on the post (N = 90) than on the pre (N = 61). This demonstrated a clear application of the concepts of impact of speed and weight.

Changes in knowledge and application of science and engineering processes after watching FETCH

To determine the overall gains for students in their understanding of science and engineering processes after watching FETCH, their total pre-scores on the process questions were compared to their total post-scores. Analyses demonstrated a statistically significant rise in these mean scores, from 1.8 to 2.3 (the maximum possible score was 6), or 30% to 38%.

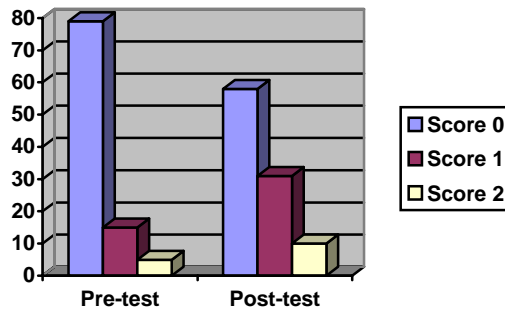
Once again, the sample was divided into separate groups by age, gender, FETCH viewing habits, and state of residence. The significant pre-post differences on the total science process score persisted when analyzed by gender and FETCH viewing habits. In terms of age, only the 10-year-olds showed significant pre-post differences on the total process scores. Further, only the students from Massachusetts – and not San Diego – showed gains.

The questions on the survey evaluated students' understanding of the following four processes: experiment design, controlling variables, brainstorming of ideas, and testing and redesigning of products. The question on design of an experiment presented students with a research scenario and asked them to indicate what they would do to improve the experiment. The questions on variables and brainstorming of ideas were multiple choice questions where, again, students were presented with research scenarios with alternatives and they had to pick the best alternative. Finally, the question on testing and redesigning of products was an open-ended question where the students wrote what their next step would be after designing a product.

Students showed statistical gains in scores from pre to post on the question about designing an experiment.

Out of these, statistical difference on the pre- and post-tests was found for the question on design of experiment ($p < .01$). Figure 3 demonstrates the percentages of students getting the scores of 0, 1, and 2 on the pre and the post test for this question, where 0 indicates the "Don't know," 1 indicates an answer where relevant scientific ideas are mentioned but not explained, and 2 indicates an answer where relevant scientific ideas are mentioned and also explained. These scientific ideas included making observations, using graphs to measure growth, and using control variables in the experiment.

Figure 3
Pre- and post-scores on the experimentation process question



The students' scores on the questions on controlling variables, brainstorming of ideas, and testing and redesigning of products did increase from pre- to post-, although these scores were not statistically significant.

Relationship between student scores on the surveys and the interviews

The post interview questions were designed to determine whether the students attributed any science knowledge gain to FETCH. Using a rubric created to score the interview responses, a total interview score was calculated (See Appendix D). A higher score indicated stronger association of the knowledge gain to the viewing of FETCH episodes. The maximum possible total score on the interview was 18. The mean score obtained was 4.7.

As mentioned earlier, the students retained a number of science ideas that they learned from FETCH, and mentioned those during the interview (See Table 9). So the lower scores on the interview indicated that although the students attributed the knowledge gain in science *content* to FETCH, they did not attribute the knowledge gain about science *processes* to FETCH. The science content on FETCH seemed to be more obvious to the students, or was easier for them to talk about, than the science and engineering processes. The students articulated the science concepts more than the science and engineering processes.

The following demographic differences were also found in the total interview score:

On the post-interviews, students articulated the science concepts more than the science and engineering processes.

- Students in Massachusetts had significantly higher interview scores (mean = 6.7) than those in California (mean = 3.1), indicating that the students in Massachusetts as a group made more associations between FETCH and the questions on the survey.
- Boys (mean = 5.4) had higher scores than did the girls (mean = 4.0). Although this difference was small, it was statistically significant.
- Younger children had higher scores than did older children. Nine-year olds had the highest scores (mean = 5.4), followed by 10-year-olds (mean = 4.8), and finally 11 year olds (mean = 1.9)

There were no differences on the interview scores based on whether the children had watched FETCH before the evaluation activity or not.

There were statistically significant correlations among the total scores on the survey, total process scores, total content scores, total applied scores and the students' scores on the interview (See Table 9). These correlations indicate that there was a specific pattern to the scores obtained by the students. Higher scores on the interview were associated with higher scores on the survey overall as well as on specific parts of the survey.

Table 9
Correlations indicating the relationship between the survey and the interview scores

	Total interview score	Total process score	Total applied score	Total content score	Total score
Total interview score	1				
Total process Score	.373*	1			
Total applied Score	.235**	.287*	1		
Total content Score	.227**	.347*	.436*	1	
Total score	.310*	.578*	.757*	.887*	1

N varies from 102 to 154; * = p<.01; ** = p <.05

CONCLUSIONS

GRG's summative evaluation of FETCH focused on the appeal of the show to its target audience and its effectiveness in influencing children's understanding of specific science concepts and their application, as well as certain science and engineering process skills. Based on the results of this evaluation, GRG draws the following conclusions.

The FETCH series continues to have high appeal for the target audience in its second season.

Most of the students (ranging from 67% to 91%) reported that they "completely loved" or "liked a lot" each episode that they watched. When asked what students liked best about the show, the most common response was that they liked learning science in a fun way.

Students showed overall gains in their knowledge about science concepts and processes after watching FETCH.

Overall, the students showed a significant increase in their scores on the science questions from the pre- to the post-tests. This difference persisted even when the sample was separated out by gender, age, FETCH viewing habits, and the state of residence.

FETCH was effective at increasing children's *understanding* of specific science concepts.

The students scored higher on all eight science content questions on the post-test than they did on the pre-test. On seven out of these eight questions, the differences were statistically significant. Also, when asked explicitly to list the science ideas they learned from FETCH, students mentioned, on average, at least one idea related to the questions on the survey.

FETCH was effective at increasing children's *application* of specific science concepts.

When asked to apply science content learned on the show to new situations, the students not only showed a significant increase in their scores from the pre- to the post-test, but also an improvement in their written explanations. Their explanations indicated clearly their increased understanding of mammals, gravity, and friction, and their ability to apply this knowledge to new contexts.

FETCH was moderately effective at increasing children's understanding and application of science processes.

One research goal of the current evaluation focused on evaluating students' understanding and application of science and engineering processes through four different questions about: (1) design of an experiment, (2) controlling variables, (3) brainstorming ideas, and (4) testing and redesigning of products.

Significant improvement was observed in the question about design of an experiment. Students were more likely on the post- than the pre- to describe scientific terms involved in an experiment such as making observations, using graphs to measure growth, and using control variables. On the other three questions, although not statistically significant, an upward trend was found from the pre- to the post-scores.

Students more readily discussed FETCH science concepts than they did FETCH science processes.

Students were able to talk about the science ideas they learned from FETCH. However, we found they were not as articulate when it came to discussing science processes they learned through FETCH. Thus, it appeared that FETCH science content was more obvious to (or easier to discuss for) the students than were FETCH science processes.

RECOMMENDATIONS

Based on the data collected through the student surveys and interviews, GRG makes the following recommendations.

Focus on the science and engineering processes during FETCH's next season.

In both Seasons 1 and 2 evaluations, students have shown significant increases in their knowledge about science concepts after watching FETCH. The learning of science processes was one of the primary foci for the current year, and the evaluation shows that although students' scores improved on the question related to design of an experiment, they still need help increasing their knowledge of science and engineering processes such as testing and redesigning.

GRG recommends that WGBH continue to focus on science processes as a primary theme of the show in the upcoming year. We recommend that WGBH highlight as explicitly as possible the science processes in each episode, through the use of graphics, diagrams and other visual aids.

Make specific alterations to the format of the show, while keeping the basic model intact.

The open-ended responses of the students and their ratings of the episodes indicate that the students enjoy the format of the FETCH show. They like the concept of competitions and learning science through the challenges on the show. For this reason, GRG recommends that WGBH maintain the basic format of the show.

However, it might prove advantageous to add a separate section at the end of each episode that reinforces both the featured science concept(s) and, most importantly, the science processes highlighted during that episode. This could be in addition to the half-time show.

Introduce new science and engineering processes to the viewers while also helping them generalize these ideas.

The current evaluation data demonstrated that even though students learn about science and engineering processes through FETCH, they do not necessarily generalize those processes to related but different scenarios. GRG recommends that the content and characters on the show emphasize and demonstrate how science processes can be generalized. For example, if the episode is dealing with the concept of experimentation and the various strategies to enhance an experiment, the cast members could be shown engaging in multiple experiments. They could draw parallels between the different experiment scenarios, which would reinforce the notion of generalizing the concept(s).

CONCLUDING STATEMENT

FETCH is an extremely popular show that is successful in teaching young children science concepts and application of these concepts. The show also demonstrates promise in teaching science processes to the children. As FETCH moves into its third season, it could benefit from the aforementioned recommendations provided.

APPENDIX A

FETCH Pre Survey

1. Are you a: Girl Boy

2. Circle your age: 7 8 9 10

3. What is your ethnicity? Hispanic Not Hispanic

4. Are you: *(Check one or more boxes.)*
 - American Indian or Alaska Native
 - Asian
 - Black or African American
 - Native Hawaiian or Other Pacific Islander
 - White
 - Other, please specify: _____

5. Have you watched FETCH! on TV? Yes No
 If yes, how often do you watch FETCH? *(Check one box.)*
 - Once a week
 - Two or three times a month
 - Once a month
 - Less than once a month
 On a scale of 1-5, how much do you like the FETCH! TV show? *(Circle one number.)*

Not at all				Awesome
1	2	3	4	5

6. How strongly do you agree or disagree with each of the following statements? *(Check one box for each.)*

	Agree a lot	Agree a little	Not sure	Disagree a little	Disagree a lot
I like science.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I enjoy learning science.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Science is boring.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Science is important to everyone's life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It is fun to build things.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Below are some questions about science. You will be learning about some of these things in the next few weeks. We want to see how much you already know about these topics. Answer each question as best you can - if you don't know an answer to a question, just take your best guess.

7. Which of the following are mammals? Circle the pictures of the mammals.



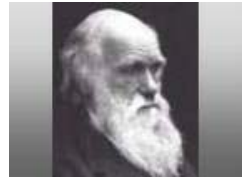
DOG



FISH



COW



MAN



SNAKE



CROW



FROG



WHALE



DOLPHIN



KANGAROO

8. Which of the following best describes what a neurologist does? Check the correct answer.

- A neurologist is a doctor who specializes in the treatment of children.
- A neurologist is a doctor who specializes in the treatment of ear, nose and throat.
- A neurologist is a doctor who specializes in the study the brain and spinal cord.
- A neurologist is a doctor who specializes in the treatment of the lungs.

9. The force with which a ball strikes the pins in a bowling alley is determined by two factors: _____ and _____.



10. Name the force that is pulling these go-carts down on the slope:

11. Name one force that is slowing the go-carts down:

12. A scientist goes into a jungle to study some animals. During his study he finds a new animal in the jungle and has to decide whether the animal is a mammal. He has observed the following characteristics in the animal:

- The animal has five limbs
- It nurses its young with milk
- It breathes air
- It has blue eyes
- It is warm-blooded
- It eats only plants and does not eat meat
- It has hair on its body
- It can climb trees
- It does not lay eggs

Do you think the scientist should classify the new animal as a mammal?

YES NO

Circle the characteristics from the above list that helped you make your decision.

13. You are at a bowling alley and can use one of the two balls in the picture below. If you roll each ball at the same speed, which ball will have more force on the pins so that you might get a strike?

- Ball A
 Ball B



Ball A
(weight = 3 pounds)

Ball B
(weight =

16 pounds)

Please explain your answer:

14. Below are pairs of sentences about the human body. For each pair, check the sentence that is TRUE.

1. The human brain is made of different parts with specific functions carried out by each part.
 The human brain is made of different parts, but many parts do the same thing.
2. Humans use a small portion of their brains in everyday life.
 Humans use a large portion of their brain in everyday life.
3. The same part of our brain is involved in smelling, tasting, seeing, touching, and hearing.
 There are different parts of our brain that help us smell, taste, see, touch, and hear.
4. Blood travels all over the body, but there is only one place on the body where we can feel a pulse.
 Blood travels all over the body, and there are many places where we can feel a pulse.
5. When you experience something stressful, your heart rate immediately goes up and you get energy.
 When you experience something stressful, your heart rate immediately goes down and you get tired and depressed.

15. Which of the two airplanes will experience less drag?

- Airplane A
- Airplane B



Airplane A



Airplane B

Please explain your answer:

16. Emilee wanted to find out if fertilizer makes plants grow faster. She grew plants in four containers. Two containers got a little bit of fertilizer and two containers got a lot of fertilizer. After four days, Emilee examined the containers and recorded the growth of the plants. She discovered that the plants in the containers with a lot of fertilizer grew taller than the plants in the containers with a little fertilizer and concluded that fertilizers make plant grow faster.

What could Emilee have done to make her experiment better? You can use the following words in your answer: observe, control, graph, prediction, measure, fair

17. Jim thinks that the more air pressure in a basketball, the higher it will bounce. He collects several basketballs and an air pump with a pressure gauge. How should Jim test out his idea?

- Bounce basketballs with different amounts of force from the same height.
- Bounce basketballs having different air pressures from the same height.
- Bounce basketballs having the same air pressure at different angles from the floor.
- Bounce basketballs having the same amount of air pressure from different heights.

18. A group of students went on a camping trip and forgot their tent. The weather forecast predicted rain for that evening. There are four students in the group.

Each student has some ideas about how to build the tent. What would be the best way for them to start?

- Vote on a leader and have the leader listen to the ideas and then decide the best way to build the tent
- Talk about as many ideas as they can and then pick the best one
- Build each idea one at a time and then choose the one that was the best
- Have each person write their idea on a piece of paper, put the pieces of paper in a hat, and have someone pick one without looking

19. Imagine that you must build a small toy sailboat and enter it into a race. You have been provided with the materials required to build a boat. With the help of a group of friends you build a small sail boat. What will you do next?

APPENDIX B

FETCH Post Survey

First, we have some questions about the FETCH episodes you watched.

1. Circle the number that best describes HOW MUCH YOU LIKED each FETCH episode.

	Didn't like it at all	Didn't like it very much	Sort of liked it	Liked it a lot	Completely loved it
Dolphin/Etiquette	1	2	3	4	5
Soapbox Derby/Dragon Boat	1	2	3	4	5
Doggie Stress Test/Gumbo	1	2	3	4	5
Bowling/Snowboarding	1	2	3	4	5
Brain/Blue Man Group	1	2	3	4	5

2. What did you like best about FETCH?

3. What did you like least about FETCH?

4. Have you watched FETCH! on TV? Yes No

If yes, how often do you watch FETCH? (Check one box.)

- Once a week
- Two or three times a month
- Once a month
- Less than once a month

5. How strongly do you agree or disagree with each of the following statements? (Check one box for each.)

	Agree a lot	Agree a little	Not sure	Disagree a little	Disagree a lot
I like science.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

I enjoy learning science.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Science is boring.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Science is important to everyone's life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It is fun to build things.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Below are some questions about science. You will be learning about some of these things in the next few weeks. We want to see how much you already know about these topics. Answer each question as best you can - if you don't know an answer to a question, just take your best guess.

6. Which of the following are mammals? Circle the pictures of the mammals.



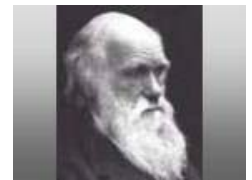
DOG



FISH



COW



MAN



SNAKE



CROW



FROG



LION



WHALE



DOLPHIN



KANGAROO

7. Which of the following best describes what a neurologist does? Check the correct answer.

- A neurologist is a doctor who specializes in the treatment of children.
- A neurologist is a doctor who specializes in the treatment of ear, nose and throat.
- A neurologist is a doctor who specializes in the study the brain and spinal cord.
- A neurologist is a doctor who specializes in the treatment of the lungs.

8. The force with which a ball strikes the pins in a bowling alley is determined by two factors:
_____ and _____.



9. Name the force that is pulling these go-carts down on the slope:

10. Name one force that is slowing the go-carts down: _____

11. A scientist goes into a jungle to study some animals. During his study he finds a new animal in the jungle and has to decide whether the animal is a mammal. He has observed the following characteristics in the animal:

- The animal has five limbs
- It nurses its young with milk
- It breathes air
- It has blue eyes
- It is warm-blooded
- It eats only plants and does not eat meat
- It has hair on its body
- It can climb trees
- It does not lay eggs

Do you think the scientist should classify the new animal as a mammal?

YES NO

Circle the characteristics from the above list that helped you make your decision.

12. You are at a bowling alley and can use one of the two balls in the picture below. If you roll each ball at the same speed, which ball will have more force on the pins so that you might get a strike?

- Ball A
 Ball B



Ball A
(weight = 3 pounds)

Ball B
(weight = 16 pounds)

Please explain your answer:

13. Below are pairs of sentences about the human body. For each pair, check the sentence that is TRUE.

14. The human brain is made of different parts with specific functions carried out by each part.

The human brain is made of different parts, but many parts do the same thing.

15. Humans use a small portion of their brains in everyday life.

Humans use a large portion of their brain in everyday life.

16. The same part of our brain is involved in smelling, tasting, seeing, touching, and hearing.

There are different parts of our brain that help us smell, taste, see, touch, and hear.

17. Blood travels all over the body, but there is only one place on the body where we can feel a pulse.

Blood travels all over the body, and there are many places where we can feel a pulse.

18. When you experience something stressful, your heart rate immediately goes up and you get energy.

When you experience something stressful, your heart rate immediately goes down and you get tired and depressed.

19. Which of the two airplanes will experience less drag?

Airplane A

Airplane B



Airplane A



Airplane B

Please explain your answer:

16. Emilee wanted to find out if fertilizer makes plants grow faster. She grew plants in four containers. Two containers got a little bit of fertilizer and two containers got a lot of fertilizer. After four days, Emilee examined the containers and recorded the growth of the plants. She discovered that the plants in the containers with a lot of fertilizer grew taller than the plants in the containers with a little fertilizer and concluded that fertilizers make plant grow faster.

What could Emilee have done to make her experiment better? You can use the following words in your answer: observe, control, graph, prediction, measure, fair

17. Jim thinks that the more air pressure in a basketball, the higher it will bounce. He collects several basketballs and an air pump with a pressure gauge. How should Jim test out his idea?

- Bounce basketballs with different amounts of force from the same height.
- Bounce basketballs having different air pressures from the same height.
- Bounce basketballs having the same air pressure at different angles from the floor.
- Bounce basketballs having the same amount of air pressure from different heights.

20. A group of students went on a camping trip and forgot their tent. The weather forecast predicted rain for that evening. There are four students in the group.

Each student has some ideas about how to build the tent. What would be the best way for them to start?

- Vote on a leader and have the leader listen to the ideas and then decide the best way to build the tent
- Talk about as many ideas as they can and then pick the best one
- Build each idea one at a time and then choose the one that was the best
- Have each person write their idea on a piece of paper, put the pieces of paper in a hat, and have someone pick one without looking

21. Imagine that you must build a small toy sailboat and enter it into a race. You have been provided with the materials required to build a boat. With the help of a group of friends you build a small sail boat. What will you do next?

APPENDIX C

FETCH questions for post - interview

Notes on the protocol:

The interview will be conducted during the post-data collection visit after the children have completed filling out the post survey. Each student will meet individually with a researcher for about 5-7 minutes. The researcher will have the student's post survey with her while asking the following questions and will show it to the student.

- Do you remember answering these questions a few weeks ago?
Y/N

- [If yes] Was it easier, or the same, or harder to answer them today?

[If easier] What made it easier? (Look for reference to FETCH episodes.)

[If harder] What made it harder? _____

[If same..... No follow-up question]

- [Regardless of how they answered above]:
[If mentioned FETCH] How many of the episodes did you watch in school?

What ideas about science did you get from watching FETCH?
[probe: How did that help you today?]

[If doesn't mention FETCH] You watched a few FETCH episodes with your class. Did you get any ideas about science from watching FETCH?

- Take a moment and think about the things you learned about science from watching FETCH. Did you see anything on FETCH that helped you answer the question about the girl who wanted to see if fertilizer makes plants grow faster (#15). Tell me a few of the ideas you got from the show.

- Some of the words you could use were: observe, control, graph, prediction, measure, and fair. Did you see anything on FETCH that helped you to use these words in your answer?

- Now I'd like you to think about what you learned from the FETCH episodes about building things. Tell me if you saw anything on FETCH that helped you to answer the question about a group of kids building a tent (#17). (I think we may need to show kids the question so they remember what it was about.)

- Now tell me if you saw anything on FETCH that helped you to answer the question about building a toy sailboat (#18).

- Okay, great. I have just one more question for you. The people who make the show are interested in your opinions as they come up with new episodes. Do you have any suggestions to make the show better? [Probe: Are there any challenges you'd like to see?]

APPENDIX D

Coding for interview questions

- Do you remember answering these questions a few weeks ago?
Y/N

- [If yes] Was it easier, or the same, or harder to answer them today?

[If easier] What made it easier? (Look for reference to FETCH episodes.)

[If harder] What made it harder? _____

[If same..... No follow-up question]

Yes = 1	NO = 0
If yes, Harder = 0	
Same = 1	
Easier = 2	

- [Regardless of how they answered above]:
[If mentioned FETCH] How many of the episodes did you watch in school?

What ideas about science did you get from watching FETCH?
[probe: How did that help you today?]

[If doesn't mention FETCH] You watched a few FETCH episodes with your class. Did you get any ideas about science from watching FETCH?

0 – Does not mention any science-related idea from FETCH
1 – Mentions science-content ideas not related to the questions on the survey
2 – Mentions at least one science-content idea related to the questions on the survey
3 – Mentions science-process ideas not related to the questions on the survey
4 – Mentions one science-process idea related to the questions on the survey
5 – Mentions multiple science-content ideas related to the questions on the survey
6 – Mentions multiple science-process ideas related to the questions on the survey
7 – Makes connections between the ideas and the answers to the questions

- Take a moment and think about the things you learned about science from watching FETCH. Did you see anything on FETCH that helped you answer the question about the girl who wanted to see if fertilizer makes plants grow faster (#15). Tell me a few of the ideas you got from the show.

0 – Don't know / No ideas / Irrelevant answer
 1 – Described an episode without making any connections to the question
 2 – Described an episode and connected it to the question
 3 – Described the ideas on FETCH with the use of words such as observe, control, graph, prediction, measure, and fair.

- Some of the words you could use were: observe, control, graph, prediction, measure, and fair. Did you see anything on FETCH that helped you to use these words in your answer?

0 – Answered No / Don't know / No ideas / Irrelevant answer
 1 – Answered yes, but was not able to describe the connection between FETCH episodes and these terms
 2 – Answered yes, and was able to describe the connection between FETCH episodes and these terms

- Now I'd like you to think about what you learned from the FETCH episodes about building things. Tell me if you saw anything on FETCH that helped you to answer the question about a group of kids building a tent (#17). (I think we may need to show kids the question so they remember what it was about.)

0 – Don't know / No ideas / Irrelevant answer
 1 – Described an episode without making any connections to the question
 2 – Described an episode and connected it to the question
 3 – Described the ideas on FETCH particularly relevant to this question such as brainstorming and teamwork

- Now tell me if you saw anything on FETCH that helped you to answer the question about building a toy sailboat (#18).

0 – Don't know / No ideas / Irrelevant answer
1 – Described an episode without making any connections to the question
2 – Described an episode and connected it to the question
3 – Described the ideas on FETCH particularly relevant to this question such as testing your product and redesigning

- Okay, great. I have just one more question for you. The people who make the show are interested in your opinions as they come up with new episodes. Do you have any suggestions to make the show better? [Probe: Are there any challenges you'd like to see?]

Open ended responses