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Summative Evaluation of *Journey into Amazing Caves* with a Student Audience

Report for

MacGillivray Freeman Films

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EXECUTIVE SUMMARY OF SUMMATIVE EVALUATION OF *JOURNEY INTO AMAZING CAVES* (STUDENT SAMPLE)

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With funding from the National Science Foundation, MacGillivray Freeman Films has produced an IMAX® film titled, *Journey into Amazing Caves*. The 40-minute film follows two women cavers on an expedition as they explore limestone caverns of the Grand Canyon, underwater caves of the Yucatan and ice caves of Greenland.

The summative evaluation reported here focused on the following major outcomes:

- To what extent and in what ways did the film appeal to eighth grade viewers?
- To what extent did the film achieve its intended viewing goals?
- Did exposure to a web-based school activity after viewing affect learning outcomes?
- What did viewers perceive that they learned from the film?
- What new information did viewers learn about scientists?

Method

Eighth graders (N = 101) from a Portland, OR, middle school attended the film at the Oregon Museum of Science and Industry. Most students in six classes completed questionnaires one week prior to seeing the film and one week after seeing the film. Three to four days after seeing the film, students in three classes participated in a web-based activity related to the film.
The following samples were obtained:

n = 37	Pre-questionnaire	Film	Web activity	Post-questionnaire (FILM+ACTIVITY)
n = 41	Pre-questionnaire	Film		Post-questionnaire (FILM)
n = 9		Film	Web activity	Post-questionnaire (FILM+ACTIVITY)
n = 14		Film		Post-questionnaire (FILM)

The four conditions did not differ significantly with respect to the classifications of gender, ethnicity and number of giant format films ever seen. The sample as a whole was 57% female and 81% white. Three-quarters of the sample had experienced two or more large-format films.

Findings

Journey into Amazing Caves was rated as moderately appealing by eight grade viewers; made a significant impact on their knowledge of cave life, cave formation, cave exploration; and influenced 40% of the audience in terms of their understanding of scientists.

To what extent and in what ways did the film appeal to student viewers?

Eighth graders were moderately positive in their quantitative ratings (1-5) of the overall entertainment value of the film. On average, the audience found the film visually exciting (mean = 3.9); learned from it (3.7); liked it (3.6); had their curiosity increased (3.6); would recommend it to others (3.5); and thought the story interesting (3.4). The ratings were independent of gender, ethnicity, and exposure to large-format films. Those students who experienced the web activity after seeing the film rated the film significantly less appealing and less visually exciting than those who were not exposed to the web.

In response to an open-ended question, the audience liked the following about the film:

- 32% Ice caves
- 18% Variety of caves
- 17% Experiential quality
- 13% Cinematography
- 10% Underwater caves

- 6% Story of science

When asked what they did not like about the film, respondents' answers focused on:

- 20% Inclusion of classroom
- 12% Boring, slow, dragged
- 9% Storyline
- 7% Too little about caves themselves
- 6% Too talky, not enough action
- 5% IMAX format caused discomfort

The audience was surprised by the

- 21% ice caves
- 13% underwater caves
- 13% IMAX screen effects
- 8% medical research
- 7% boring, slow, long film
- 5% diversity of caves
- 5% danger for cavers, filmers
- 5% good film
- 4% how explored caves
- 4% canyon caving

Those who were disappointed with the film noted:

- 13% the film was too long, boring, slow
- 10% too short
- 7% storyline
- 7% need for more or better explained information
- 6% need to see more caves

To what extent did the film achieve its intended viewing goals?
Did exposure to a web-based school activity after viewing affect learning outcomes?

Viewing the film significantly increased knowledge, as measured by a 20-point content test on the intended viewing goals. The average gain score for students who saw only the film (FILM) was 3.9 points and the average gain for students who saw the film and did a web activity (FILM + ACTIVITY) was 2.4 points; both gains are significantly above a zero improvement. We can conclude that seeing the film with or without doing the web activity significantly improved eighth graders' knowledge about cave life, cave exploration techniques and cave formation. However, exposure to the web activity did not significantly add to the film knowledge base. An analysis of test questions relating specifically to the web pages indicates that doing the web activity did not add to student knowledge about ice caves or underwater caves.

What did viewers perceive that they learned from the film?

The most interesting things learned from the film included the following:

- 31% about collecting microorganisms in caves to develop new medicines
- 15% about ice caves
- 10% about how dangerous caving is
- 10% about halocline
- 9% about different caves

What new information did viewers learn about scientists?

Two-fifths of respondents felt that learned something about scientists that they had not known before viewing the film. Their new learning included:

- 30% that scientists would search caves for specimens
- 18% that scientists don't just work in labs or behind computers
- 8% how dedicated scientists are
- 5% how scientists risk their lives

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INTRODUCTION

With support from the National Science Foundation, MacGillivray Freeman Films has produced an IMAX® film titled, *Journey into Amazing Caves*. The 40-minute film follows two women cavers on an expedition as they explore limestone caverns of the Grand Canyon, underwater caves of the Yucatan and ice caves of Greenland.

The summative evaluation reported here focused on the following major outcomes:

- To what extent and in what ways did the film appeal to 8th grade viewers?
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- What did students perceive that they learned from the film?
- What new information did viewers learn about scientists?

METHOD

Design

A quasi-experimental pretest/posttest non-equivalent comparison group design was planned with middle school students to evaluate the film and an ancillary web-based activity. Intact school classes were assigned to one of two treatments: viewing the film only (FILM) and viewing the film followed by completion of a content-related web-based activity (FILM + ACTIVITY).

Procedure

From a list of middle schools already signed up to attend the film at Oregon's Museum of Science and Industry in May, 2001, one middle school was recruited successfully in Portland, OR. A science teacher administered the pre-viewing questionnaire as part of the eighth grade regular classroom activity. One week later, about 100 eight graders took a field trip to Oregon's Museum of Science and Industry to see *Journey into Amazing Caves.* Four days after viewing, three of six classes completed a web-based activity (described below) while a researcher observed their interactions. The day after classes had finished the web lab, the science teacher administered the post-viewing questionnaire to everyone who had seen the film one week earlier.

Pre-viewing and Post-viewing Questionnaires

Demographic and Background Variables. The previewing questionnaire asked about interest in and knowledge of caves. The post-viewing questionnaire established students' status with respect to three classification variables (gender, ethnicity, number of IMAX films ever seen).

Film Appeal. Post-viewing respondents rated the film on a variety of descriptors, explained what they liked and did not like about the film and why, and filled out two sentence completion items: "I was surprised . . ." and "I was most disappointed . . . ."

Film Knowledge. Both the pre-viewing and post-viewing questionnaires included a knowledge test to assess understanding of the viewing goals. Twelve "true-false-don't know" questions and 8 "true-false" questions comprised a 20-point test about content covered in the film. Questions were randomized in different orders for pre and post.

Underground caves form due to erosion of soil between rocks.	False
Cave bats eat insects and fruit.	True
A halocline is where sea water and fresh water meet in an underwater cave.	True
Ice caves form in glaciers as a result of minor earth movements.	False
Microorganisms from caves may be a source of new medicines.	True
Colored layers along a cave wall reveal the age of glacial ice.	True
Bacteria cannot live in the extreme cold of an ice cave.	False
Stone formations in underground caves are extremely durable.	False
Ice caves in glaciers are not permanent but form anew each year.	True
Animals that live in caves are called extremophiles.	False
Underwater cave exploration is dangerous because of ceiling debris falling.	True
Excellent eyesight permits underwater cave animals to live in total darkness.	False

Circle each and every object that cavers use to explore caves:

Scuba tank	Heatgun	Ice screws	Raft
Chalk	Diveline	Helmet	Ice Skates

["true" responses include scuba tank, ice screws, raft, diveline, helmet]

Additional open-ended content questions included (a) what was the most interesting thing you learned; and (b) did you learn anything about scientists that you did not know before viewing the film.

Web-Based Activity

Four days after viewing *Journey into Amazing Caves,* three 8th grade classes of about 60 students total completed a web-based activity associated with the film in the school computer lab. The web-based activity, designed by the researchers with review by Janna Emmel of MacGillivray Freeman Films, was included in order to assess the added value of an Internet activity. The student activity sheet appears in the Appendix.

At the beginning of each lab session, a researcher introduced herself as an independent researcher who worked with the producers of the caves film; she then distributed the activity sheets and briefly reviewed the instructions at the top of the sheet. Students then commenced the activity, which consisted of answering questions on the sheet using information contained in the *Learning from Caves* section of the *amazingcaves.com* web site. All

of the computers in the lab were set at the opening page of the site prior to the session to ensure all students began the activity from the same place.

The researcher was present to help with technical issues but did not interfere with students' experience with the activity. A classroom teacher was on hand to answer questions that arose about the activity itself. At the end of each session, students rated how much they liked the overall experience of doing the activity.

Although this evaluation focused on the value of the web activity in reinforcing the film content, the observations during the activity labs constitute useful formative information for future web designs. The Appendix includes a report on class time on task, technical issues encountered and issues and questions that arose surrounding students' use of the activity sheet and website.

Sample

The participating Portland, OR, middle school serves middle to middle-lower income families and reports 15% minorities in its 8th grade, mostly Asian/Pacific Islanders. Although potentially 120 8th graders were available, many students did not return permission slips in time to take the field trip. Paired pre and post-viewing questionnaires were obtained from 78 students who had seen the film, including 37 who completed the web activity. Post-viewing only questionnaires were obtained from 23 students who had seen the film, including 9 who completed the web activity. So the four condition samples included the following:

Pre-questionnaire	Film	Web-activity	Post-questionnaire	n = 37
Pre-questionnaire	Film		Post-questionnaire	n = 41
	Film	Web-activity	Post-questionnaire	n = 9
	Film		Post-questionnaire	n = 14

Information from demographic and background questions was used to determine whether the four groups above differed. Chi-square analyses revealed no differences in distributions of gender, ethnicity or number of large-format films previously viewed. Because our conditions are equivalent in background characteristics, where appropriate the data and feedback from groups is combined in this report. Table 1 summarizes the demographic information for the whole film-viewing sample of 101 8th graders.

Table 1. Demographic and background variables

Variable	*N*	*Categories*	*Percent*
Gender	101	Female	57%
		Male	43%
Ethnicity	101	White	81%
		Minority (12% Asian)	19%
Number of IMAX films ever seen	101	1 movie	22%
		2 movies	22%
		3 movies	25%
		4 or more movies	31%

Respondents to the pre-viewing questionnaire only were asked how interested they were in learning about caves and how much they already knew about caves. Only 11% of the pre-viewing audience was "very interested" in the film topic and 30% were "moderately" interested (see Table 2). Only 3% of the pre-viewing group felt that they knew "a lot" about caves prior to seeing the film; most respondents (56%) felt they knew "a little" (see Table 3). Males were more interested in caves and rated themselves as more knowledgeable as compared with females.[1]

Table 2. Interest in learning about caves (Pre-viewing only)

Variable	*N*	*Categories*	*Percent*
Interest	78	Very interested	11%
		Moderately interested	30%
		A little interested	42%
		Not interested at all	17%

Table 3. Self-reported knowledge of caves (Pre-viewing only)

Variable	*N*	*Categories*	*Percent*
Knowledge	78	Know a lot	3%
		Know a moderate amount	6%
		Know a little	56%
		Know nothing	35%

[1] Statistical analyses in this report, include , as appropriate, chi-square and t- tests of means. Any results with a p value of less that .05 are reported as "significant." All comparisons were made with respect to the classifications of gender, ethnicity and frequency of viewing large-format films.

RESULTS

Appeal of *Journey into Amazing Caves*

About four to five days after seeing the film, viewers rated the film overall on a variety of descriptors, as indicated in Table 4. Respondents were positive about the overall entertainment value of the film. On average, students liked the film, found it visually exciting, informative and curiosity-raising but were least interested in the story. Liking the film was correlated highly with story interest (r_s = .62). There were no subsample rating differences for gender, ethnicity, frequency of previous IMAX film viewing, pre-viewing interest in or knowledge of caves. Those who did not experience the web activity (n = 55) rated the film as significantly more appealing and visually exciting than those who did the web activity (n = 46), although both groups gave high mean ratings for these two descriptors (see Table 4 for specifics).

Table 4. Mean ratings of film's entertainment value

	1 2 3 4 5	
Disliked the film	3.6	Liked the film
	Web activity = 3.4; No web activity = 3.9	
Visually boring	3.9	Visually exciting
	Web activity = 3.6; No web activity = 4.1	
Learned nothing	3.7	Learned a lot
Decreased my curiosity	3.6	Increased my curiosity
Will not recommend to others	3.5	Will recommend to others
Boring story	3.4	Interesting story

What viewers liked

Responses of what students (N=101) wrote that they liked about *Journey into Amazing Caves* and why were sorted into the categories presented in Table 5 below; each viewer may have given more than one category of response in their answer.

Most respondents were impressed by the ice caves (32%), by the variety of caves (18%) and by the experiential quality (17%). Smaller portions of the audience focused on the cinematography, the underwater caves and the medical story, as indicated in Table 5.

Table 5. What viewers liked about *Journey into Amazing Caves*

Categories	*%*	*Examples of Responses*
Ice caves	32%	• "When they swung back and forth and climbed down the ice cave." • "At any second the ice could have fell." • "I loved the blues."
Variety of caves	18%	• "Different caves, haven't seen some like those." • "All different caves, fun looking at them all."
Experiential quality	17%	• "Felt as if I was exploring too." • "How it was like you were part of the film."
Cinematography	13%	• "Cool camera shots." • "Way the camera angles made it seem more real."
Under water caves	10%	• "Kind of scary in the underwater cave." • "How they kicked up silt and couldn't see, thrilling."
Story of science	6%	• "When they tried to find medicine to cure diseases."

What viewers did not like

Student responses (N= 101) indicating a disliked feature were sorted into categories presented in Table 6 below. The strongest concerns were a dislike of the classroom sections and the story and a desire for more action.

Table 6. What viewers did not like about *Journey into Amazing Caves*

Categories	*%*	*Examples of Responses*
Classroom	20%	• "Boring when she talked to her class." • "How teacher kept talking to her class, irrelevant to story plot." • "Didn't care about her class."
Boring, Slow, Dragged	12%	• "Went by too slow, need more action." • "Wasn't very exciting and got kind of boring."
Story	9%	• "Story wasn't really exciting." • "Story telling about people was boring."
More about caves	7%	• "Not enough of seeing them in caves."
Too talky, not enough action	6%	• "More action instead of talking all the time."
IMAX format caused discomfort	5%	• "Fast moving camera made me dizzy."

What surprised viewers

The post-viewing sample (N=101) was asked to complete the sentence, " I was surprised . . . ." Responses were sorted with keywords, and percentages of each major mutually exclusive category are presented in Table 7. Most viewers were surprised by the ice caves (21%), the underwater caving (13%) and effects of the big screen (13%).

Table 7. Viewers' completion of "I was surprised . . . "

Categories	*%*	*Examples of Responses "I was surprised . . . "*
Ice caves	21%	• "how big ice cave was and what it takes to get in it and explore it." • "when the guy descended 500 feet into the ice cave." • "never knew they had ice caves, they were beautiful."
Underwater caves	13%	• "by information on sea water meeting fresh water." • "see them crawling through a little hole in the underwater cave."
Big screen effects	13%	• "by the noise and how you got dizzy." • "it seemed as if I moved with the film."
Medical research	8%	• "how much cave microbes can do like cure diseases." • "different forms of cave exploring, glacial, underwater."
Boring, slow, long	7%	• "how boring it was." • "it went too slow and was too long."
Diversity of caves	5%	• "there was all different types of caves."
Danger for cavers; filmers	5%	• "they risked their lives."
Good film	5%	• "that the movie was so good."
How explored caves	4%	• "what kinds of conditions they went through to cave."
Canyon caving	4%	• "when guy was on the tope and crossing from one cliff to another."

What most disappointed viewers

Respondents (N=101) also completed the sentence stem: "I was most disappointed . . ." Table 8 indicates that the largest group of respondents felt the film was "too long or boring" (13%), whereas 10% felt the film was "too short."

Table 8. Respondents' Completion of "I was most disappointed . . . "

Categories	*%*	*Examples of Responses "I was most disappointed . . . "*
Too long, boring, slow	13%	• "Movie dragged on" • "no action."
Too short	10%	• "Ended so soon."
Storyline	7%	• "didn't have a storyline." • "that the story was not interesting."
Need more, better explained info	7%	• "little amount of information given about caves." • "that they didn't explain those cave words better."
Didn't see more caves	6%	• "Didn't get to see more caves."

Impact on Knowledge

Achievement of intended viewing goals by the film alone. Recall of main content points as presented in *Journey into Amazing Caves* was assessed via a 20-point True-False test (see page 2 for specific questions). "Don't Know" was provided as a possible answer for the 12 sentence statements but was scored as "incorrect." To assess the influence of the film alone, we calculate an improvement or gain score by subtracting pretest scores from post-test scores. Of the 41 students in the pre/post sample who saw the FILM only and did not do a web activity, 90% improved in their post-test score. The average or mean gain score was 3.9 points, significantly above no improvement of 0 points[2] (see Table 9 first row).

For the post-test only sample who saw only the film, the post-test mean achievement score was 14. 2, not significantly different from the mean of 14.3 produced by those who had completed a pre-test (see Table 9 second row); thus, the pretest was not an influence in the scoring improvement. **We can conclude that seeing the film significantly improved 8th graders' knowledge about cave life, cave exploration techniques and cave formation.**

Table 9. Test Scores for FILM only groups

Samples	*N*	*Mean*	*Median*	*Minimum (Possible 0)*	*Maximum (Possible 20)*
Pre-test/Post-test Sample					
Pre-test of FILM only group	41	10.4	11	5	17
Post-test of FILM only group	41	14.3	14	10	18
		Mean gain = +3.9			
Post-test Only Sample	14	14.2	15	5	18
Post-test of FILM only group					

Achievement of intended viewing goals of film with web activity. Of the 37 students in the pre/post sample who saw the film and did a web activity (FILM + ACTIVITY), 68% improved in their post-test score. The average or mean gain score was 2.4 points, significantly above no improvement of 0 points[3] (see Table 10 first row). So, experiencing the film and the activity improved students' knowledge base.

For the post-test only sample who saw the film and did the activity, the post-test mean achievement score was 13.8, not significantly different from the mean of 14.0 produced by those who had completed a pre-test (see Table 10 second row); thus, the pretest was not an influence in the scoring improvement. **We can conclude that seeing the film and doing the activity significantly improved 8th graders' knowledge about cave life, cave exploration techniques and cave formation.**

Table 10. Test Scores for FILM + ACTIVITY groups

Samples	*N*	*Mean*	*Median*	*Minimum (Possible 0)*	*Maximum (Possible 20)*

[2] One sample t - test, t (40) = 8.652, p 0.0001

[3] One sample t - test, t (36) = 4.343, p 0.0001

Pre-test/Post-test Sample					
Pre-test of FILM+ACTIVITY group	37	11.7	11	6	18
Post-test of FILM+ACTIVITY group	37	14.0	14	7	19
		Mean gain = +2.4			
Post-test Only Sample Post-test of FILM+ACTIVITY group	9	13.8	15	7	19

Achievement of intended viewing goals of film with and without web activity. Seeing the film (FILM) and doing a web activity after seeing the film (FILM+ACTIVITY) both yielded improvement in factual knowledge, but was value added to the film by the exposure to the web activity? Gain scores were compared for the FILM+ACTIVITY group (mean gain = 2.4) and the FILM only group (mean gain = 3.9). Contrary to expectations, students who were not exposed to the web activity showed significantly increased scores from pretest to posttest compared with those who did the web activity.[4] **Thus, exposure to the web activity did not improve knowledge and may have interfered with recall of the factual information.**

Web Activity

The Appendix includes a detailed analysis of what happened as students used the web site: www.amazingcaves.com. Most students did not have difficulty carrying out the web activity over a period of 50-60 minutes. The main negatives were not being able to locate the screens mentioned in the activity (i.e., not noticing them listed in the gray band at the top of the website) and a dislike of having to read (and read and read) the small screen print as opposed to doing something more interactive. Students (n = 42) rated the appeal of the activity on a 1 to 5 scale with a relatively neutral mean of 3.2, where 5 means "liked very much." Appeal rating for the web activity was highly correlated with appeal rating of the film (r_s = .49) but not related to any other background or demographic variable. Note that those in the pre/post sample who did the web activity also rated the appeal of the film slightly lower (mean =3.4) than those who did not do the web activity (mean = 3.8), although this difference was not significant.

There were six questions on the post-test specific to ice caves and five questions specific to underwater caves. All student sub-samples answered a similar number of these questions correct on the post-test whether they worked on the relevant web activity or not; **thus, doing the appropriate web activity did not add to student knowledge about ice caves or underwater caves** (see Appendix for more detail).

[4] Two sample ttest, t (1, 72) = 2.201, p = 0.03

Most interesting thing learned. Prior to completing the test section mentioned above, an open-ended question asked viewers to describe the most interesting thing that they learned from the film. Table 11 presents the main categories of responses. The largest group (31%) responded that the most interesting thing learned was about the collection of microorganisms for medical research.

Table 11. Most interesting thing learned from the film

Categories	*%*	*Examples of Responses*
About collecting microorganisms in caves to develop new medicines	31%	• "getting samples of water you can make into medicine." • "how important caves are to discover new chemicals for medicine."
About ice caves	15%	• "that the glaciers have timeline layers in them." • "waterfall can freeze in 1 or 2 days."
How dangerous caving is	10%	• "how underwater cave searching is dangerous." • "that ice caves are very pretty but dangerous."
About halocline, where sea water and fresh water meet	10%	• "halocline where salt and fresh water meet." • "when you mix salt and fresh water you get a blurry section in between two layers."
About different caves	9%	• "about the different types of caves."

Anything new learned about scientists. Two-fifths (40%) of students felt that they had learned something about scientists that they had not known before viewing the film. Those who said they had learned something new about scientists did not differ in demographics from those who said they had not learned something new, but the two groups did differ in two of their quantitative ratings of the film (curiosity and learning). Table 12 presents the significantly different means for the two groups:
those who had learned something new about scientists (Yes; n = 40) and those who said they had not learned something new (No; n = 61). Despite the beyond chance differences, the mean ratings for both groups are above neutral on the five point scales.

Table 12. Mean ratings of film's entertainment value

1	2	3	4	5	
Disliked the film			3.6		Liked the film
Visually boring			3.9		Visually exciting
Learned nothing			3.7 No = 3.4; Yes= 4.1		Learned a lot
Decreased my curiosity			3.6 No = 3.3; Yes= 4.0		Increased my curiosity
Will not recommend to others			3.5		Will recommend to others
Boring story			3.4		Interesting story

Table 13 presents the main categories of responses of what viewers felt they had learned about scientists. Most respondents were impressed that scientists would search caves for cures to disease (30%) and that don't just work in labs (18%).

Table 13. New learning about scientists

Categories	*%*	*Examples of Responses*
That scientists would search caves for specimens	30%	• "that they go down into ice to find cures." • "in a while they might find a cure for diseases out of a cave."
They don't just work in labs	18%	• "that they don't stay in lab." • "didn't know scientists caved."
How dedicated they are	8%	• "takes a lot of work to find out what's in the water."
How scientists risk their lives	5%	• "they risk their lives going under caves, ice and water."

DISCUSSION

- *To what extent and in what ways did the film appeal to student viewers?*

  Eighth graders were moderately positive in their quantitative ratings (1-5) of the overall entertainment value of the film. On average, the audience found the film visually exciting (mean = 3.9); learned from it (3.7); liked it (3.6); had their curiosity increased (3.6); would recommend it to others (3.5); and thought the story interesting (3.4). The ratings were independent of gender, ethnicity, and exposure to large-format films. Those students who experience the web activity after seeing the film rated the film significantly less appealing and visually exciting than those who were not exposed to the web.

  Viewers were most impressed by the ice caves (32%) of the film, by the variety of caves (18%) and by the experiential quality (17%). Smaller portions of the audience liked the cinematography, the underwater caves and the story of the science. Respondents were surprised most by seeing the ice caves (21%) and underwater caves (13%) and by the big screen effects (13%). Smaller groups were surprised by the medical research, the diversity of caves and the dangers of caving.

  The eighth graders disliked most the classroom sequences (20%) and felt the film was boring or slow (12%). Smaller portions were disappointed in the storyline or wanted to see more caves.

- *To what extent did the film achieve its intended viewing goals?*
- *Did exposure to a web-based school activity after viewing affect learning outcomes?*

  Viewing the film significantly increased knowledge, as measured by a 20-point content test on the intended viewing goals. The average gain score for students who saw only the film (FILM) was 3.9 points and the average gain for students who saw the film and did a web activity (FILM + ACTIVITY) was 2.4 points; both gains are significantly above a zero improvement. We can conclude that seeing the film with or without doing the web activity significantly improved eighth graders' knowledge about cave life, cave exploration techniques and cave formation. However, exposure to the web activity did not significantly add to the film knowledge base. An analysis of test questions relating specifically to the web pages indicates that doing the web activity did not add to student knowledge about ice caves or underwater caves.

- *What did viewers perceive that they learned from the film?*

  The audience felt that the most interesting thing they learned was about collecting microorganisms in caves to develop new medicines (31%); about ice caves (15%); about the halocline (10%) and the dangers of caving (10%).

- *What new information did viewers learn about scientists?*

  About two-fifths of post-viewing respondents felt that they had learned something about scientists that they had not known before viewing the film. Most were impressed

that scientists would search caves for samples (30%), that they don't just work in labs (18%) and that they are dedicated (8%).

In conclusion, *Journey into Amazing Caves* was rated as moderately appealing by eighth grade viewers; made a significant impact on their knowledge of cave life, cave formation, cave exploration; and influenced 40% of the audience in terms of their understanding of scientists.

APPENDIX

***Journey into Amazing Caves* web-based activity**
May 2001

Four days after viewing *Journey into Amazing Caves* at the Oregon Museum of Science and Industry (OMSI) in Portland, OR, three 8th grade classes completed a web-based activity associated with the film in the school computer lab. A researcher observed the three classes.

At the beginning of each session, the researcher introduced herself as an independent researcher who worked with the producers of the CAVES film; She then distributed the activity sheets and briefly reviewed the instructions at the top of the sheet. Students then commenced the activity, which consisted of answering questions on the sheet using information contained in the *Learning from Caves* section of the *amazingcaves.com* web site. All of the computers in the lab were set at the opening page of the site prior to the session to ensure all students began the activity from the same place.

During each session, the researcher was present to help with technical issues, but she did not interfere with students' experience with the activity. A classroom teacher was on hand to answer questions that arose about the activity itself. At the end of each session, the researcher asked students to rate how much they liked the overall experience of doing the activity on a scale of 1-5, where 1 means "didn't like it at all" and 5 means "liked it very much."

Observations of Use

Comments about the three individual sessions are included below. Four types of issues are reviewed for each session: class time on task, technical issues encountered, and issues and questions that arose surrounding students' use of the activity sheet and website.

Session 1

Class time on task: 60 minutes

Technical issues encountered: Although the researcher arrived on site in time to prepare all of the computers for use of the *amazingcaves.com* website, the lab was not available until 20 minutes before class time due to emergency electrical work that had to be conducted in the ceiling rafters of the lab; therefore, although the researcher was able to load the website on all of the computers, she was not able to access all of the relevant pages on all of the computers in time for the first class. This meant that for a handful of students, the web pages were slow to load (approx. 1 minute load time). The following 2 classes didn't have this problem since the students in the first class had already clicked on all of the relevant pages (therefore they were much faster to load from this point on). This first class was given an additional 10 minutes to complete the activity to compensate for the longer wait time encountered.

Activity sheet use: The majority of the students completed the activity sheet without expressing any specific concerns, issues, or questions. Several students, however, expressed

at least some confusion in understanding the goal of the activity. The following comments/questions about the activity sheet were recorded:

- *I don't get what you are supposed to do.*
- *The directions aren't so clear.*
- *It's hard to tell looking at this thing what to do. The directions are so small and mushed together.*
- *What's a terrestrial cave?*
- *So am I supposed to just pick one type of cave and then find answers out about just that one?*

Students asked these questions of one another and/or the teacher. Students generally offered one another an answer. The teacher generally referred students back to the activity sheet and asked them to re-read the instructions.

None of the students were heard making comments relating to the appeal of the activity sheet.

Website use: Note the following:

1. Apart from the initial problem with the slow loading time, most of the students didn't show any major problems in staying within the site or using/navigating it to complete the activity.
2. About a handful of students indicated that they couldn't locate where the relevant pages were listed on the *Learning about Caves* page (the gray band at the top of the screen). These students asked the teacher or one another for assistance.
3. Only one student was observed clicking pages that the class was not instructed to use (per the activity sheet); this student clicked on the page that described how the film was made.
4. One link on the list "Nancy Diary" appeared to be accessed less frequently than the assigned pages.

The following comments and questions were recorded about the site:

Negative comments:

- *This website doesn't do very much. You just have to keep reading things to get the answers. There's nothing much else to do (2 students were heard making comments to this effect).*

Positive comments:

- *This is pretty cool. It looks like you can find out a bunch of stuff (referring to the opening page of Nancy's Diary)*
- *I think it's cool that you can find out more about how the film was made (referring to section on how the film was made).*
- *Some of the pictures look kind of neat. They should have more like that (pointing to the class picture under "Greenland" at Nancy's site).*

Questions:

- *Where are all the things you click on? (A handful of students were heard asking this question).*

- *I can't find the answer for how my cave type was formed. It doesn't say, so where are you supposed to look? (several students made similar remarks about this aspect of the activity sheet).*

Session 2

Session time on task: 50 minutes

Technical issues encountered: Only one student clicked out of the website, but the correct address was typed into the address bar and the student was back on-track within a matter of seconds.

Activity sheet use: The majority of the students completed the activity sheet without expressing any specific concerns, issues, or questions. As in the first session though, several students indicated some confusion in understanding the goal of the activity. The following comments/questions were recorded:

- *What am I supposed to do?*
- *I don't get the point of this.*
- *Are you only supposed to pick one kind of cave?*
- *What does it mean about why would scientists want to explore your cave?*
- *Does equipment mean like tools? Could it be something like special shoes? I don't get some of the instructions.*

These students asked these questions of one another and/or the teacher. In response, students generally offered one another an answer. The teacher generally referred students back to the activity sheet and asked them to re-read the instructions.

A few students were observed making comments relating to the appeal of the activity sheet, as follows:

- *This whole activity is a little dumb. It isn't something I would want to do at home, and they give you almost no room to write in answers in these little boxes.*
- *I don't want to be mean, but this is kind of a boring assignment…is it okay if I color in the squares (border of sheet) instead?*
- *It's kind of cool that you get to pick just one kind of cave and then research that out.*

Website use: Note the following:

1. The majority of the students didn't show any major problems in staying within the site or using/navigating it to complete the activity.
2. Several students indicated they couldn't locate where the pages were listed on the *Learning about Caves* page (the gray band at the top of the page) and asked for assistance.
3. None of the students were observed clicking pages that they were not instructed to use (per the activity sheet).
4. The one link on the list "Nancy Diary" appeared to be accessed less frequently than the assigned pages.

The following comments/questions about the site were recorded:

Negative comments:

- *I hope you don't mind, but this website is a little boring. All you do is read, read, read.*
- *You need good eyeglasses to read all the small print on the screen.*

Questions:

- *Where are the pages they tell you to click on to learn about the questions? (several students asked this type of question)*
- *Where would I find information on how my cave was formed? It doesn't say (several students made similar remarks)*
- *Where do you find something about the kinds of equipment to take in a cave?*

Session 3

Session time on task: 50 minutes

Technical issues encountered: none

Activity sheet use: The majority of the students completed the activity sheet without expressing any specific concerns, issues, or questions. A few students expressed confusion over the goal of the activity. The following comments/questions were recorded:

- *It's a little tricky to figure out how to start.*
- *What's the idea here? What are you supposed to do?*
- *Could an ice pick be a kind of equipment?*

Students asked these questions of one another and/or the teacher. Students generally offered one another an answer. The teacher generally referred students back to the activity sheet and asked them to re-read the instructions.

None of the students were observed making comments relating to the appeal of the activity sheet.

Website use: Note the following:

1. Most of the students didn't show any major problems in staying within the site or using/navigating it to complete the activity.
2. A few students didn't see where the pages were listed on the *Learning about Caves* page (gray border on top) and asked for assistance.
3. None of the students were observed clicking pages that they were not instructed to use (per the activity sheet).
4. The one link on the list "Nancy's Diary" appeared to be accessed somewhat less frequently than the other assigned pages.

The following comments/questions about the site were recorded:

Negative comments:

- *This website kinda sucks. They should have more interactives or cool graphics, and not so much words that are so small you can barely read them.*
- *This thing has information about caves in it, but that's not that much fun at all.*
- *I can't find the answers very easily.*

Positive comments:

- *The caver's (Nancy) site is the most interesting part. The pictures and stories are good.*
- *There are a lot of links that might be good to explore, like if you are at home on a fast computer and have the time to look. I could see doing that.*

Questions:

- *Where are the things you are supposed to click on? (a few students asked this question)*

Summary of Students' Recording on Activity Sheets

Three cave types were available to choose from. Out of 46 students, 1 (2%) chose the terrestrial cave, 34 (74%) chose the ice cave and 11 (24%) chose the underwater cave. Using five sections of the web site, students were to find answers to four questions:

1) What 2 pieces of equipment do you want to take with you to explore your cave?
2) Describe how your cave type formed.
3) Why would scientists want to explore your cave?
4) Name one or more animals or organisms you see in your cave.

Terrestrial cave. One student chose the terrestrial cave but had some difficulty completing the activity sheet for this cave; he was only able to list equipment.

Underwater cave. Eleven students chose the underwater cave.

1) All were able to list two pieces of equipment, typically "scuba tanks," "lights" and a "diveline."
2) Only one student noted that the underwater cave was formed by dissolution of soluble rocks; five explained that the cave is filled with ground water or a high water table; but five gave incorrectly the description for the formation of a "sea cave" - formed by "ocean waves pounding at the base of seashore cliffs."
3) All said that scientists wanted to explore an underwater cave to look for "things in the water to cure diseases."
4) All students were able to name an animal that they would see in an underwater cave: "salamanders" (6); "cave fish" (5); "cray fish" (5); "amphipods" (3); bacteria (3).

Ice cave. Thirty-four students chose the ice cave. Three said that they could not locate information about ice caves in their search of the web pages.

1) The remaining were able to list two pieces of equipment to take into an ice cave, typically "ropes," "crampons" (or "ice shoes"), "ice picks," "flashlight," and "helmet."
2) Formation by "melting water running under the glaciers to erode tunnels" was described by 65% of the ice cave students; the remaining either could not find the description or made something up (e.g., "ice and snow").
3) All respondents said that scientists wanted to explore an ice cave to "find organisms that can cure diseases" or "find out how old the ice is."
4) As for animals in ice caves, 24% could not find any mention, 56% wrote "bacteria," "extremophile," or "tardigrade," and the remaining noted arctic foxes or polar bears.

There were six questions on the post-test specific to ice caves and five questions specific to underwater caves. As indicated in the table below, all student sub-samples answered a similar number of these questions correct on the post-test whether they worked on the relevant web activity or not; thus, doing the web activity did not add to student knowledge about ice caves or underwater caves.

Mean Post-Test Scores for Cave Type Questions

Samples	*N*	*Mean*
6 Ice Cave Questions		
Did ice cave web activity	34	4.3
Did other cave type web activity	12	4.3
Did no web activity	55	4.3
5 Underwater Cave Questions		
Did underwater cave web activity	11	3.2
Did other cave type web activity	35	3.5
Did no web activity	55	3.4