

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

Absolute Zero Summative Evaluation

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TABLE OF CONTENTS

Executive Summary.....	i
Introduction.....	1
Methods	4
Evaluation of the Broadcast	4
Evaluation of Outreach Materials & Campaign	5
Results From Evaluation of the Broadcast.....	7
Profile of Participants.....	7
<i>Absolute Zero</i> -Related Topics: Awareness, Interest, and Motivation Pre and Post-Viewing	9
Assessments of the Program.....	15
Results From Evaluation of Outreach Materials & Campaign	19
Profile of Outreach Evaluation Participants	19
Materials: Outreach Guides and Demonstration Activities.....	20
Materials: <i>Absolute Zero</i> Campaign Website.....	25
Materials: PBS/NOVA Website.....	26
Campaign: Outreach Activities Conducted.....	28
Campaign: Process of Partnership.....	31
Campaign: Impact on ISE and Suggestions for Future Similar Projects..	34
Conclusions and Recommendations	39
Broadcast.....	39
Outreach Materials	40
Outreach Campaign.....	40
Appendix A: National Partners, Participants, and Experts	42
Appendix B: Supplementary Data	43
Additional Tables from Broadcast Evaluation	43
Additional Tables from Teachers' Evaluations of Outreach Materials....	51
Appendix C: Examples of <i>Absolute Zero</i> Outreach Activities	57
Appendix D: Evaluation Instruments.....	59

EXECUTIVE SUMMARY

In 2008, Goodman Research Group, Inc. (GRG) conducted summative evaluation of *Absolute Zero*, a collaborative effort of the University of Oregon's Cryogenic Helium Turbulence Laboratory and Twin Cities Public Television. The films were produced by Meridian/Windfall Productions, Washington DC, and/Windfall Films in London, UK. Outreach was spearheaded by Devillier Communications, Inc. The *Absolute Zero* project was centered on a two-part documentary about low-temperature physics, which aired on PBS/NOVA in early January 2008, as well as an outreach campaign, which included approximately 20 National Partner and Participant organizations, scientific experts, a website, and two educational outreach guides.

The main goal of the summative evaluation was to assess the influence of the series on viewers and to explore the extent to which the outreach activities, materials, and partnerships were effective. The full evaluation report details methods and results across all components of evaluation, including evaluation of the broadcast with adults as well as with middle and high school students and evaluation of the outreach campaign and outreach materials with National Partners and Participants, *Absolute Zero* Experts, and science teachers.

METHODS

GRG used a multi-method approach to evaluate the *Absolute Zero* broadcast, outreach campaign, and outreach materials. For the evaluation of the broadcast, 52 adult participants who are regular NOVA viewers and 354 middle and high school students participated in a viewer study. They viewed both hours of the *Absolute Zero* broadcast and completed surveys: one before viewing, one between viewing Parts 1 and 2 (adults only), and one after viewing. Surveys were designed to obtain baseline information and assess participants' awareness of and interest in the topics featured in the broadcast and the program's overall appeal.

To evaluate the outreach campaign, GRG conducted a web-based survey with representatives from National Partner/Participant organizations (N=7), telephone interviews with *Absolute Zero* Experts (N=7), and follow-up telephone interviews with three respondents from the Partner/Participant survey. The survey and phone interviews focused on two broad areas of inquiry: (1) process of partnership in the *Absolute Zero* Campaign, and (2) outreach activities conducted, including publicity.

In addition to process evaluation of the outreach campaign, GRG assessed the overall appeal and usefulness of the outreach materials: the educator guides, the PBS/NOVA website and *Absolute Zero* campaign website. The Partner/Participant survey and interviews with Participants, Partners, and Experts also included some questions regarding these areas. The science teachers (N=6) whose students participated in the evaluation of the *Absolute Zero* broadcast provided feedback on the outreach guides themselves, including demonstration activities, and websites.

KEY FINDINGS

Absolute Zero Broadcast:

- The *Absolute Zero* broadcast achieved its aims of increasing awareness about low-temperature physics among both adults and students.
- Post-viewing, adult viewers were more interested in science and reported being likely to pay attention to *Absolute Zero*-related topics in the future. Post-viewing, students reported decreases in their intentions to engage in science-related activities as well as in their interest in learning more about the topics featured in the broadcast.
- Both adult and student viewers were quite positive about *Absolute Zero*. Adult viewers provided more positive ratings for Part 1 than for Part 2.

Absolute Zero Outreach Materials and Campaign:

- Teachers as well as National Partners/Participants rated both outreach guides highly.
- Teachers reported that demonstration activities in the guides were easy to conduct, engaging for students, and a very useful way to supplement viewing the broadcast. They reported being quite likely to use the guides and to lead demonstration activities in the future.
- Outreach campaign participants were extremely positive about the work of Devillier Communications, Inc., the outreach campaign organizers.
- National Partners/Participants, and Experts wished that the broadcast and the outreach had been better coordinated in terms of their timelines, or that that there had been more formal events for outreach campaign members to participate in and/or promote at the time of the broadcast.
- National Partners, Participants and Experts were eager for high-quality outreach materials and were very positive about the ways that the materials facilitated their conducting outreach activities. They tended to be positive about their own activities yet unaware of whether other activities were being conducted by others involved with the campaign.

KEY RECOMMENDATIONS

Considering the results across all components of the evaluation, GRG offers the following recommendations for potential future projects similar to *Absolute Zero*:

- In broadcasts with highly technical or complicated content, consider presenting those more technical elements alongside segments which viewers see as relevant to their lives.
- Continue to create science programs that feature less well-known topics, as was the case with low-temperature physics.
- If students are an intended audience for future broadcasts, consider allowing for a longer length of evaluation follow-up to assess more distal gains in interest or engagement in science-related activities.
- If possible, foster means by which to encourage informal science educators to use the outreach guides and broadcast in conjunction with one another, as they seem mutually reinforcing and enhancing.
- Consider targeted outreach to informal science educators to enable them to become aware of outreach materials.
- An engaged and dedicated central team is critical for effective communication with individuals and organizations involved with a national outreach campaign.
- Attempt to integrate the broadcast event with outreach events, for instance, hold public screenings of the broadcast with brief comments from scientific experts and the producer(s), followed by a question-and-answer period.
- Consider continuing to create future outreach campaigns with national partnership and reach that bring together organizations with similar topical or educational foci.
- Continue to produce high-quality ISE outreach materials for topics where few exist.
- Consider having a way to organize outreach events and facilitate communication among people leading events so outreach happens in a less ad hoc fashion. This may build more momentum to national campaign efforts as well as encourage connections among outreach participants as well as between the outreach and broadcast.

INTRODUCTION

The primary goal of the project was to introduce the public to and increase awareness of the field of low-temperature physics.

The *Absolute Zero* project was centered on a two-part documentary about low-temperature physics, which aired on PBS/NOVA in January 2008, as well as an outreach campaign, which included 21 National Partner and Participant organizations, scientific experts, a website, and two educational outreach guides. Part 1 of the broadcast, *Absolute Zero: The Conquest of Cold* aired on January 8, 2008, and Part 2, *Absolute Zero: The Race to Absolute Zero* aired on January 15, 2008.

The *Absolute Zero* Project was a collaborative effort of the University of Oregon's Cryogenic Helium Turbulence Laboratory and Twin Cities Public Television, the PBS presenting station. The films were produced by Meridian/Windfall Productions headquartered in Washington, DC, and Windfall Films in London, UK. Devillier Communications, Inc. spearheaded the outreach/promotion campaign. Funding for the project was provided by the National Science Foundation (NSF) Informal Science Education division, the Alfred P. Sloan Foundation, and the BBC. The NSF funding was awarded to the University of Oregon, with Russell J. Donnelly, Professor of Physics, as the Principal Investigator. The Co-Principal Investigators were Meredith Burch of Meridian Productions and Dr. Richard Hudson of Twin Cities Public Television.

The primary goal of the project was to introduce the public to and increase awareness of the field of low-temperature physics. The programs were inspired, in part, by Tom Shachtman's book, *Absolute Zero and the Conquest of Cold*. The two-part documentary "demonstrates how civilization has been profoundly affected by the mastery of cold" and "explores key concepts, significant individuals and events in the field of low-temperature physics and the enormous impact that the mastery of cold has had on society through such technologies as air conditioning, refrigeration and liquefied gases."

The *Absolute Zero* outreach campaign had the following goals:

- Engage the American audience in a story that touches their lives in innumerable ways while generating the greatest possible audience for *Absolute Zero*.
- Stimulate active learning by the general public and students about low temperature physics and the science of cold including new technological advances involving cold temperature.
- Introduce some of the most important scientific breakthroughs and human achievements in this relatively unknown field of low temperature physics.
- Serve as a catalyst for community-based collaboration and partnerships with science museums, libraries, schools, PBS stations and related organizations.
- Actively engage science professionals, researchers and technicians in public outreach and education.

The outreach campaign included 18 National Partner organizations and three National Participant organizations, including professional physics associations (American Institute of Physics), laboratories (National High Magnetic Field Laboratory), and informal science education organizations (Association of

Science-Technology Centers). Partner and Participant organizations were invited to participate based on their content expertise and/or the member populations they served (e.g., science teachers). Once on board, those organizations recommended additional potential Partner/Participant groups. Each organization was invited to have a representative sit on the National Awareness Advisory Committee and consult the components of the outreach campaign.

The campaign also included eight *Absolute Zero* Experts, physicists from around the country with expertise on low-temperature physics who led outreach efforts, promoted the campaign and broadcast, and answered questions submitted via the campaign website. Experts often were members of Partner/Participant organizations who were recommended by those groups to participate in the campaign. Appendix A contains a complete list of National Partner and Participant organizations as well as Experts.

The products of the outreach campaign included the following:

- A website (www.absolutezerocampaign.org),
- The *Absolute Zero Community Education Outreach Guide*, which contains activities and experiments for teachers and informal educators of middle-school students to lead, and
- The *Absolute Zero Science Educator's Guide*, which gives formal and informal educators tips on how to engage students in science and low-temperature physics.

On the campaign website, visitors can learn about the broadcast, explore information and games related to low-temperature physics, and ask a question of an *Absolute Zero* Expert.

PBS/NOVA created a website separate from the outreach campaign (www.pbs.org/wgbh/nova/zero) to support and expand upon the broadcast. The NOVA website interactives were created under the aegis of Twin Cities Public Television's Richard Hudson, one of the project's co-PIs.

EXTERNAL SUMMATIVE EVALUATION

The main goal of the summative evaluation was to assess the influence of the series on viewers and to explore the extent to which the outreach activities, materials, and partnerships were effective.

In 2004, prior to submission of the original NSF grant proposal, Goodman Research Group, Inc. (GRG) was invited by Project Director Meredith Burch to conduct the external summative evaluation of the *Absolute Zero* project. Subsequently, GRG's evaluation was as a subcontractor to the University of Oregon, which was the NSF grantee.

The main goal of the summative evaluation was to assess the influence of the series on viewers and to explore the extent to which the outreach activities, materials, and partnerships were effective. This report describes methods and results for all evaluation components:

- Evaluation of the broadcast with adult and classroom student viewers,
- Evaluation of the outreach campaign and materials, including:
 - A survey with National Partners and Participants;
 - Interviews with Partners and *Absolute Zero* Experts; and

- Evaluation with middle and high school teachers of the outreach guides and associated demonstration activities and websites.

The specific objectives of the evaluation of the broadcast were to document (and assess, as feasible) the influence of the broadcast on viewers, specifically:

- The extent to which the content of *Absolute Zero* interested viewers,
- The extent to which viewers made gains in their awareness of the subject of low-temperature physics, and
- Viewers' motivation to learn more about low-temperature physics.

Because the scientific content featured in the broadcast was quite complex, the project's Principal Investigator wanted to focus the evaluation on increasing viewers' interest and awareness rather than increasing their knowledge of content. Therefore, gains in specific content knowledge were not goals of the evaluation.

Objectives of GRG's evaluation of the outreach campaign and materials were to document and assess as feasible:

- The process of how partnerships unfolded;
- The scope of the outreach activities that were conducted by Partners, Participants, and *Absolute Zero* Experts; and
- The overall appeal and usefulness of the outreach guides and of the PBS/NOVA and *Absolute Zero* Campaign websites.

With the decision by the producers to broadcast *Absolute Zero* on NOVA, there was a shift in focus of the broadcast evaluation away from underserved audiences to a viewer audience of regular NOVA viewers. Finally, all of the outreach activities had been conducted prior to the start of GRG's evaluation contract. Thus, the evaluation of the outreach primarily was retrospective, based on Partners', Participants', and Experts' reports of the activities they conducted and their involvement with the campaign.

METHODS

This section provides information on the methods used to evaluate the broadcast and the outreach materials and campaign. In addition to the methods described below, Russell Donnelly provided feedback on the broadcast survey, while Linda Devillier, Professor Donnelly, and Meredith Burch provided feedback on the outreach component.

EVALUATION OF THE BROADCAST

GRG conducted evaluation to assess the short-term impact of *Absolute Zero* on two groups of viewers: 1) adults and 2) middle and high school students.

GRG conducted an evaluation to assess the short-term impact of Absolute Zero on two groups of viewers: 1) adults and 2) middle and high school students.

GRG recruited adults who reported regular NOVA viewing (at least twice per month) to watch both hours of *Absolute Zero* in real time, when the episodes aired on January 8 and 15, 2008. Fifty-two adults fully participated in the evaluation; this included viewing both hours of *Absolute Zero* live and completing three web-based surveys: one before Part 1 aired, one between the airdates of the two episodes (i.e., between January 9 and January 14, 2008), and one within two weeks after Part 2 aired. Those who completed all activities each received a \$75 electronic gift card as an honorarium.

Middle and high school students viewed DVDs of the *Absolute Zero* broadcast in their classrooms. Their teachers, who were recruited by GRG, agreed to show the broadcast in class and administer surveys to students as well as to collect the completed surveys and return them to GRG. The teachers themselves participated in a separate component of this evaluation; they evaluated the *Absolute Zero* outreach materials, as described below.

For student viewers, full participation in the study included viewing both hours of *Absolute Zero* in their classrooms (during Spring 2008) and completing two paper-and-pencil surveys: a pre-viewing survey before watching Part 1 and a post-viewing survey after watching Part 2. In all, 18 classrooms with 324 students participated in the study; 286 student viewers completed both pre- and post-viewing surveys.

Adult and student surveys included questions about the following:

- Demographic information;
- Overall awareness of and interest in the topics featured in the broadcast;
- Self-reported behaviors related to finding out about scientific research;
- Favorite and least favorite aspects of the program; and
- Overall appeal of the program.

EVALUATION OF OUTREACH MATERIALS & CAMPAIGN

Outreach Campaign

To document and assess the outreach campaign, including how partnerships unfolded and what outreach activities were conducted, GRG conducted the following evaluation activities with Partners, Participants, and Experts:

- (1) A web-based survey with representatives from National Partner/Participant organizations (N=7),
- (2) Telephone interviews with *Absolute Zero* Experts (N=7), and
- (3) Follow-up telephone interviews with three respondents from the Partner/Participant survey.

The web-based survey and phone interviews focused on two broad areas of inquiry: (1) process of partnership in the *Absolute Zero* Campaign, and (2) outreach activities conducted, including publicity. Devillier Communications, Inc. provided GRG with names and contact information of Partners, Participants, and Experts for these evaluation activities.

Outreach Materials

In addition to process evaluation of the outreach campaign, GRG assessed the overall appeal and usefulness of the outreach materials, including the educator guides and the PBS/NOVA and *Absolute Zero* websites. The Partner/Participant survey and interviews with Partners, Participants, and Experts (described above) included some questions regarding these areas.

In addition, the six middle and high school science teachers whose classroom students participated in the evaluation of the *Absolute Zero* broadcast provided feedback on the outreach guides themselves, including demonstration activities, and websites. These six teachers each received a \$200 electronic gift card after their full participation, which included:

- Reading the *Absolute Zero Community Education Outreach Guide* and the *Absolute Zero Science Educator's Guide*, and leading two demonstration activities;
- Recording students' reactions to the *Absolute Zero* PBS/NOVA website after they explored it in class; and
- Completing a web-based teacher survey.

We advise that data from the Partner/Participant outreach survey and interviews with Partners, Participants, and Experts be interpreted through a lens of potentially significant selection bias and with an awareness of small sample sizes. We invited 29 individuals to participate in the Partner/Participant survey. Of those, six were undeliverable or out of the office for the entire duration of the survey, and ten never responded, despite several reminders. The overall response rate was 45%.

GRG evaluated the outreach campaign and also assessed the overall appeal and usefulness of the outreach materials, including the educator guides and the PBS/NOVA and Absolute Zero websites.

Of the 13 Partners/Participants who did complete the survey, only three Partners also volunteered to participate in follow-up interviews (no Participants volunteered for interviews). In addition, seven Experts were interviewed, for a total of ten outreach interviews. It may be the case, as is often true with evaluations of this nature, that people who did respond to the survey and interviews were those individuals who were most committed to and/or most enjoyed the program, as they were the ones willing to participate in the evaluation several months after the conclusion of the broadcast and outreach campaign.

RESULTS FROM EVALUATION OF THE BROADCAST

The pre- and post-viewing surveys completed by adults and by classroom students were similar in that they included the same general questions about viewers' interest in science and reactions to the program. Results from both groups, therefore, are presented side-by-side in the same section of this report to illustrate similarities and differences in overall patterns of response. However, it is important to recall that data were collected independently from these two viewer groups and no statistical comparisons were made between their responses. Thus, the reader is cautioned against making direct comparisons between the two groups or interpreting findings as evidence of group differences more generally.

Data from this portion of the evaluation are presented in terms of percentages rather than number of participants. In addition, presented means are on a scale from 1 (least positive ratings) to 5 (most positive ratings). Matched pairs t-tests were used for pre-viewing to post-viewing comparisons.

PROFILE OF PARTICIPANTS

Results represent data from the 52 adult viewers and 324 classroom student viewers who completed all activities of the research study. A majority of adult participants were female, of Caucasian/white race, were between 35 and 49 years-old, and had attended college. In addition, 70% of adult viewers reported household incomes of \$50,000 or more (Table 1).

Table 1
Profile of Participants, Adults

		Percentage
Gender	Female	73%
	Male	27%
Race/Ethnicity	Caucasian/White	77%
	African-American/Black	8%
	Asian/Pacific Islander	6%
	Latino/Hispanic	6%
	Native American	2%
Age	18 – 34 years-old	35%
	35 – 49 years-old	52%
	50 – 64 years-old	11%
	> 65 years-old	2%
Total Annual Household Income	< \$20,000	0
	\$20,000 - \$24,999	8%
	\$25,000 - \$34,999	4%
	\$35,000 - \$49,999	19%
	\$50,000 - \$74,999	23%
	\$75,000 - \$99,999	23%
> \$100,000	23%	
Highest Level of Education Completed	High school degree	14%
	Some college	31%
	College degree	33%
	Some graduate/professional school	6%
	Graduate/professional degree	17%

N=52.

Most of the student viewers were of Caucasian/white race, and were fairly evenly divided between males and females. They were relatively evenly distributed by whether they were in middle versus high school. Roughly 30% of students were in grade six and another 30% were in grade eleven (Table 2).

A majority of adult participants were female, of Caucasian/white race, were between 35 and 49 years-old, and had attended college.

Table 2
Profile of Participants, Students

		Percentage
Gender	Female	48%
	Male	52%
Race/Ethnicity*	Caucasian/White	89%
	African-American/Black	5%
	Asian/Pacific Islander	5%
	Latino/Hispanic	7%
	Native American	5%
	Other	10%
Grade	6 th	30%
	7 th	16%
	8 th	1%
	9 th	16%
	10 th	3%
	11 th	32%
	12 th	2%
School level	Middle school	47%
	High school	53%

N=319-322.

*Percentages may total >100%, because participants were able to check more than one response.

ABSOLUTE ZERO-RELATED TOPICS: AWARENESS, INTEREST, AND MOTIVATION PRE AND POST-VIEWING

At pre and post-viewing, participants responded to various questions about their awareness of, likelihood of paying attention to, interest in, and motivation to learn more about topics and themes featured in the program (as noted in the Introduction, content knowledge was not assessed in this research). These included the following areas:

1. Science of cold/low-temperature physics,
2. History of science,
3. Races among scientists towards a scientific breakthrough,
4. Competing scientific theories,
5. General chemistry, and
6. General physics.

In addition to those six topics, students responded to the additional topic of science in general.

Student viewers were relatively evenly distributed by whether they were in middle versus high school. Roughly 30% of students were in grade six and another 30% were in grade eleven.

Awareness of and Attention to Program Topics

Adults and student started with quite different baseline levels of awareness of the topics featured in the broadcast. Prior to viewing *Absolute Zero*, a majority of adult viewers had heard of *all* of the topics and themes featured in the broadcast (somewhat surprisingly, over 70% of adults had heard of low-temperature physics), while less than 50% of students had heard of *any* of the topics. The science of cold was the topic of which both adults and students were least aware. Most adult participants had learned of these topics through another person they know, the media/news, or school (see Appendix B).

At post-viewing, both adult and student participants reported marked increases in their awareness of topics and themes featured in Absolute Zero.

At post-viewing, both adult and student participants were asked “How much did your awareness of the following topics change since watching *Absolute Zero*?” Both groups reported marked changes in their awareness of topics and themes featured in *Absolute Zero*. Most strikingly, over 90% of adults reported being more aware of the science of cold, competing scientific theories, history of science, and races among scientists towards a scientific breakthrough (see Table 3 for means).

Table 3
Adults’ Self-Reported Changes in Awareness of Topics Post-Viewing

	Awareness (Means) ++
Chemistry	3.40
Physics	3.42
The science of cold / low-temperature physics	4.25
Races among scientists towards a scientific breakthrough	3.94
Competing scientific theories	3.85
History of science	3.94

n= 52

++ Five-Point Scale: 1(less aware now), 2 (no change), 3 (slightly more aware now), 4 (somewhat more aware now), 5 (a lot more aware now)

At the pretest, students were asked the same question about their familiarity with topics related to the broadcast and their familiarity with science in general. At posttest, they were asked how much their awareness had changed. Among students, there were significant increases for all topics featured in the broadcast pretest to posttest (Table 4).

Table 4
Students' Familiarity with and Changes in Awareness of Topics Pre and Post

	Pre-Viewing: Familiarity+ (Means)	Post-Viewing: Changes in Awareness ++ (Means)
Science in general	2.96	3.93
Chemistry	1.99	3.77
Physics	2.16	3.69
The science of cold / low-temp. physics	1.70	4.34
Races among scientists towards a scientific breakthrough	1.87	4.01
Competing scientific theories	2.12	3.82
History of science	2.11	4.03

n= 275-282 valid pairs (where student completed both pre and post survey)

*** For all topics, $p < 0.001$ from pretest to posttest (for students only)

+ Five-Point Scale: 1 (not at all familiar) to 5 (extremely familiar)

++ Five-Point Scale: 1 (less aware now), 2 (no change), 3 (slightly more aware now), 4 (somewhat more aware now), 5 (a lot more aware now)

Regarding attention to stories about science topics, at pretest, adults noticed stories about races among scientists and competing scientific theories. At posttest, they reported being very inclined to pay attention to a story or news piece about the science of cold as well as about the history of science, two topics featured prominently in *Absolute Zero* (Table 5).

At posttest, adults reported being very inclined to pay attention to a story or news piece about the science of cold as well as about the history of science, two topics featured prominently in Absolute Zero.

Table 5
Adults' Self-Reported Attention to Stories about Science Topics

	Pre-Viewing: % who heard/saw story in past month	Post-Viewing: likelihood of Paying Attention to Story/News Piece + (Means)
Chemistry	n/a	3.54
Physics	n/a	3.52
Science of cold/low temperature physics	37%	4.23
Races among scientists towards a scientific breakthrough	56%	3.92
Competing scientific theories	58%	3.79
History of science	37%	4.02

n = 52. Percentages total >100% because participants were able to select more than one response.

+ Scale: 1 (not at all likely) to 5 (extremely likely)

At pretest, students most often reported having heard or seen a story in the past month about science in general (middle school students only). However, at posttest, students reported low likelihood of paying attention to any of the topics in the future (Table 6).

Table 6
Students' Attention to Stories about Science Topics (Pre and Post)

	Pre-Viewing: % who heard/saw story in past month	Post-Viewing: likelihood of Paying Attention to Story/News Piece+ (Means)
Science in general*	62%	2.37
Chemistry*	22%	2.13
Physics	28%	1.39
Science of cold/low temperature physics	12%	1.70
Races among scientists towards a scientific breakthrough	23%	1.57
Competing scientific theories	20%	1.45
History of science	22%	1.46
None of the above topics	28%	n/a

Adult n = 52, Student n = 126-321. Percentages total >100% because participants were able to select more than one response.

+ Scale: 1 (not at all likely) to 5 (extremely likely)

*Only middle school students (n = 126) responded to the question about *general chemistry* at post-viewing and about *science in general* at both pre and post viewing.

Interest in *Absolute Zero* Topics, Motivation to Learn More

Nearly all adult participants were interested in all six topics prior to participating in the study. Even considering this high pre-viewing level of interest, at post-viewing, participants were quite interested in learning more about all topics. (Table 7).

Table 7
Adults' Mean Interest in and Motivation to Learn More About Topics

	Pre-viewing	Post-viewing	
	Interest in learning more+	Changes in interest++	Changes in motivation to learn more+++
General chemistry	3.65	3.42	3.25
General physics	3.73	3.35	3.23
The science of cold	4.04	3.92	3.69
Races among scientists towards a scientific breakthrough	4.27	3.94	3.71
Competing scientific theories	4.29	3.79	3.60
History of science	3.98	3.88	3.75

n = 52.

+ Scale: 1 (not at all interested) to 5 (extremely interested)

++ Scale: 1 (less interested now) to 5 (a lot more interested now)

+++ Scale: 1 (less motivated now) to 5 (a lot more motivated now)

At posttest, students were significantly more interested in learning more about races among scientists towards a scientific breakthrough.

Student viewer data presents a different story. At pre-viewing, students expressed great interest in learning more about the science of cold as well as the history of science, two topics featured prominently in *Absolute Zero*. At posttest, however, there were significant decreases in students' interest in learning more about these topics, as well as in learning about competing scientific theories (Table 8). It may be the case that students' interested in these topics will be piqued further in the future than this evaluation could capture. One might also posit that they felt they had learned enough from the series to suit them.

Students were significantly more interested in learning more about races among scientists towards a scientific breakthrough (Table 8). This topic cuts across various scientific content areas and is something with which students may more easily identify.

Table 8
Students' Interest in Learning More About Topics, Pre and Post Viewing

	Pre-Viewing Means	Post-Viewing Means
Science in general	2.79	2.85
Chemistry	2.73	2.75
Physics	2.46	2.52
Science of cold / low-temp. physics ***	4.02	2.91
Races among scientists towards a scientific breakthrough ***	2.22	2.51
Competing scientific theories ***	2.49	2.17
History of science ***	3.96	2.51

*** p < 0.001. n = 276-280 valid pairs (student completed both pre and post survey).

+ Scale: 1(not at all interested) to 5 (extremely interested)

General Interest in Science & Science-Related Activities

The sample of adult viewers reported a high level of general interest in science. When asked how their interest in science compared to most people they know, the mean for adults was 4.25, indicating a very high level of interest. In fact, 82% of adults said they had *more* or *much more* interest than other people they know (Table 9). This is perhaps not surprising given that adults were selected to participate based on being self-reported frequent NOVA viewers.

In addition to their higher than average interest in science, over 80% of adult participants also reported being *more* or *much more* knowledgeable about the latest scientific developments compared to most people they know. Nearly 80% of adults reported being *moderately*, *very*, or *extremely* active at seeking out information related to the latest advancements in science. Movies and documentaries were most often cited (by 42% of adults) as the resource most relied upon for obtaining this information (see Appendix B).

For students, the mean value for interest in science compared to their classmates was 3.08, as displayed in Table 10. Nearly half of students reported that they were *no more or less* interested in science compared to their classmates.

Table 9
Adults' Interest in Science
Compared to People You Know

	Percentage (mean=4.25)
Much less	0
Less	0
No more or less	17%
More	40%
Much more	42%

n=52

Table 10
Students' Interest in Science
Compared to Your Classmates

	Percentage (mean=3.08)
Much less	8%
Less	14%
No more or less	46%
More	24%
Much more	8%

n=319

In keeping with their interest in science in general, a majority of adult viewers reported interest in the main NOVA website (www.pbs.org/wgbh/nova) and the *Absolute Zero*-specific NOVA website (www.pbs.org/wgbh/nova/zero). Over 80% of adult participants had visited the main NOVA website two or more times in the three months prior to participating in the viewer study. At posttest, 94% of adult participants either had visited the main NOVA site since beginning the viewer study or had plans to visit the site in the future. Thus, only 6% said they had neither visited nor had plans to visit the NOVA site. Additionally, only 8% of viewers said they had not yet and had no plans to visit the *Absolute Zero*-specific NOVA website (Appendix B).

In contrast to the adult viewers' interest in science programs, roughly half of students reported being relatively infrequent viewers of television science-related programs (48% reported *never*, *once a year*, or *a few times a year*). Most students in the study (81%) had never before seen a NOVA program (Appendix B). Moreover, only 6% of students had visited the NOVA website; they were

asked this question at pretest only. This is not particularly surprising, since the audience for NOVA is typically adults with high interest in science.

ASSESSMENTS OF THE PROGRAM

Across the ratings, adults and students generally were very positive about the program.

Across the ratings, adults and students generally were very positive about the program overall (Table 11). Adults' ratings tended to be higher than those provided by students. Adult viewers rated Part 1 more positively than Part 2 (79% rated Part 1 *very good* or *excellent*, whereas 62% gave these ratings for Part 2).¹ All but one adult participant watched the entire hour of Part 1, and all participants watched the entire hour of Part 2. Adult viewers were relatively evenly split regarding whether they watched the program alone (56%) or with family (44%).

Table 11
Overall Rating of Program

	Adults:		Students: Overall Percentage (mean = 3.08)
	Part 1 Percentage (mean= 4.12)	Part 2 Percentage (mean= 3.81)	
Poor	0	0	6%
Fair	6%	14%	22%
Good	15%	25%	37%
Very good	40%	29%	29%
Excellent	39%	33%	6%

Adult n = 52, Student n = 313.

All participants rated the content of the program as generally easy to understand (over 70% of participants, both adults and students, rated both as *very* or *fairly* easy to understand). Adult participants found Part 1 significantly easier to understand than Part 2 ($p < 0.01$, Table 12).

¹Adults provided separate ratings for Part 1 and Part 2, whereas students rated the broadcast overall (both parts together). Statistical comparisons between adults' ratings of Part 1 and Part 2 were made using paired samples t-tests.

Table 12
Content of Program

	Adults: Part 1 Percentage (mean=1.84)	Adults: Part 2 Percentage (mean=2.29)	Students: Overall Percentage
Very difficult to understand	0	6%	5%
Fairly difficult to understand	6%	12%	17%
Neither easy nor difficult to understand	10%	12%	n/a
Fairly easy to understand	47%	48%	63%
Very easy to understand	37%	23%	15%

Adult n = 51. Adults rated parts 1 and 2 separately.
Student n = 308. Students rated both parts of the program together.

Among adults, Part 1 was rated as significantly more interesting, informative and visually-appealing than Part 2. They found that the information presented was significantly clearer in Part 1 than in Part 2. Students also provided positive ratings for how interesting they found the program, the clarity of the information presented, and its visual appeal (Table 13).

Table 13
Adults' Ratings for Part 1 and Part 2

	Adults: Means for Part 1	Adults: Means for Part 2	Students: Means Overall
How interesting was it?*	4.21	3.87	3.08
How informative was it?***	4.56	4.12	n/a
How engaging was it?	4.08	3.79	n/a
How clear was the information presented in it?*	4.22	3.90	3.29
How visually appealing was it? ***	4.31	3.85	3.31

Adult n = 51 – 52, Student n = 310 – 312.
All ratings were on a scale from 1(Not at all) to 5(Extremely).
* p<0.05; ** p<0.01; *** p<0.001 for comparisons between Parts 1 and 2 (adults).

Over half of adults and nearly 75% of students reported that *most* or *almost all* of the information in *Absolute Zero* was new to them (Table 14).

Table 14
Amount of New Information

	Adults: Part 1 Percentage	Adults: Part 2 Percentage	Students: Percentage
Almost none was new	4%	2%	3%
Some was new	39%	29%	23%
Most was new	42%	54%	41%
Almost all was new	15%	15%	33%

Adult n = 52, Student n = 307.

Adults rated their favorite and least favorite stories from the two parts of the broadcast. For both Part 1 and Part 2, most favorite stories tended to be about topics to which participants’ could relate – perhaps that they viewed as more relevant to their own lives and/or focusing on human nature and interactions, whereas their least favorite stories were on topics that were more theoretical in nature .

For both Part 1 and Part 2, most adults’ favorite stories tended to be about topics to which they could relate

Their favorite stories from Part 1 were:

- Frederic Tudor, “The Ice King,” and ice harvesting;
- James Joule’s experiments; and
- The development of ice-making machines, refrigerators, and the refrigeration cycle.

Their least favorite story from Part 1 was the debate about heat as a substance versus heat as a form of motion. Table 15 presents adult viewers’ most and least favorite stories.

Table 15
Adult Viewers’ Favorite and Least Favorite Story from Part 1

	Favorite story	Least favorite story
Drebbel and the air conditioning of Westminster	8%	6%
The development of different types of thermometers and temperature scales	21%	10%
Debates about heat as a substance versus heat as a form of motion	4%	39%
Frederic Tudor, “The Ice King,” and ice harvesting	25%	4%
James Joule’s experiments	23%	6%
The development of ice-making machines, refrigerators, and the refrigeration cycle	23%	2%
Clarence Birdseye’s discovery of flash freezing food products	10%	8%
Willis Carrier and the development of commercial and residential air conditioners	8%	2%
Other	2%	23%

n = 51 – 52.

Viewers provided the following comments about Part 1:

Very interesting introduction to cold measurement. The scientists were very knowledgeable and it held my interest. It was interesting to see the advances through the years.

It was interesting to see the different concepts of cold and how they arrived at the conclusion of cold being an absence of heat and not an added property to a substance.

I thought it was informative about how scientists developed the laws of thermodynamics. I liked that the show gave some personal information about the scientists and reenacted some of the experiments.

I was actually just in awe of everything I was learning. Before the show I didn't even know how any of the ice was made or how an AC worked. I just learned so much.

Absolute Zero is a great program. I love the education, the presentation and the aesthetics.

Participants' favorite story from Part 2 was the race between James Dewar and Kamerlingh Onnes to liquefy hydrogen. Their least favorite segment was about theories concerning practical applications of and uses for Bose-Einstein condensates (e.g., quantum computers). Table 16 presents most and least favorite stories from Part 2.

Table 16
Adults' Favorite and Least Favorite Story from Part 2

	Favorite story	LEAST favorite story
The race between James Dewar and Kamerlingh Onnes to liquefy hydrogen in the late 1800s	44%	14%
The race between the Boulder lab (Cornell & Wieman) and the MIT lab (Ketterle) to create a Bose-Einstein condensate in the 1990s	33%	19%
Theories about practical applications of and uses for Bose-Einstein condensates (e.g., quantum computers)	22%	35%
Other	2%	2%

n = 52.

Regarding Part 2, adult viewers noted the following:

I thought it was interesting listening to the recounts of the race to liquefy the gases to get down to absolute zero. The scientists interviewed were interesting and made it easy and fun to watch. A lot of it went over my head but I still liked it.

Part 1 was much easier to follow than Part 2. It was very interesting and I think all students in science classes should watch it.

It was very much like reading a mystery. I particularly liked (and felt sorry for) James Dewar. Wondered how he could move on to other studies.

Part 2 of Absolute Zero provided me with information I had never dreamed of. There were so many experiments done to try to reach absolute zero. It seemed each experiment would bring them a little closer but absolute zero was unattainable.

RESULTS FROM EVALUATION OF OUTREACH MATERIALS & CAMPAIGN

This section of the report details results from data collection activities that focused on evaluating of the outreach campaign and materials, and it is organized according to the various components of the outreach campaign.

Results include data from the survey with National Partners/Participants (N=13), interviews with National Partners (N=3) and *Absolute Zero* Experts (N=7), and survey data from classroom teachers (N=6). Data from the evaluation of the outreach campaign and materials are presented in terms of number of participants, as N < 50 in each component of that evaluation.

PROFILE OF OUTREACH EVALUATION PARTICIPANTS

National Partners/Participants and Experts

More National Partners than Participants responded to the survey, and the interviews were conducted mainly with Experts. Of those interviewed, five indicated that they approached the campaign to become a Partner or Expert, and five individuals were invited to join by a representative of the campaign. Table 17 presents a profile of National Partner/Participant and Expert participants in the outreach data collection activities.

The Partners/Participants involved in the development of the guides were quite pleased both with the process used in developing the outreach guides and their organization's role in developing the guides.

Table 17
Profile of Outreach Evaluation Participants: Partners, Participants, Experts

		Survey (N=13)	Interview (N=10)
Participation in campaign	Partner	11	3
	Participant	2	0
	Expert	n/a	7
	Outreach recipient	n/a	n/a
Member of National Awareness Advisory Committee	Yes	5	n/a
	No	8	n/a
Org.'s Member(s) served as Expert	Yes	7	n/a
	No	4	n/a
Involved in development of outreach guides	Yes	5	n/a
	No	8	n/a

The five Partners/Participants involved in the development of the guides were quite pleased both with the process used in developing the outreach guides (mean = 4.25) and their organization's role in developing the guides (mean = 4.50).

Teachers

All of the teachers who participated in the evaluation of the outreach materials had training in science. Most teachers were interested in participating in the evaluation to get ideas about classroom activities and the free DVD's of the *Absolute Zero* program. On average, teachers had been teaching science for 14 years (Table 18).

Table 18
Profile of Participants, Teachers

	# Teachers	
Training in science	Science degree – undergraduate	4
	Science degree – graduate	3
	Science Certification	3
	Some science coursework, no formal degree or certification	0
	No formal science training	0
Reasons for participation	Ideas for classroom activities	6
	Free DVDs of the <i>Absolute Zero</i> program	5
	The topic of low temperature physics	3
	The opportunity to participate in research	3
	Interest in NOVA or PBS programs in general	3
	Other	1
Grade level	Middle School Teacher	2
	High School Teacher	3
	Middle and High School Teacher	1

N = 6. Numbers may total >6 because teachers could check more than one response.

MATERIALS: OUTREACH GUIDES AND DEMONSTRATION ACTIVITIES

In both the classroom study and the survey to National Partners/Participants, respondents rated the two *Absolute Zero* outreach guides. Data are presented for both groups of participants in the following section. Teachers read through and then rated the *Absolute Zero Community Education Outreach Guide* and *Absolute Zero Science Educator's Guide* in order to prepare for the classroom demonstration activities that they conducted.

It should be noted that the guides were developed for both teachers and informal educators of middle school students. However, the research study part of this evaluation included classroom teachers, who were more likely to conduct these types of activities with their students than were informal educators.

Community Education Outreach Guide

Four teachers were *very* or *extremely familiar* with the content presented in the guide, and all but one teacher found the *Community Education Outreach Guide* to be *extremely helpful* overall. Teachers and National Partners/Participants reported that the Guide is *extremely effective* at supplementing the content featured in the *Absolute Zero* program.

Both teachers and National Partners/Participants were very positive about features of the guide, particularly its format, readability, and content (Tables 19 and 20). Partners believed that the guide would be quite useful to teachers and informal educators of middle school students (mean = 4.00).

Table 19
Teachers' Ratings of the
Community Education Outreach
Guide

	Mean
Format	4.67
Readability	4.50
Illustrations	3.83
Content	4.67

n=6.

Table 20
Partners'/Participants'/ Ratings of
the *Community Education*
Outreach Guide

	Mean
Format	4.45
Readability	4.45
Illustrations	4.10
Content	4.45
Guide overall	4.36

n=12-13.

Both teachers and National Partners/Participants were very positive about features of the Community Education Outreach Guide.

Teachers found the “Refrigeration” and “Understanding Heat and Energy” and the “Demonstration” text boxes and “Additional Ideas” text boxes to be the most useful sections and features of the guide. (Table 21).

Table 21
Most Useful Sections and Features of the *Community Educ. Outreach Guide*

	# Teachers who rated sections/features most useful	
Sections of the Guide	Refrigeration	5
	Understanding Heat and Energy	4
	Thermometers	3
	States of Matter	3
	The Quest for Absolute Zero	3
	Cold Animals	2
	Cryogenics and technology	1
	Superconductivity	1
Features of the Guide	“Demonstration” text boxes	6
	“Additional ideas” text boxes	4
	Sections called “The Main Show”	3
	Sections called “Get Students Involved”	3
	Materials lists	1

N=6 teachers. Numbers total >6 because teachers could check more than one response.

Finally, teachers felt that the guide fit *moderately well* with their curriculum and that the guide was *somewhat* or *generally* relevant to their teaching. Five out of six teachers were *very* or *extremely likely* to use the guides in their classrooms again.

Demonstration Activities

Teachers found it useful to show the Absolute Zero broadcast to students in conjunction with conducting activities. Likewise, they found the demonstration activities to be quite useful at supplementing the content of the broadcast.

Teachers conducted two or three demonstration activities from the *Absolute Zero Community Education Outreach Guide*. All teachers conducted the *Making Things Cold* activity. Teachers then chose which additional activity (or activities, in the case of the four teachers who led two additional activities) to conduct. Results are presented according to the *Making Things Cold* activity and *Other Activities* (see Table 22 for how they rated the characteristics of these activities).

Teachers found it useful to show the *Absolute Zero* broadcast to students in conjunction with conducting activities. The mean for *Making Things Cold* was 4.17 (out of 4), while the mean for *Other Activities* was 4.30. Likewise, they found the demonstration activities to be quite useful at supplementing the content of the broadcast.

Teachers found it quite easy to conduct the activities as well as to use the directions in the guide, and all but one teacher read neighboring content in the outreach guide in preparation to lead the activities. Only two teachers modified

Making Things Cold, and three teachers incorporated some of the “Additional Ideas” listed in the guide, while other activities were modified in six cases.

In general, teachers believed that *Making Things Cold* was a more appropriate activity for high school students than for middle school students, while they were evenly split between high school and middle school for other activities. They rated the activities as enhancing their science curriculum by building off of material already included in the curriculum.

Finally, teachers found that the activities were quite engaging for students and helped students learn science process skills – much more so than helping them learn science content. Teachers reported being very likely to use these activities again in the future.

Table 22
Characteristics of Activities

	Means for <i>Making Things Cold</i>	Means for Other Activities
Usefulness at supplementing content in broadcast	4.17	4.30
Ease of conducting activities	4.00	4.60
Ease of using the directions in the guide	4.33	4.60
How engaging was activity for students	4.00	4.50
Effectiveness at helping students learn science content	3.14	2.83
Effectiveness at helping students learn science process skills	4.50	3.67
Teacher’s likelihood of using activity again in future	4.50	4.60

N=6 teachers.

Scale for each statement was from 1 (most negative) to 5 (most positive)

Science Educator’s Guide

National Partners/Participants rated specific features of the guide quite highly. They most appreciated the readability, content, format, complementarity to the other guide, and its overall usefulness (Table 23).

Table 23
National Partner/Participant Ratings of the *Science Educator's Guide*

	Mean
Format	4.17
Readability	4.33
Illustrations	4.08
Content	4.25
Guide overall	4.25
Usefulness to teachers & informal educators of middle school students	4.10
Effectiveness at complementing <i>Community Education Outreach Guide</i>	4.30

N=13.

Scale: 1 (least effective) to 5 (most effective)

All teachers found the guide *generally* or *extremely* effective at complementing the *Absolute Zero Community Education Outreach Guide*. The two portions of the guides that teachers found most helpful were “Science Inquiry: Teaching More Than Facts” and “Talking the talk.” Teachers varied regarding whether the content in the guide was new to them; half of teachers reported that the content was familiar but that the guide remained a good refresher.

Among teachers, three of the six participating teachers used the guide in preparation for conducting the demonstration activities in the classroom and reported the following:

I used this guide to write my lesson plan for the topic and the activity. Of real value were the personal stories and the section on how to use inquiry with this particular topic. I do not think it can ever be presented too frequently, as it is of vital importance to the future of my students.

The guide gave me a couple of ideas of how to present the material in a better way. I also liked the activities; I think they are very relevant to the content.

I really liked how it encouraged teaching the history of science and of scientists... it offered another way to capture the interest of students who may not yet understand the connection of real people to scientific ideas.

Teachers who did not use the guide in preparation for the demonstration activities reported that the guide was more relevant to informal science educators (appropriately, as that was a large intended audience for the guide), and the guide’s content was less relevant to more experienced classroom teachers. One experienced teacher reported that the guide would be useful for teachers in training: *I felt that the guide would be an excellent resource and discussion springboard for new science teachers, but I was already familiar*

National Partners/Participants most appreciated the readability, content, format, and overall usefulness of the Science Educator's Guide as well as its complementarity to the other outreach guide.

with most of the content. I teach a Graduate level course in Methods of Science Instruction, and I would like to use this Educator’s Guide with them. Three out of six teachers reported being *very* or *extremely likely* to use the guides in their classrooms again.

MATERIALS: ABSOLUTE ZERO CAMPAIGN WEBSITE

Four teachers used the campaign website (www.absolutezerocampaign.org) in conjunction with the guides to help prepare them for the demonstration activities. Two found the website *extremely* useful while two found the site *a little* or *somewhat* useful. Table 24 presents the areas of the website that teachers visited.

Table 24
Areas of the website that teachers visited

	#Teachers
About <i>Absolute Zero</i>	4
Get Involved	4
Press Room	2
Discussion Boards	2
National Partners	1
Ask the Experts	1

Regarding the “Get Involved” section of the website, teachers were most likely to visit the Low-Temp Basics; Resources, Activities, and Experiments; and Historical Timeline sections. They generally reported these sections to be useful (Table 25).

Table 25
Sub-Sections of the “Get Involved” Section of Campaign Website

	# teachers who visited area of site	# teachers who found area useful
Low-Temp Basics	4	3
Resources, Activities and Experiments	3	3
Historical Timeline	3	2
Nobel Laureates	2	0
Pictures and Biographies	1	0
Absolutely Real	1	0
<i>Absolute</i> Fun and Games: More Cool Links	1	0
<i>Absolute</i> Fun and Games: Crossword Puzzles	1	1
<i>Absolute</i> Fun and Games: Trivia Quiz	0	0
<i>Absolute</i> Fun and Games: Sudoku Puzzles	0	0

N=6 teachers.

National Partners/ Participants rated the Absolute Zero Campaign website as very useful both to their work as a National Partner/ Participant and to teachers and informal educators of middle school students.

All of the teachers reported they would be *very* or *extremely likely* to visit the website again. Three teachers reported being *very* or *extremely likely* to encourage students to visit the site.

Additionally, National Partners/Participants provided feedback on the campaign website. All survey respondents had visited the site, and they rated it as very useful both to their work as a National Partner/Participant (mean=4.00) and to teachers and informal educators of middle school students (4.08).

MATERIALS: PBS/NOVA WEBSITE

Overall, teachers found the PBS/NOVA website (www.pbs.org/wgbh/nova/zero) to be effective at providing science content, supplementing content from the *Absolute Zero* program and, especially, providing content about the history of science (Table 26).

Table 26
Teachers' Ratings of the PBS/NOVA Website

Website's effectiveness at:	Mean
Supplementing the content featured in the <i>Absolute Zero</i> program	4.00
Providing science content (e.g., temperature scales)	4.50
Providing content about the history of science (e.g., milestones in cold research)	4.67
Helping students practice scientific processes (e.g., observation, experimentation)	3.83

N=6 teachers.

Four out of six teachers thought the site was *very* or *extremely engaging* for students. Five teachers reported being *very* or *extremely likely* to use the website again with their students.

Classroom Activities on PBS/NOVA Website

Participating teachers had their students visit the PBS/NOVA *Absolute Zero* website. These six teachers had 18 classrooms of 354 middle and high school students visit the website (students' use was not prescribed). The data below concern teachers' reports about the areas of the site students visited as well as the components they appeared to enjoy most versus least (Table 27).

Table 27
Classroom Activities on PBS/NOVA Website

	# classes visited	# classes enjoyed most*	# classes enjoyed least*
Absolute Hot	14	3	6
A Sense of Scale	14	3	5
Milestones in Cold Research	14	4	4
The Conquest of Cold	11	1	5
Ultracold Atoms	11	1	5
How Low Can You Go?	16	7	1
States of Matter	14	5	2
A Matter of Degrees	11	4	0
Anatomy of a Refrigerator	11	3	2
The Ice Trade	10	10	0

N=18 classes.

*Numbers may total >18 because teachers could indicate more than one area for “enjoyed most” and more than one area for “enjoyed least.”

Overall, teachers reported that students most enjoyed the interactive components of the site the most, with emphasis on the strategic elements of “The Ice Trade”. Students also enjoyed the “How Low Can You Go?” graphics. Students were also interested in “A Sense of Scale,” “Absolute Hot,” and “The Anatomy of a Refrigerator.”

They liked the simulation with the "Ice Trade", and found that it was tricky to make a profit. They also liked the visual graphics on the "How Low Can You Go" simulation.

They especially enjoyed the anatomy of a refrigerator, and shared this with their parents and grandparents. One student actually brought an old letter from his great-grandparents in which a method using sawdust and ice cut from a pond was used to refrigerate food. ... We also had the auto tech instructor bring in an air conditioning system out of a car to show students how it worked.

Two students discovered points at which the numerical values of Celsius and Fahrenheit were the same. They seem to have discovered this for the first time using the “Sense of Scale” site.

They enjoyed the idea of having these Web sites available, and a few of them actually exhausted all of the sites. I have one student who now plans to visit Ohio State University where they are using pulsed lasers to cool atoms. His idea is to develop a science fair project next year on absolute zero. He is still talking about this unit.

Regarding what students liked the least, most comments focused on the content as well as the aesthetics of the website. In general, students felt that there was too much text on the site. Students did not like “Ultracold Atoms” and found “Conquest of Cold” to be boring. Additionally, students were often confused by the website instructions.

Regarding the evaluation overall, teachers generally were quite positive about their own and their students’ experiences.

They had a hard time understanding the content of these areas of the website.

Regarding the evaluation overall, teachers generally were quite positive about their own and their students’ experiences:

My students are still visiting the websites on their own, even though we have moved on to another subject. I appreciate the fact that they are educating themselves with such accurate information, and that the process is one that I believe in with respect to science education. The guides from this project are going to be used again in my classroom, because they are engaging, they offer inquiry-based science, and because my students really like them overall.

Overall the program and the activities were very well developed and involving for the students.

I was extremely impressed with this entire teaching package (videos, websites and educator guides). The content was appropriate to both academic level of my students and to the standards of the course I teach. The students found the material engaging. I intend to incorporate several of the activities and websites into my teaching next year.

CAMPAIGN: OUTREACH ACTIVITIES CONDUCTED

During their telephone interviews, the *Absolute Zero* Partners and Participants described the outreach activities they conducted with their membership and/or in their communities. Additionally, some interviewees provided GRG with names and contact information of teachers who attended various outreach activities, and evaluators corresponded with them to learn about those activities.

Throughout this section, vignettes are presented alongside data from Partner/Participant surveys and interviews in order to highlight some of these outreach activities. Where there was feedback from activity recipients (e.g., local teachers), their voices are included. See Appendix C for additional examples of outreach activities conducted by Partners, Participants, and Experts.

Outreach Activity Vignette: Superconductivity in Southern Mississippi

Dr. Alina Gearba, Assistant Professor of physics at University of Southern Mississippi and *Absolute Zero* Expert, led demonstrations on the science of cold at approximately 20 high schools in Southern Mississippi, including high schools that do not have physics classes.

Dr. Gearba had college students from her laboratory join her during these demonstrations, often visiting the high schools from which they graduated. She primarily chose demonstrations from the *Absolute Zero Community Education Guide*, including those involving liquid nitrogen and those related to superconductivity.

Dr. Gearba was invited for repeat visits by many schools, and she noted that her student audiences were always larger during the second visit. Principals began to notice that “*physics isn’t boring; it’s neat.*” One high school teacher noted that students “*were enthusiastic about the frozen demonstrations; they talked about absolute zero for weeks after the demo.*” Dr. Gearba estimates that she reached 1,000 students in Southern Mississippi through her outreach efforts.

Survey respondents described the outreach activities they conducted in the following categories:

- Information dissemination, including on websites, via mail (electronic and postal), newspaper articles, the organizations’ print publications), and at professional conferences;
- Answering questions sent to the *Absolute Zero* Campaign website (Experts only);
- Conducting demonstration activities (i.e., those from the outreach guides) at local schools, camps, and in their own laboratories (Experts);
- Distributing guides, DVDs of *Absolute Zero*, and creating their own outreach kits related to low-temperature physics;
- Hosting talks focusing on low-temperature physics;
- Holding an awards competition featuring low-temperature physics themes.

Outreach Activity Vignette: The Society of Physics Students

Gary White is the Assistant Director of Education at the American Institute of Physics (AIP), where he directs the Society of Physics Students (SPS) and Sigma Pi Sigma. AIP is an *Absolute Zero* National Partner.

He led several outreach activities to the SPS membership related to *Absolute Zero*, including email (to 12,000 people) and postal mail promotion (to an additional 30,000 people) of the broadcast, mailing outreach guides to every SPS chapter, and promoting the broadcast and campaign on his organization's website.

In his capacity as director of SPS, he recruited several SPS chapter advisors to serve as *Absolute Zero* Experts. Mr. White served as a consultant and reviewer for an AIP publication that adopted *Absolute Zero* as its theme. Finally, SPS developed an outreach kit (SPS Outreach Catalyst Kits, or SOCKS) around the theme of low temperature physics. These kits included the *Absolute Zero* book by Tom Shachtman and physics toys for local SPS chapters to use in leading science demonstrations to middle school youth.

Partners and Participants promoted the broadcast series and/or the outreach in a variety of ways (Table 28), primarily in print media, through listservs, and on websites.

Table 28
Promotion of Broadcast and Outreach

	Broadcast	Outreach
Via my organization's magazine, newsletter, or bulletin	12	9
Via a message to a member listserv	8	9
Via my organization's Web site	9	9
At a professional conference	5	5
At an event my organization hosted/attended (e.g., an open house, a networking event)	5	3
Other	3	2

n=13. Numbers total >13 because participants could check more than one response.

One organization worked with a local PBS station, and ten respondents noted that their organization conducted *Absolute Zero* outreach activities. Of those, six organizations conducted those activities on their own, two organizations worked with other *Absolute Zero* Partner/Participant organizations, and two involved non Partner/Participant organizations. A representative from the National Institute of

Partners and Participants promoted the broadcast series and/or the outreach in a variety of ways, primarily in print media, through listservs, and on websites.

Standards and Technology (Partner organization) coordinated a symposium with Principal Investigator Russell Donnelly and other scientific experts that was held at the national meeting of the American Association for the Advancement of Science (non-Partner organization). The American Institute of Physics worked with two organizations under its umbrella—Society of Physics students and Sigma Pi Sigma—to promote *Absolute Zero* to members.

In general, interviewees were unaware of other outreach activities being conducted. Some had heard about and/or watched the webcast posted on the campaign website. Others were aware that there were other National Partners/Participants conducting outreach, but they were unsure of what they were doing.

Outreach Activity Vignette: Frozen Flowers in Frozen Burlington, VT

Dr. Dennis Clougherty, *Absolute Zero* Expert and Professor of Physics at the University of Vermont, hosted demonstrations on the physics of cold for local middle school students at his laboratory. He had been conducting these demonstrations for years prior to *Absolute Zero* but saw the outreach campaign as an opportunity to promote the NOVA broadcast.

One of the visitors to Dr. Clougherty's lab was a middle school teacher from Burlington; she was accompanied by 84 middle school students and five additional staff members. This teacher raved about her own and her students' reactions to the floating disc and frozen flowers demonstrations as well as about the homemade thermometer.

She noted that there was *very high interest* among the students and that the activities fit well with their curriculum. "*Students were talking about it at home and at school. Within hours, I had teachers from other teams asking me where we went.*" About Dr. Clougherty and his staff, she said, "*UVM staff was great and was able to explain complex concepts at a level that students could understand.*"

CAMPAIGN: PROCESS OF PARTNERSHIP

The results about the outreach campaign are quite positive from those who responded. Nonetheless, as noted in the Methods section, they must be considered in light of potentially significant selection and non-response bias. Specifically, those individuals who chose to participate in evaluation activities (several months after the *Absolute Zero* broadcast and, in many cases, several more months since spearheading outreach activities) may have been more invested in and positive about the outreach campaign. Due to delays in the

broadcast, the outreach campaign activities often occurred several months before the broadcast aired.

In general, Experts and Partners/Participants provided three main reasons for joining the campaign:

1. Because of a “good fit” between their/their organization’s work (either low-temperature physics or science education) and that of the campaign,
2. An opportunity to have outreach opportunities and materials, and
3. To have additional tools/means to promote their organization.

Partners and Participants indicated high levels of satisfaction with the outreach partnership process, particularly with the *responsiveness of outreach campaign organizers* (Devillier Communications, Inc.) *the goals of the outreach campaign*, and *receiving relevant project-related information* (Table 29).

Partners and Participants indicated high levels of satisfaction with the outreach partnership process.

They were somewhat less satisfied with the project’s pace toward its goals, though they recognized that delays were somewhat difficult to avoid. One participant specifically noted that “*the organizers did a fabulous job, but were hamstrung by the inevitable delays in getting an air date, which made building momentum very difficult.*”

Table 29
Satisfaction with Outreach Partnership Process

	Mean
Responsiveness of outreach campaign organizers	4.91
The goals of the outreach campaign	4.33
Receiving relevant project-related information	4.25
My overall experience as a National Partner/ Participant in the <i>Absolute Zero</i> outreach campaign	4.15
Opportunity for communication with other partner/participant organizations	4.10
Support for participation in the campaign	4.09
Expectations for participation in the campaign	3.83
The project’s pace toward its goals	3.73

n= 10 – 13.

In general, Partners and Participants found the outreach campaign to be quite successful at fulfilling each of its goals, particularly those of *actively engaging science professionals, researchers and technicians in public outreach and education*; and *introducing some of the most important scientific breakthroughs and human achievements in this relatively unknown field of low temperature physics*. In addition, they gave a high rating (average of 4.22 out of 5) to the outreach campaign overall (Table 30).

Table 30
Success of Campaign at Fulfilling its Goals

	Mean
Actively engage science professionals, researchers and technicians in public outreach and education.	4.33
Introduce some of the most important scientific breakthroughs and human achievements in this relatively unknown field of low temperature physics.	4.17
Stimulate active learning by the general public and students about low temperature physics and the science of cold, including new technological advances involving cold temperature.	3.80
Serve as a catalyst for community-based collaboration and partnerships with science museums, libraries, schools, PBS stations and related organizations.	3.78
Engage the American audience in a story that touches their lives in innumerable ways while generating the greatest possible audience for Absolute Zero.	3.64
Outreach campaign overall	4.22

n= 9–12.

The Outreach Campaign partnership allowed the partnering organizations to do jointly what they perceived could not be done by one organization alone.

Overall, they were quite positive about the partnership process and the role of the campaign, particularly in their assessments that *the outreach campaign allowed us to do what cannot be done by one organization alone* (Table 31). Additionally, 12 of 13 survey respondents indicated that, if given the choice now, they would recommend that their organization serve as an *Absolute Zero* National Partner/Participant.

Table 31
Agreement with Statements About Outreach Campaign Partnership

	Mean
The outreach campaign allowed us to do what cannot be done by one organization alone.	4.83
The outreach campaign allowed us to underscore a subject that is not well known or appreciated by the students and the American public	4.62
The campaign allowed us to become involved in an important public broadcasting endeavor	4.46
This was a joint endeavor worth doing.	4.38
Overall, appropriate partners were included in the campaign.	4.36
The project established trust and respect among Partners and Participants.	4.18

n=11 – 13.

CAMPAIGN: IMPACT ON ISE AND SUGGESTIONS FOR FUTURE SIMILAR PROJECTS

Interviewees perceived the campaign as making a contribution to the field of informal science education by:

- Increasing the accessibility of low-temperature physics as well as the public's interest in and awareness of physics and its applications;
- Creating educational outreach guides that will provide a lasting benefit to informal educators; and
- Focusing on a novel topic.

They also noted that it would have been helpful if the broadcast and outreach had been more fully integrated with one another, as well as if the broadcast airdate had been finalized at an earlier point. If these two things had occurred, they would have helped to sustain momentum from the outreach activities that often had been conducted months prior to the broadcast.

Survey respondents were positive about the significance of the outreach campaign. Specifically, they were enthusiastic about connections to public television and NOVA as well as about the content of the broadcast:

Great opportunity to establish/re-establish ties to the public television community.

Being able to tie it to PBS and NOVA was key.

It actually got young people and teachers thinking about cryogenics as a really interesting and important part of science.

Interviewees had the following recommendations for aspects of the *Absolute Zero* campaign that they suggested continue to be carried forward into future campaigns:

1. To have a high-quality website go live early in the outreach period,
2. To have a campaign with nationwide reach,
3. To produce and distribute guides for educators, and
4. To continue to include informal science professionals alongside those in “hard science” professionals.

Regarding what might be different in a future outreach effort from the *Absolute Zero* campaign, interviewees offered the following suggestions:

- They noted that the biggest challenge is in selecting the topic. They suggested that future organizers consider a more forward-looking, less historical focus and/or a topic with more diversity (i.e., gender, race/ethnicity) among its scientists, both historically and currently, if possible;
- Hold more large-group events to coincide with the broadcast (i.e., large group screenings of the broadcast) and get earlier buy-in from the public television community (if possible); they noted that the outreach “was louder” than the broadcast itself.

Survey respondents were positive about the significance of the outreach campaign. Specifically, they were enthusiastic about connections to public television and NOVA as well as about the content of the broadcast.

As an Expert, you put in a lot of effort, and you wait for some big boom. It would have been nice if the boom had been louder.

- Consider adding more “technical meat” to the website (such as links “to the whole world of low temperature physics”);
- If possible, offer a financial incentive to informal educators (such as financial assistance of \$100 for purchasing materials necessary to lead demonstration activities or purchase DVDs of the broadcast);
- Have more clearly-defined roles for Experts;
- Structure the outreach so that the campaign approaches and invites potential Experts rather than having would-be Experts ask to join the campaign.

Respondents to the survey had less to say regarding recommendations for future potential campaigns, though they did offer the following:

Make the educational outreach opportunities more clear. It was difficult to get our members involved in this part because it was up to the participants to come up with a program...there weren't any pre-established programs.

Maybe a program on a topic like nanotechnology or biophysics/medical physics. There is little awareness in the public sector of how basic physics has resulted in many medical treatment breakthroughs. Another area might be energy awareness.

GRG'S EVALUATIONS OF OTHER NOVA PROGRAMS

For numerous science documentaries and television series that have had National Science Foundation Informal Science Education (NSF ISE) funding, GRG has conducted external evaluations. These have included several NOVA programs. We believed it would be instructive to provide brief summaries of some of those evaluations to determine whether there were consistencies among the findings and how findings from the *Absolute Zero* evaluation compared with them. We have focused on the following NOVA programs: *Einstein's Big Idea*, *Saved by the Sun*, *Building Big*, and *Runaway Universe*.

Most of the evaluations have assessed both changes in learning as a result of the broadcast programs (either via retrospective post-surveys or using a pre-post design) and viewers' overall opinions of the shows, as well as their interest in and motivation to further pursue the topic presented. Several evaluations have also included assessing the effectiveness of outreach initiatives.

Most of the evaluations (notably *Einstein's Big Idea* and *Saved by the Sun*, as well as *Absolute Zero*) have involved the assessment of both typical NOVA viewers as well as viewers with less familiarity with the NOVA series including high school and college students.

In general, these assessments have provided similar outcomes, whereby the science programs were found to be quite effective in enhancing learning and future interest in related topics. For most of these projects, GRG has recommended to the clients they continue using similar formats while also extending viewership to a wider audience.

Einstein's Big Idea and *Absolute Zero* both used dramatic recreations as part of the programs. The Einstein docudrama presentation format appealed to its audience and was particularly effective in teaching science across history, especially since $E=mc^2$ is a topic of interest to the public. Several of the segments in *Absolute Zero* also had high appeal for the viewers, though some of the concepts presented were difficult for viewers to understand. (When GRG conducted a literature review, searching for any published studies on differences in learning science concepts based on different program formats, we found none in the informal science arena.)

Institutional partnerships did not appear to affect either the degree of learning or the opinions of the programs. Specifically, participants in the *Building Big* evaluation expressed extremely positive opinions regarding the partnership, as did outreach initiative partners in *Absolute Zero*.

The majority of these evaluations highlighted the importance of providing additional sources to enhance the information received via the TV series. Notably, accompanying websites, library resource kits, and/or teacher's guides were recommended. Other recommendations more specific to individual evaluations included being aware of potential gender disparities when analyzing outcomes data (*Building Big*), allocating additional funding for follow-up

evaluation in order to assess longitudinal changes/consistencies (*Building Big*) as well as location of survey placement on websites if that is the means of survey distribution (*Cracking the Code*). Following are brief descriptions of the programs mentioned above.

EINSTEIN'S BIG IDEA

Einstein's Big Idea, a multi-part NOVA program, used dramatic recreations of Einstein and other scientists who were key to the development of the equation $E=mc^2$. For WGBH, GRG conducted a two-part study on the role of the broadcast series in aiding viewer learning; the sample consisted of both regular NOVA viewers and high school students who watched the program as part of their science class. Results indicated that *Einstein's Big Idea* was successful in teaching both groups of viewers the basic content related to $E=mc^2$. Each group showed statistically significant increases in their ability to identify the terms of the equation after watching the program.

The NOVA program was particularly effective in providing regular NOVA viewers and student viewers with a deeper understanding of the multiple scientists whose work contributed to the famous equation. Additionally, after watching the program, almost all NOVA viewers either continued engaging with content related to *Einstein's Big Idea* or had plans to do so. Many had visited the program's accompanying web site or taken other steps to learn more. Meanwhile one-quarter of high school students also planned to continue engaging with the program's content.

Given these outcomes, GRG recommended that WGBH build on the public's interest and extend *Einstein's Big Idea* content further, by creating new programming to explore the components and use of the $E=mc^2$ equation in more depth. We are aware of the high cost of producing dramatic recreations, making this format less likely to produce.

SAVED BY THE SUN

The NOVA series, *Saved by the Sun*, which aired in 2007 and dealt with solar energy, was primarily funded by a private foundation, The Lemelson Foundation. The foundation provided funding for both the documentary and an accompanying classroom activity that gave teachers ideas to use with their students both before and after watching the program. GRG conducted a pre-post viewer study with 80 participants, including both regular NOVA viewers as well as those who do not typically watch science programming.

Results revealed that both types of viewers showed statistically significant gains in their knowledge of topics related to solar energy after watching *Saved by the Sun*. They both also rated the program as either very or extremely effective at having a positive influence on respondents' attitudes in several key areas and rated the program highly. GRG recommended that WGBH work to build on this initial impact by reaching out to new groups of non-science viewers.

BUILDING BIG

In 2001, GRG conducted specific viewing groups across the United States designed to assess viewers' perceptions of WGBH's *Building Big* TV series. Different groups each viewed different episodes from the five-episode series. Participants completed a post-viewing survey and participated in short discussion groups to gather impressions of the show. Overall, the series proved successful at enhancing knowledge of key science and engineering principles, and participants were highly interested in these concepts.

Somewhat similar to *Absolute Zero*, this project involved partnerships with collaborating organizations, which proved successful. One of the key recommendations GRG provided for this study was to allocate funding for follow-up evaluation in order to assess longitudinal changes/consistencies.

RUNAWAY UNIVERSE

GRG evaluated another NOVA special that aired in 2001, produced by Tom Lucas Production (and funded by the NSF). The one-hour documentary, *Runaway Universe*, was assessed to determine general interest and appeal as well as to determine whether and to what extent the documentary succeeded in demonstrating the scientific process/scientific techniques and science-related phenomena.

Nearly all viewers recognized and appreciated the way the producers were able to take a complex topic and explain it clearly for viewers. Although the content was sometimes over the viewers' heads, respondents pointed to some elements of the documentary that enhanced the clarity of the presented information. Most viewers suggested including more graphics in the video and indicated that the length (one-hour) may be prohibitive for full viewing in a high school classroom setting.

GRG recommended a Teacher's Guide devoted entirely to the video for use in the classroom to enhance learning. Additionally, the use of a related website or other multimedia outlet was suggested as a way of enhancing the information provided in the documentary.

CONCLUSIONS AND RECOMMENDATIONS

Considering results from all components of the evaluation, both of the broadcast and of the outreach, GRG offers the following conclusions and recommendations for similar types of informal science education programs and outreach initiatives in the future.

BROADCAST

Both adult and student viewers were positive about *Absolute Zero*. Adult viewers of the two-part program provided more positive ratings for Part 1 than for Part 2, in terms of the show being interesting, informative, and visually-appealing. It seemed as though the content in Part 2 was too complicated for some viewers to understand; their least favorite segment was about theories concerning practical applications of and uses for Bose-Einstein condensates (e.g., quantum computers), which was one of the most scientifically-complicated portions of the program. In contrast, they enjoyed segments that had a human interest.

Recommendation: In future broadcasts with highly technical or complicated content, consider presenting those more technical elements alongside segments which viewers see as relevant to their own lives today. These should be tested formatively.

After viewing the broadcast, both adults and students reported being more aware of the topics featured in *Absolute Zero*. This result persisted despite likely ceiling effects in adults' interest in these topics (they had very high pre-viewing interest levels). **Moreover, adult viewers were more interested in science and reported being likely to pay attention to *Absolute Zero*-related topics in the future.**

Recommendation: Continue to create science programs that feature less well-known topics, as was the case with low-temperature physics.

Post-viewing, students reported decreases in their interest in learning more about the topics featured in the broadcast. These results align with those from prior GRG research studies with students, which have found that middle and high school students tend to describe themselves as being uninterested in science topics. It may be that students' interest is sparked further in the future.

Or, it may be that students felt they had learned enough about these topics through the broadcast and activities. Additionally, anecdotal reports from teachers involved in the classroom study indicated that individual students were quite interested in continuing to learn about these topics, but those individual effects were not evident in average ratings across all students.

***Recommendation:** If students are an intended audience for future broadcasts, consider allowing for a longer length of evaluation follow-up to assess more distal gains in interest or engagement in science-related activities.*

OUTREACH MATERIALS

Both teachers and National Partners/Participants rated both outreach guides quite highly. Teachers found the guides easy to use and helpful in leading demonstration activities. They provided slightly lower ratings for the Science Educator's Guide, not surprising since they were not its primary audience (informal science educators were). Yet they still found it to be a useful resource, including for training upcoming science teachers.

Teachers reported that demonstration activities in the guides were easy to conduct, engaging for students, and nice way to supplement viewing the broadcast. Overall, they reported being quite likely to use the guides and to lead demonstration activities in the future.

***Recommendation:** If possible, foster means by which to encourage informal science educators to use the outreach guides and broadcast in conjunction with one another, as they seem mutually reinforcing and enhancing.*

***Recommendation:** Consider targeted outreach to informal science educators to enable them to become aware of outreach materials.*

OUTREACH CAMPAIGN

Outreach campaign participants were extremely positive about the work of Devillier Communications, Inc. The efforts and dedication of that team appeared to keep outreach participants engaged and on board with the campaign despite the outreach having peaked so far in advance of the broadcast. Despite those delays, there were still very high levels of satisfaction with the partnership process among respondents to this evaluation.

***Recommendation:** Continue to have an engaged and dedicated central team communicating with individuals and organizations involved with a national outreach campaign.*

National Partners/Participants, and Experts wished that the broadcast and the outreach had been better coordinated in terms of their timelines, or that that there had been more formal events for outreach campaign members to participate in and/or promote at the time of the broadcast. Campaign participants seemed eager to attend such events but less willing or able to organize them individually.

***Recommendation:** In future efforts, attempt to integrate the broadcast event with outreach events, for instance, hold a public screening of the broadcast with a lecture from scientific experts.*

National Partners and Participants were positive about the range of organizations included in the campaign.

***Recommendation:** Consider continuing to have future outreach campaigns with national partnership and reach that bring together organizations with similar topical or educational foci.*

National Partners, Participants and Experts were eager for high-quality outreach materials (and some joined the campaign specifically for such materials), and they were very positive about the ways that the materials facilitated their conducting outreach activities. They tended to be positive about their own activities yet unaware of whether other activities were being conducted by others involved with the campaign. Recipients of outreach activities were quite positive about those activities as well.

***Recommendation:** Continue to produce high-quality ISE outreach materials for topics where few to none exist.*

***Recommendation:** In future campaigns, consider having a way to organize outreach events and facilitate communication between outreach participants leading events so outreach happens in a less ad hoc fashion. This may build more momentum to national campaign efforts as well as encourage connections among outreach participants as well as between the outreach and broadcast.*

APPENDIX A: NATIONAL PARTNERS, PARTICIPANTS, AND EXPERTS

National Partner and Participant Organizations in Outreach Campaign

	Organization
	Acoustical Society of America
	American Association of Physics Teachers
	American Institute of Physics
	American Physical Society
	American Society of Heating, Refrigerating and Air-Conditioning Engineers
	Association of Science-Technology Centers
	Center for Ultra Cold Atoms
	Cryogenic Society of America
	Los Alamos National Laboratory
National Partners	National High Magnetic Field Laboratory
	National Society of Hispanic Physicists
	Nat'l Alliance of State Science & Math. Coalitions
	Optical Society of America
	PIRA - Physics Instructional Resource Association
	SACNAS - Society for Advancement of Chicanos and Native Americans in Science
	Sigma Pi Sigma
	Society of Physics Students
	TryScience.org
	USA Today Education
	Department of Energy, Office of Science
National Participants	National Institute of Standards and Technology
	National Science Teachers Association

N=19 National Partner organizations; N=3 National Participant organizations.

Absolute Zero Scientific Experts

Name	Institution
Dr. Dennis Clougherty	University of Vermont
Dr. David Haase	North Carolina State University
Dr. Alina Gearba	University of Southern Mississippi
Dr. Eric Palm	National High Magnetic Field Laboratory
Professor John Pfothenhauer	University of Wisconsin
Dr. Roberto Ramos	Drexel University
Dr. Greg Swift	Los Alamos National Laboratory
Dr. Dwight Whitaker	Williams College

N=8.

APPENDIX B: SUPPLEMENTARY DATA

ADDITIONAL TABLES FROM BROADCAST EVALUATION

Table B1
Adults' Current Knowledge of Latest Scientific Developments (Compared to Most People They Know)

	Percentage
Much less	2%
Less	0
No more or less	21%
More	60%
Much more	17%

n = 52.

Mean = 3.92

Table B2
Adults: How Active at Seeking Out of Information on Latest Advancements in Science

	Percentage
Not at all active	2%
Somewhat active	19%
Moderately active	21%
Very active	39%
Extremely active	19%

n = 52.

Mean = 3.54

Table B3
Adults: News Source Most Relied on for Info. on Science Advancements

	Percentage
Movies & documentaries	42%
National news	14%
Online news	14%
Web site	12%
Magazines	6%
Public radio	4%
National newspaper	4%
Classes/lectures	2%
Friends/family	2%

n = 51.

Table B4
Students' Frequency of watching science-related programs on television

	Percentage
Never	18%
Once a year	7%
A few times a year	23%
Once a month	7%
A few times a month	21%
Once a week or more	13%
More than once a week	11%

n = 322.

Table B5
Students' Frequency of watching NOVA

	Percentage
Never	81%
Once a year	6%
A few times a year	7%
Once a month	1%
A few times a month	3%
Once a week or more	1%
More than once a week	1%

n = 324.

Table B6
Pre-viewing: Adults' Visits to NOVA Website in Past Three Months

	Percentage
None	15%
1 time	4%
2 – 3 times	43%
4 – 5 times	22%
> 5 times	17%

n = 52.

Table B7
Post-viewing: Adults' Visits to Websites Since Pre-Viewing Survey

	Main NOVA website %	Ab. Zero NOVA site%
Not visited, do not plan to visit	6%	8%
Not visited but plan to visit	14%	21%
1 time	15%	17%
2 – 3 times	29%	33%
4 – 5 times	27%	12%
> 5 times	10%	10%

n = 52.

Table B8
Pre-viewing: Science-Related Activities in Past Month

	Never Adults	Never Youth	Once or twice A	Once or twice Y	Several Times Adults	Several Times Youth
Discussed science-related issues with friends, family, or colleagues	0	25%	31%	51%	69%	24%
Noticed stories in the news about science	2%	30%	27%	52%	71%	18%
Read a book about a science topic	19%	53%	56%	35%	25%	12%
Watched a science-related television program	0	32%	19%	36%	81%	32%
Visited a Web site to learn about a scientific topic	7%	52%	44%	36%	48%	12%
Attended a science-related lecture or presentation	56%	n/a	21%	n/a	23%	n/a
Visited a museum or science center	33%	58%	48%	30%	20%	12%
Participated in a science club or group	n/a	84%	n/a	12%	n/a	4%
Done science experiments at home	n/a	49%	n/a	36%	n/a	15%
Participated in another science-related activity	n/a	79%	n/a	14%	n/a	7%

Adult n = 52, Youth n = 298-324.

Table B9
Post-viewing: Science-Related Activities as a Result of (Adults) / Since (Youth) Watching *Absolute Zero*

	Yes Adults	Yes Youth	No A	No Y	Not yet but plan to Adults	Not yet but plan to Youth
Discussed science-related issues with friends, family, or colleagues	94%	26%	4%	61%	2%	13%
Noticed stories in the news about science	n/a	26%	n/a	65%	n/a	9%
Read a book about a science topic	23%	14%	42%	77%	35%	9%
Watched a science-related television program	81%	38%	14%	52%	6%	10%
Visited a Web site (other than <i>Absolute Zero</i> site) to learn about a scientific topic	44%	17%	33%	74%	23%	9%
Attended a science-related lecture or presentation	12%	n/a	69%	n/a	19%	n/a
Visited a museum or science center	25%	12%	31%	71%	44%	17%
Tried to stay more up-to-date on science issues	69%	n/a	17%	n/a	14%	n/a
Participated in a science club or group	n/a	8%	n/a	87%	n/a	5%
Done science experiments at home	n/a	18%	n/a	74%	n/a	8%
Participated in another science-related activity	n/a	9%	n/a	84%	n/a	7%

Adult n = 52, Youth n = 302-307.

Table B10
Pre: Adults Who Had Heard of
Following Science Topics

	Percentage
Science of cold/low temperature physics	73%
Races among scientists towards a scientific breakthrough	92%
Competing scientific theories	85%
History of science	92%

n = 52. Percentages total >100% because participants were able to select more than one response.

Table B11
Pre: Students Who Had Studied
the Topics in School

	Percentage
Chemistry	33%
Physics	43%
Science of cold/low temperature physics	15%
Races among scientists towards a scientific breakthrough	17%
Competing scientific theories	39%
History of science	44%
None of the above topics	25%

n=319. Percentages total >100% because participants were able to select more than one response.

Table B12
Pre-viewing: Adults Became Aware of Topics via What Source

	Percentage
Through someone I know	67%
Through my job	9 (17%)
Through school	22 (42%)
Through media/news	32 (62%)
Online	13 (25%)
Other	2 (4%)

n = 52. Percentages total >100% because participants were able to select more than one response.

Table B13
Pre-viewing: Students' Familiarity with Topics

	Not at all	A little	Somewhat	Very	Extremely
Science in general (Mean = 2.96)	5%	22%	49%	20%	4%
Chemistry (Mean =2.03)	31%	41%	22%	5%	1%
Physics (Mean =2.13)	33%	32%	23%	11%	1%
The science of cold/low- temperature physics (Mean =1.69)	52%	32%	11%	5%	0
Races among scientists towards a scientific breakthrough (Mean = 1.85)	46%	31%	18%	3%	2%
Competing scientific theories (Mean =2.12)	36%	31%	20%	11%	2%
History of science (Mean =2.10)	25%	48%	18%	8%	1%

n = 317-321.

Table B14
Post-viewing: Changes in Students' Awareness of Topics

	I'm less aware now.	My awareness is the same.	I'm slightly more aware now.	I'm somewhat more aware now.	I'm a lot more aware now.
Science in general (Mean = 3.94)	3%	30%	38%	22%	7%
Chemistry (Mean =3.80)	7%	31%	38%	19%	5%
Physics (Mean =3.72)	6%	39%	31%	19%	5%
The science of cold/low- temperature physics (Mean =4.32)	4%	17%	23%	27%	29%
Races among scientists towards a scientific breakthrough (Mean = 4.02)	5%	28%	27%	26%	14%
Competing scientific theories (Mean =3.83)	6%	35%	30%	22%	7%
History of science (Mean =4.05)	5%	24%	33%	24%	14%

n = 306-313.

Table B15
Post-Viewing: Adults' Changes in Awareness

	No change	Slightly more aware now	Somewhat more aware now	A lot more aware now
General chemistry (mean=3.40)	21%	37%	23%	19%
General physics (mean=3.42)	21%	37%	21%	21%
The science of cold (mean=4.25)	6%	15%	27%	52%
History of science (mean=3.94)	8%	25%	33%	35%
Races among scientists towards a scientific breakthrough (mean=3.94)	8%	25%	33%	35%
Competing scientific theories (mean=3.85)	6%	33%	33%	29%

n = 52.

Table B16
Post-viewing: Likelihood of Paying Attention to Story/News Piece

	Not at all likely Adults	Not at all likely Youth	A little likely Adults	A little likely Youth	Somewhat, Very or Extremely likely Adults	Somewhat, Very or Extremely likely Youth
Science in general (Middle school youth mean= 2.37)	n/a	26%	n/a	37%	n/a	37%
General chemistry (Adult mean= 3.54) (Middle school youth mean= 2.13)	2%	37%	8%	29%	90%	34%
General physics (mean=3.52) (Youth mean= 1.39)	0	28%	14%	27%	86%	45%
The science of cold (mean=4.23) (Youth mean=1.70)	0	20%	4%	28%	96%	52%
Races among scientists towards a scientific breakthrough (mean=3.92) (Youth mean= 1.57)	2%	22%	8%	26%	91%	52%
Competing scientific theories (mean=3.79) (Youth mean= 1.45)	2%	24%	6%	29%	93%	47%
History of science (mean=4.02) (Youth mean= 1.46)	2%	28%	4%	28%	95%	48%

Adult n = 52, youth n=126-310. Only middle school youth responded to the question about general chemistry at post-viewing and about science in general at pre and post viewing.

Table B17

Pre-viewing: Adults' Interest in Learning More About Science Topics

	Not at all interested	A little interested	Somewhat, Very, or Extremely interested
General chemistry (mean=3.65)	4%	4%	93%
General physics (mean=3.73)	4%	8%	89%
The science of cold (mean=4.04)	2%	2%	97%
History of science (mean=3.98)	2%	6%	93%
Races among scientists towards a scientific breakthrough (mean=4.27)	0	2%	98%
Competing scientific theories (mean=4.29)	0	0	100%

n = 52.

Table B18

Post-Viewing: Adults' Changes in Interest

	Less interested now	No change in interest	Slightly, somewhat, or a lot more interested now
General chemistry (mean=3.42)	0	25%	75%
General physics (mean=3.35)	2%	21%	77%
The science of cold (mean=3.92)	2%	6%	93%
History of science (mean=3.88)	2%	10%	89%
Races among scientists towards a scientific breakthrough (mean=3.94)	0	14%	87%
Competing scientific theories (mean=3.79)	0	7%	87%

n = 52.

Table B19
 Post-Viewing: Adults' Changes in Motivation to Learn More About Topics

	Less motivated now	No change in motivation	Slightly, somewhat, or a lot more motivated now
General chemistry (mean=3.25)	4%	23%	73%
General physics (mean=3.23)	4%	25%	71%
The science of cold (mean=3.69)	2%	19%	79%
History of science (mean=3.75)	0	19%	81%
Races among scientists towards a scientific breakthrough (mean=3.71)	0	14%	87%
Competing scientific theories (mean=3.60)	2%	17%	81%

n = 52.

Table B20
 Pre-Viewing: Students' Interest in Learning More About Topics

	Not at all	A little	Somewhat	Very	Extremely
Science in general (Mean =2.77)	13%	28%	34%	18%	7%
Chemistry (Mean =2.71)	17%	29%	26%	21%	7%
Physics (Mean =2.48)	26%	28%	26%	13%	7%
The science of cold (Mean =4.00)	35%	29%	20%	10%	6%
Races among scientists towards a scientific breakthrough (Mean =2.20)	34%	30%	24%	7%	5%
Competing scientific theories (Mean =2.18)	33%	34%	19%	11%	3%
History of science (Mean =3.96)	37%	30%	23%	8%	2%

n = 319-322.

Table B21
 Post-Viewing: Students' Interest in Learning More About Topics

	Not at all	A little	Somewhat	Very	Extremely
Science in general (Mean = 2.86)	12%	25%	34%	23%	6%
Chemistry (Mean = 2.74)	17%	25%	31%	20%	7%
Physics (Mean = 2.55)	23%	27%	27%	19%	4%
The science of cold, also called low- temperature physics (Mean = 2.90)	15%	23%	31%	21%	10%
Races among scientists towards a scientific breakthrough (Mean = 2.53)	23%	27%	30%	15%	5%
Competing scientific theories (Mean = 2.48)	22%	32%	28%	14%	4%
History of science (Mean = 2.51)	23%	28%	29%	15%	5%

n = 305-310.

ADDITIONAL TABLES FROM TEACHERS' EVALUATIONS OF OUTREACH MATERIALS

Table B22
 Teachers' Ratings of the *Community Education Outreach Guide*

	1: Poor	2	3	4	5: Excellent
Format (mean=4.67)	--	--	--	2	4
Readability (mean=4.50)	--	--	1	1	4
Illustrations (mean=3.83)	--	1	1	2	2
Content (mean=4.67)	--	--	--	2	4

N=6.

Table B23

Usefulness of showing *Absolute Zero* to students with whom teachers conducted activities

	Making Things Cold (mean=4.17)	Other Activities (mean=3.40)
Not at all useful	0	1
A little	0	1
Generally	1	1
Very	3	2
Extremely useful	2	4

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

Table B24

Effectiveness of activity supplementing the content of show

	Making Things Cold (mean=4.17)	Other Activities (mean=4.30)
Not at all effective	--	--
A little	--	--
Generally	1	1
Very	3	5
Extremely effective	2	4

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

Table B25

Ease of obtaining materials for *Absolute Zero* activities compared to other activities

	Making Things Cold	Other Activities
More effort to obtain	0	1
Less effort to obtain	1	4
About the same amount of effort to obtain	5	5

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

Table B26

Preparation for activities

	Making Things Cold	Other Activities
Read only the demonstration instructions in the box	1	1
Read the neighboring content in that section of the guide	5	9

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

Table B27
Ease of conducting activity

	Making Things Cold (mean=4.00)	Other Activities (mean=4.60)
Not at all easy	0	0
A little	0	0
Generally	1	1
Very	4	2
Extremely easy	1	7

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

Table B28
Did you modify the activity?

	Making Things Cold	Other Activities
Yes	2	6
No	4	4

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

Table B29
Did you incorporate any “Additional Ideas”

	Making Things Cold
Yes	3
No	3

N=6 teachers.

Table B30
Ease of using the Outreach Guide’s directions

	Making Things Cold (mean=4.33)	Other Activities (mean=4.60)
Not at all easy	0	0
A little	0	0
Generally	2	1
Very	0	2
Extremely easy	4	7

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

Table B31
Appropriate grade levels by activity

	Making Things Cold	Other Activities
5 th grade	2	6
6 th grade	2	4
7 th grade	3	5
8 th grade	3	8
9 th grade	3	6
10 th grade	4	3
11 th grade	4	6
12 th grade	2	2

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

Table B32
Appropriate class type by activity

	Making Things Cold	Other Activities
Chemistry	5	8
Physics	3	4
General Science	6	9
Other*	3	4

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

*Other types of classes included Earth science, honors biology, and physical science.

Table B33
How engaging was this activity for students?

	Making Things Cold (mean=4.00)	Other Activities (mean=4.50)
Not at all engaging	0	0
A little	0	0
Generally	1	1
Very	4	3
Extremely engaging	1	6

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

Table B34
Effectiveness of activity at:

		1 Not at all effect ive	2	3	4	5 Extre mely Effec tive
Making Things Cold	Helping students learn science content (Mean=3.14)	1	1	2	2	1
	Helping students learn science process skills (mean=2.83)	0	2	3	1	0
Other Activities	Helping students learn science content (mean=4.50)	0	0	0	6	6
	Helping students learn science process skills (mean=3.67)	0	2	2	6	2

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

Table B35
Likelihood of using the activity in the future

	Making Things Cold (mean=4.50)	Other Activities (mean=4.60)
Not at all likely	--	--
A little	--	--
Generally	--	1
Very	3	2
Extremely likely	3	7

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

Table B36
Activity and science curriculum

	Making Things Cold	Other Activities
Enhance your science curriculum, by building off of material already included in the curriculum.	5	8
Enrich your science curriculum, by focusing on topics outside of your regular curricular content.	1	2

N=6 teachers. N>6 for “other activities” as some teachers conducted 2 additional activities.

Table B37
Teachers' familiarity with topics prior to classroom study

	Mean	1: Not at all familiar	2	3	4	5: Extremely familiar
Races among scientists towards a scientific breakthrough	3.83	0	0	3	1	2
Competing theories, current or historic, about a scientific phenomenon	4.00	0	0	1	4	1
History of science	4.00	0	0	2	2	2
The science of cold (low-temperature physics)	3.60	0	2	0	1	2

N=5-6

Table B38
Teachers' past experience and future interest in teaching topics

	Number of teachers with teaching experience	Mean	1: Not at all familiar	2	3	4	5: Extremely familiar
Races among scientists towards a scientific breakthrough	3	3.83	4.00	0	1	1	1
Competing theories, current or historic, about a scientific phenomenon	4	4.00	4.33	0	0	1	2
History of science	4	4.00	4.50	0	0	0	3
The science of cold (low-temperature physics)	2	3.60	4.00	0	1	1	1

N=5-6

Table B39
Teachers' interest in learning more about topics

	Mean	1: Not at all familiar	2	3	4	5: Extremely familiar
Races among scientists towards a scientific breakthrough	4.33	0	1	0	1	4
Competing theories, current or historic, about a scientific phenomenon	4.83	0	0	0	1	5
History of science	4.83	0	0	0	1	5
The science of cold (low-temperature physics)	3.67	0	0	3	2	1

N=5-6

APPENDIX C: EXAMPLES OF *ABSOLUTE ZERO* OUTREACH ACTIVITIES

Examples of *Absolute Zero* Outreach Activities Conducted by Partners, Participants, and Experts

Organization/Expert	Activity (What & Where)
American Association of Physics Teachers American Society of Heating, Refrigerating and Air-Conditioning Engineers Cryogenic Society of America	<i>Absolute Zero</i> publicity flyers at national conferences
American Institute of Physics (umbrella organization for Sigma Pi Sigma & Society for Physics Students)	<ul style="list-style-type: none"> -Promoted broadcast and outreach via email, postal mail, and AIP publications -Hosted competitions featuring low-temperature physics themes -Promoted NSTA Webinar -Created outreach kits featuring low-temperature physics
Association of Science-Technology Centers (ASTC)	<ul style="list-style-type: none"> -Publicized <i>Absolute Zero</i> via member listserv, e-newsletter, and ASTC print publications -Distributed outreach guides at ASTC conference
National High Magnetic Field Laboratory	<ul style="list-style-type: none"> -Ambassadors' Dinner for ~60 local (FL) science teachers & resource staff; included lecture & demonstration activity from outreach guide - Distributed educational materials (including outreach guides and broadcast DVDs) to science teachers -<i>Absolute Zero</i> highlighted during lab's open house -Publicized broadcast & campaign via newsletter and email to local teachers -Website, "Cryogenics for English Majors" http://www.magnet.fsu.edu/education/tutorials/magnetacademy/cryogenics/index.html
National Science Teachers Association & National Institute of Standards and Technology	<ul style="list-style-type: none"> <i>Absolute Zero</i> Webinar featuring Nobel Laureate Bill Phillips http://www.absolutezerocampaign.org/ask_experts/webinars.htm
Dr. Alina Gearba, University of Southern Mississippi	Led demonstrations to ~1,000 local high school students
Dr. David G. Haase, North Carolina State University (former director of the Science House)	<ul style="list-style-type: none"> -Answered questions sent to <i>Absolute Zero</i> website -Publicized broadcast to local teachers -Publicized broadcast & campaign on Science House website

Organization/Expert	Activity (What & Where)
Dr. Dennis Clougherty, University of VT	-Hosted demonstrations for local middle schools -Answered questions sent to <i>Absolute Zero</i> website -Publicized <i>Absolute Zero</i> via university news office, local newspaper, local public radio interview, linked to campaign on his website: http://www.uvm.edu/~dcloughe/
Dr. Greg Swift, Los Alamos National Laboratory	-Publicized broadcast via interview in local newspaper, link to campaign website -Answered questions sent to <i>Absolute Zero</i> website
Dr. John Pfötenhauer, University of Wisconsin Madison (UWM)	-Organized UWM students to run hands-on station at the UWM's 2007 Engineering Expo entitled <i>Absolute Zero</i> -Distributed outreach guides to local teachers -Publicized <i>Absolute Zero</i> to the cryogenics community
Dr. Roberto Ramos, Drexel University	-Worked with Society of Physics students to lead demonstrations at local area high schools -Hosted public lectures featuring low-temperature physics -Led demonstration activities at local summer Bible camp -Distributed outreach guides
Dr. Russell Donnelly (Principal Investigator) & National Institute of Standards and Technology	"What's Hot in Cold" symposium at American Association for the Advancement of Science meeting, included ~7 additional presenters

Data for this table were gathered from the following sources: *Absolute Zero* Campaign website, interviews with National Partners and Experts, and Campaign Update Newsletters.

APPENDIX D: EVALUATION INSTRUMENTS

Pre-Viewing Survey, Adults (Evaluation of Broadcast)

Welcome to the *Absolute Zero* pre-viewing survey!

Thank you for participating in the evaluation of the NOVA program *Absolute Zero*. The survey should take less than 10 minutes to complete. As you move through the survey, use the “back” and “next” buttons at the bottom of the screen. Do NOT use your browser's buttons as this may result in lost data.

To begin the survey, enter the ID number from your email invitation in the box below and press “next.”

1. How active are you at seeking out information on the latest advancements in science?
 - Not at all active [*If checked, skip next question. All other responses continue to next question.*]
 - Somewhat active
 - Moderately active
 - Very active
 - Extremely active

2. What one resource do you rely on the *most* to get information on the latest advancements in science?
 - National news broadcast
 - Local news broadcast
 - An online news source
 - Public radio news
 - Science documentaries, programs, and movies
 - National newspaper
 - Regional/local newspaper
 - Weekly newspaper science pieces such as The Science Times
 - Science-based Web site
 - Radio programs such as Science Friday
 - Magazines
 - Classes and/or lectures
 - Friends and/or family

3. In the past three months, how many times have you visited the NOVA Web site (<http://www.pbs.org/wgbh/nova/>)?
 - I have not visited the Web site in the past three months.
 - One time
 - Two or three times
 - Four or five times
 - More than five times

4. In the past month have you:

	Never	Once or twice	Several Times
Discussed science-related issues with friends, family, or colleagues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Noticed stories in the news about science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Read a book about a science topic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Watched a science-related television program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visited a Web site to learn about a scientific topic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Attended a science-related lecture or presentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visited a museum or science center	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Compared to most people you know:

	Much Less	Less	No More or Less	More	Much More
How interested are you in science?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How current is your knowledge of the latest developments in science?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. Have you heard of the following science topics?

- The science of cold / low temperature physics
 - Races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)
 - Competing theories, current or historic, about a scientific phenomenon (e.g., whether the Earth or sun is the center of the universe)
 - History of science (e.g., history of a specific scientific development, life history of a scientist)
- [[If any of the above are checked, proceed to next two questions]]*
- None of the above topics *[[skip next 2 questions if checked]]*

7. How did you become aware of these topics? Check all that apply.

- Through someone I know (e.g., a friend, family member)
- Through my job
- Through school
- Through media/news; please specify: _____
- Online; please specify which website/listserv: _____
- Other, please specify: _____

8. In the past month, have you heard or seen a story about any of the following topics (e.g., on the news, on TV, at a movie, in a book, at an event)? Check all that apply.

- Races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)
- Competing theories, current or historic, about a scientific phenomenon (e.g., whether

the Earth or sun is the center of the universe)

- History of science (e.g., history of a specific scientific development, life history of a scientist)
- The science of cold / low temperature physics

9. How familiar are you with the following topics?

	Not at all familiar	A little familiar	Somewhat familiar	Very familiar	Extremely familiar
General chemistry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
General physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The science of cold	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
History of science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. How interested are you in learning more about the following topics?

	I don't know; I've never heard of this topic	Not at all interested	A little interested	Somewhat interested	Very interested	Extremely interested
General chemistry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
General physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The science of cold	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
History of science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Races among scientists towards a scientific breakthrough	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Competing scientific theories	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Final Questions About You

11. How often do you watch science-related programs on TV?

- Never
- Once a year
- A few times a year
- Once a month
- A few times a month
- Once a week or more
- More than once a week

12. What is the highest level of education you have completed?

- Some high school
- High school degree
- Some college
- College degree
- Some graduate/professional school
- Graduate/professional degree
- Other: _____

13. What is your occupation? _____

14. Are you:
- Female
 - Male

15. How do you describe yourself? (*Check all that apply.*)

- Caucasian or White
- Asian or Pacific Islander
- Latino or Hispanic
- Native American
- African-American or Black
- Other (describe) _____

16. What is your age?

- 18-34 years-old
- 35-49
- 50-64
- 65 or older

17. What is your total annual household income (before taxes)?

- Less than \$20,000
- \$20,000 to \$24,999
- \$25,000 to \$34,999
- \$35,000 to \$49,999
- \$50,000 to 74,999
- \$75,000 to \$99,999
- \$100,000 or more

Thank you! This completes the pre-viewing survey. Hour one of *Absolute Zero* will air on NOVA on the evening of January 8 (check your local PBS listings for stations and exact times). You will receive the mid-point web survey on January 9.

Mid-Point Survey, Adults (Evaluation of Broadcast)

Welcome to the *Absolute Zero* mid-point viewing survey!

Thank you for continuing to participate in the evaluation of NOVA's *Absolute Zero* series. The survey should take less than 10 minutes to complete. As you move through the survey, use the "back" and "next" buttons at the bottom of the screen. Do NOT use your browser's buttons as this may result in lost data.

To begin the survey, enter the ID number from your email invitation in the box below and press "next."

Did you watch the entire hour of the *Absolute Zero* program?

- Yes, I watched the entire hour.
- No, I only watched some portions.

With whom did you watch *Absolute Zero*? (Check all that apply)

- Alone
- With family
- With friends
- With colleagues
- Other; please describe: _____

In one or two sentences, please describe your overall impressions of part one *Absolute Zero*: [text box]

How would you describe the content presented in part one of *Absolute Zero*?

- It was very easy to understand.
- It was fairly easy to understand.
- It was neither easy nor difficult to understand.
- It was fairly difficult to understand.
- It was very difficult to understand.

Overall, how would you rate the program?

- Poor
- Fair
- Good
- Very good
- Excellent

Please rate the following for part one of *Absolute Zero*. If there is a question you can't answer, select "I don't know," but please try to answer every question as best you can.

	Not at All	A Little	Generally	Very	Extremely	I don't know
How interesting was it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How informative was it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How engaging was it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How clear was the information presented in it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How visually appealing was it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How much of the information presented in part one of *Absolute Zero* was new to you?

- Almost none of the information presented was new to me. *[[If checked, skip next question. All other responses proceed to next question.]]*
- Some of the information presented was new to me.
- Most of the information presented was new to me.
- Almost all of the information presented was new to me.

Please write one or two sentences to describe one new thing you learned from watching part one of *Absolute Zero*. [text box]

Which story from this program was your favorite?

- Drebbel and the air conditioning of Westminster
- The development of different types of thermometers and temperature scales (Fahrenheit, Celsius, Kelvin)
- Debates about heat as a substance (*Lavoisier's* caloric theory) versus heat as a form of motion (Count Rumford's theory)
- Frederic Tudor, "The Ice King," and ice harvesting
- James Joule's experiments converting mechanical movement to work, generating heat
- The development of ice-making machines, refrigerators, and the refrigeration cycle
- Clarence Birdseye's discovery of flash freezing food products
- Willis Carrier and the development of commercial and residential air conditioners
- Other, please specify: _____

Why was this story your favorite? [text box]

Which story from this program was your LEAST favorite?

- Drebbel and the air conditioning of Westminster
- The development of different types of thermometers and temperature scales (Fahrenheit, Celsius, Kelvin)
- Debates about heat as a substance (*Lavoisier's* caloric theory) versus heat as a form of motion (Count Rumford's theory)
- Frederic Tudor, "The Ice King," and ice harvesting
- James Joule's experiments converting mechanical movement to work, generating heat
- The development of ice-making machines, refrigerators, and the refrigeration cycle
- Clarence Birdseye's discovery of flash freezing food products
- Willis Carrier and the development of commercial and residential air conditioners
- Other, please specify: _____

Why was this story your least favorite? [text box]

If you were not participating in a viewer study, how likely would you be to watch part two of *Absolute Zero*?

- Not at all likely to watch part two
- Somewhat likely
- Moderately likely
- Very likely
- Extremely likely to watch part two

Please write any additional comments about part one of *Absolute Zero*. [text box]

Thank you! This completes the mid-point viewing survey. Part two of *Absolute Zero* will air on NOVA on Tuesday, January 15. You will receive an email invitation for the final post-viewing survey one to two weeks after part two airs.

Post-Viewing Survey, Adults (Evaluation of Broadcast)

Welcome to the *Absolute Zero* post-viewing survey!

Thank you for participating in the evaluation of NOVA's *Absolute Zero* program. The survey should take less than 10 minutes to complete and is the final step in your participation in the viewer study.

To begin the survey, please enter your ID number, found in your email invitation then click on the "Begin Survey" button. As you move from page to page in the form, use the Back and Continue buttons at the bottom of the page to navigate. Please, do NOT use your browser's buttons - if you do, your information will be lost.

The first set of questions pertains only to PART TWO of *Absolute Zero (The Race to Absolute Zero)*.

1. Did you watch the entire hour of the *Absolute Zero* program?
 - Yes, I watched the entire program.
 - No, I only watched some portions.

2. In one or two sentences, please describe your overall impressions of part two of *Absolute Zero*: [text box]

3. How would you describe the content presented in part two of *Absolute Zero*?
 - It was very easy to understand.
 - It was fairly easy to understand.
 - It was neither easy nor difficult to understand.
 - It was fairly difficult to understand.
 - It was very difficult to understand.

4. Overall, how would you rate part two of *Absolute Zero*?
 - Poor
 - Fair
 - Good
 - Very good
 - Excellent

5. Please rate the following for part two of *Absolute Zero*. If there is a question you can't answer, select "I don't know," but please try to answer every question as best you can.

	Not at All	A Little	Generally	Very	Extremely	I don't know
How interesting was it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How informative was it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How engaging was it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How clear was the information presented in it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How visually appealing was it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. How much of the information presented in part two of *Absolute Zero* was new to you?
 Almost none of the information presented was new to me. *[[If checked, skip next question. All other responses proceed to next question.]]*
 Some of the information presented was new to me.
 Most of the information presented was new to me.
 Almost all of the information presented was new to me.
7. Please write one or two sentences to describe one new thing you learned from watching part two of *Absolute Zero*. [text box]
8. Which story from this program was your favorite?
 The race between James Dewar and Kamerlingh Onnes to liquefy hydrogen in the late 1800s
 The race between the Boulder lab (Eric Cornell & Carl Wieman) and the MIT lab (Wolfgang Ketterle) to create a Bose-Einstein condensate in the 1990s
 Theories about practical applications of and uses for Bose-Einstein condensates (e.g., quantum computers)
 Other, please specify: _____
9. Why was this story your favorite? [text box]
10. Which story from this program was your LEAST favorite?
 The race between James Dewar and Kamerlingh Onnes to liquefy hydrogen in the late 1800s
 The race between the Boulder lab (Eric Cornell & Carl Wieman) and the MIT lab (Wolfgang Ketterle) to create a Bose-Einstein condensate in the 1990s
 Theories about practical applications of and uses for Bose-Einstein condensates (e.g., quantum computers)
 Other, please specify: _____
11. Why was this story your least favorite? [text box]

The remaining questions pertain to the entire *Absolute Zero* program, parts one and two.

12. How much has your interest in each of the following topics changed since you watched the *Absolute Zero* program?

	I'm less interested now.	My interest is the same.	I'm slightly more interested now.	I'm somewhat more interested now.	I'm a lot more interested now.
General chemistry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
General physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The science of cold	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
History of science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Races among scientists towards scientific breakthrough	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Competing scientific theories	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

13. How much has your awareness of each of the following topics changed since you watched the *Absolute Zero* program?

	My awareness is the same.	I'm slightly more aware now.	I'm somewhat more aware now.	I'm a lot more aware now.
General chemistry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
General physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The science of cold	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
History of science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Races among scientists towards a scientific breakthrough	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Competing scientific theories	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

14. How much has your motivation to learn more about each of the following topics changed since you watched the *Absolute Zero* program?

	I'm less motivated now.	My motivation is the same.	I'm slightly more motivated now.	I'm somewhat more motivated now.	I'm a lot more motivated now.
General chemistry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
General physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The science of cold	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
History of science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Races among scientists toward scientific breakthrough	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Competing scientific theories	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

15. How likely are to you pay attention to a story or news piece about the following?

	Not at all likely	Somewhat likely	Moderately likely	Very likely	Extremely likely
General chemistry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
General physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The science of cold	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
History of science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Races between scientists to achieve breakthroughs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Competing scientific theories	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

16. In the time since you completed the pre-viewing survey, how many times have you visited the NOVA Web site (www.pbs.org/wgbh/nova/)?

- I have visited the Web site many times (More than 5 times)
- I have visited the Web site several times (4-5 times)
- I have visited the Web site a few times (2-3 times)
- I have visited the Web site one time
- I have not visited the Web site, but I plan to.
- I have not visited the Web site, and I do NOT plan to.

17. In the time since you completed the pre-viewing survey, how many times have you visited the *Absolute Zero* Web site (<http://www.pbs.org/wgbh/nova/zero/>)?

- I have visited the Web site many times (More than 5 times)
- I have visited the Web site several times (4-5 times)
- I have visited the Web site a few times (2-3 times)
- I have visited the Web site one time
- I have not visited the Web site, but I plan to.
- I have not visited the Web site, and I do NOT plan to.

18. As a result of watching *Absolute Zero*, have you:

	Yes	No	Not yet, but I plan to
Discussed science-related issues with friends, family, or colleagues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Read a book about a science topic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Watched another science-related television program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visited a Web site other than the <i>Absolute Zero</i> site to learn about issues similar to those presented in <i>Absolute Zero</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Attended a science-related lecture or presentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visited a museum or science center	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tried to stay more up-to-date on science issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

19. Please enter the email address where you wish to receive the Amazon.com gift certificate.

Your email address will be used only for purposes of sending your gift certificate, and it will not be entered or stored with your responses to the survey questions.

Email address: _____ [text box]

Your responses have been submitted.

This completes the follow-up survey. Thank you for your participation in the viewer study!
Please allow 4-6 weeks for processing and receipt of your gift certificate.

Pre-Viewing Survey, Middle School Students (Evaluation of Broadcast)

1. How often do you watch science-related programs on TV?
 - Never
 - Once a year
 - A few times a year
 - Once a month
 - A few times a month
 - Once a week or more
 - More than once a week

2. Which science-related programs do you watch? _____

3. How often do you watch the science program, NOVA?
 - Never
 - Once a year
 - A few times a year
 - Once a month
 - A few times a month
 - Once a week or more
 - More than once a week

4. Have you ever visited the NOVA Web site (<http://www.pbs.org/wgbh/nova/>)?
 - No
 - Yes

5. In the past month have you:

	Never	Once or twice	Several Times
Discussed science-related issues with friends or family outside of school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Noticed stories in the news about science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Read a book about a science topic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Watched a science-related television program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visited a Web site to learn about a scientific topic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visited a museum or science center	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participated in a science club or group	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Done science experiments at home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participated in another science-related activity: If yes, what activity? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. Compared to your classmates, how interested are you in science?
 Much less Less No more or less More Much more
7. How familiar are you with science in general?
 Not at all A little Somewhat Very Extremely
8. How familiar are you with chemistry?
 Not at all A little Somewhat Very Extremely
9. How familiar are you with physics?
 Not at all A little Somewhat Very Extremely
10. How familiar are you with races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)?
 Not at all A little Somewhat Very Extremely
11. How familiar are you with competing scientific theories (e.g., whether the Earth or sun is the center of the universe)?
 Not at all A little Somewhat Very Extremely
12. How familiar are you with the history of science (e.g., the development of a scientific event or life story of a scientist)?
 Not at all A little Somewhat Very Extremely
13. How familiar are you with the science of cold, also called low-temperature physics?
 Not at all A little Somewhat Very Extremely
14. Have you ever studied any of these topics in school? *Please check all that apply.*
- Chemistry
 - Physics
 - Races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)
 - Competing scientific theories (e.g., whether the Earth or sun is the center of the universe)
 - History of science (e.g., the development of a scientific event or life story of a scientist)
 - The science of cold, also called low-temperature physics
 - None of the above topics
15. In the past month, have you heard or seen a story about any of the following topics (e.g., on the news, on TV, at a movie, in a book, on the Internet, at an event)? *Check all that apply.*
- Science in general
 - Chemistry
 - Physics
 - Races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)
 - Competing scientific theories (e.g., whether the Earth or sun is the center of the universe)
 - History of science (e.g., the development of a scientific event or life story of a

scientist)

The science of cold, also called low-temperature physics

None of the above topics

16. How interested are you in learning more about science in general?

Not at all A little Somewhat Very Extremely

17. How interested are you in learning more about chemistry?

Not at all A little Somewhat Very Extremely

18. How interested are you in learning more about physics?

Not at all A little Somewhat Very Extremely

19. How interested are you in learning more about races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)?

Not at all A little Somewhat Very Extremely

20. How interested are you in learning more about competing scientific theories (e.g., whether the Earth or sun is the center of the universe)?

Not at all A little Somewhat Very Extremely

21. How interested are you in learning more about the history of science, (e.g., the development of a scientific event or life story of a scientist)?

Not at all A little Somewhat Very Extremely

22. How interested are you in learning more about the science of cold, called low-temperature physics?

Not at all A little Somewhat Very Extremely

Final Questions About You

23. What grade are you in?

5th 6th 7th 8th

24. How old are you? _____

25. What is your mother's occupation? _____

26. What is your father's occupation? _____

27. Are you:

Female Male

28. How do you describe yourself? *Check all that apply.*

Caucasian or White

Asian or Pacific Islander

Latino or Hispanic

Native American

African-American or Black

Other (describe) _____

Pre-Viewing Survey, High School Students (Evaluation of Broadcast)

1. How often do you watch science-related programs on TV?
 - Never
 - Once a year
 - A few times a year
 - Once a month
 - A few times a month
 - Once a week or more
 - More than once a week

2. Which science-related programs do you watch? _____

3. How often do you watch the science program, NOVA?
 - Never
 - Once a year
 - A few times a year
 - Once a month
 - A few times a month
 - Once a week or more
 - More than once a week

4. Have you ever visited the NOVA Web site (<http://www.pbs.org/wgbh/nova/>)?
 - No
 - Yes

5. In the past month have you:

	Never	Once or twice	Several Times
Discussed science-related issues with friends or family outside of school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Noticed stories in the news about science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Read a book about a science topic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Watched a science-related television program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visited a Web site to learn about a scientific topic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visited a museum or science center	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participated in a science club or group	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Done science experiments at home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participated in another science-related activity: If yes, what activity? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. Compared to your classmates, how interested are you in science?

- Much less Less No more or less More Much more

7. How familiar are you with the following topics?

	Not at all familiar	A little familiar	Somewhat familiar	Very familiar	Extremely familiar
Science in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chemistry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Competing scientific theories (e.g., whether the Earth or sun is the center of the universe)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
History of science (e.g., the development of a scientific event or life story of a scientist)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The science of cold, also called low-temperature physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. Have you ever studied any of these topics in school? *Check all that apply.*

- Chemistry
- Physics
- Races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)
- Competing scientific theories (e.g., whether the Earth or sun is the center of the universe)
- History of science (e.g., the development of a scientific event or life story of a scientist)
- The science of cold
- None of the above topics

9. In the past month, have you heard or seen a story about any of the following topics (for example, on the news, on TV, at a movie, in a book, on the Internet, at an event)? *Check all that apply.*

- Chemistry
- Physics
- Races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)
- Competing scientific theories (e.g., whether the Earth or sun is the center of the universe)
- History of science (e.g., development of a scientific event or life story of a scientist)
- The science of cold
- None of the above topics

10. How interested are you in learning more about the following topics?

	Not at all interested	A little interested	Somewhat interested	Very interested	Extremely interested
Science in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chemistry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Races among scientists towards a scientific breakthrough (e.g., competition to be the first to find cure for a disease)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Competing scientific theories (e.g. whether the Earth or sun is the center of the universe)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
History of science (e.g., the development of a scientific event life story of a scientist)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The science of cold, also called low-temperature physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Final Questions About You

11. What grade are you in?

- 9th 10th 11th 12th

12. How old are you? _____

13. What is your mother's occupation? _____

14. What is your father's occupation? _____

15. Are you:

- Female Male

16. How do you describe yourself? *Check all that apply.*

- Caucasian or White Asian or Pacific Islander
 Latino or Hispanic Native American
 African-American or Black Other (describe) _____

Post-Viewing Survey, Middle School Students (Evaluation of Broadcast)

1. In one or two sentences, please describe your overall impressions of *Absolute Zero*:

2. How would you describe the content presented in *Absolute Zero*?

- It was very easy to understand.
 It was fairly easy to understand.
 It was fairly difficult to understand.
 It was very difficult to understand.

3. Overall, how would you rate *Absolute Zero*?

- Poor Fair Good Very good Excellent

4. How interesting was *Absolute Zero*?

- Not at all A little Somewhat Very Extremely

5. How clear was the information presented in *Absolute Zero*?

- Not at all A little Somewhat Very Extremely

6. How visually appealing was *Absolute Zero* (e.g., the images on screen, the “look” of the show)?

- Not at all A little Somewhat Very Extremely

7. How much of the information presented in *Absolute Zero* was new to you?

- Almost none of the information presented was new to me.
 Some of the information presented was new to me.
 Most of the information presented was new to me.
 Almost all of the information presented was new to me.

8. Please write 1 – 2 sentences to describe one new thing you learned from watching *Absolute Zero*.

9. How has your awareness of science in general changed since watching *Absolute Zero*?

- Less aware now
 No change
 Slightly more aware now
 Somewhat more aware now
 A lot more aware now

10. How has your awareness of chemistry changed since watching *Absolute Zero*?
- Less aware now
 - No change
 - Slightly more aware now
 - Somewhat more aware now
 - A lot more aware now
11. How has your awareness of physics changed since watching *Absolute Zero*?
- Less aware now
 - No change
 - Slightly more aware now
 - Somewhat more aware now
 - A lot more aware now
12. How has your awareness of races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease) changed since watching *Absolute Zero*?
- Less aware now
 - No change
 - Slightly more aware now
 - Somewhat more aware now
 - A lot more aware now
13. How has your awareness of competing scientific theories (e.g., whether the Earth or sun is the center of the universe) changed since watching *Absolute Zero*?
- Less aware now
 - No change
 - Slightly more aware now
 - Somewhat more aware now
 - A lot more aware now
14. How has your awareness of history of science (e.g., the development of a scientific event or life story of a scientist) changed since watching *Absolute Zero*?
- Less aware now
 - No change
 - Slightly more aware now
 - Somewhat more aware now
 - A lot more aware now
15. How has your awareness of the science of cold (also called low-temperature physics) changed since watching *Absolute Zero*?
- Less aware now
 - No change
 - Slightly more aware now
 - Somewhat more aware now
 - A lot more aware now
16. How interested are you in learning more about science in general?
- Not at all
 - A little
 - Somewhat
 - Very
 - Extremely
17. How interested are you in learning more about chemistry?
- Not at all
 - A little
 - Somewhat
 - Very
 - Extremely

18. How interested are you in learning more about physics?
 Not at all A little Somewhat Very Extremely
19. How interested are you in learning more about races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)?
 Not at all A little Somewhat Very Extremely
20. How interested are you in learning more about competing scientific theories (e.g., whether the Earth or sun is the center of the universe)?
 Not at all A little Somewhat Very Extremely
21. How interested are you in learning more about history of science (e.g., the development of a scientific event or life story of a scientist)?
 Not at all A little Somewhat Very Extremely
22. How interested are you in learning more about the science of cold (also called low-temperature physics)?
 Not at all A little Somewhat Very Extremely
23. Since watching *Absolute Zero*, how likely are to you pay attention to a story or news piece about science in general (for example, on the news, on TV, at a movie, in a book, on the Internet, at an event)?
 Not at all A little Somewhat Very Extremely
24. Since watching *Absolute Zero*, how likely are to you pay attention to a story or news piece about chemistry?
 Not at all A little Somewhat Very Extremely
25. Since watching *Absolute Zero*, how likely are to you pay attention to a story news piece about physics?
 Not at all A little Somewhat Very Extremely
26. Since watching *Absolute Zero*, how likely are to you pay attention to a story or news piece about races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)?
 Not at all A little Somewhat Very Extremely
27. Since watching *Absolute Zero*, how likely are to you pay attention to a story or news piece about competing scientific theories (e.g., whether the Earth or sun is the center of the universe)?
 Not at all A little Somewhat Very Extremely
28. Since watching *Absolute Zero*, how likely are to you pay attention to a story or news piece about history of science (e.g., the development of a scientific event or life story of a scientist)?
 Not at all A little Somewhat Very Extremely
29. Since watching *Absolute Zero*, how likely are to you pay attention to a story or news piece about the science of cold, also called low-temperature physics?
 Not at all A little Somewhat Very Extremely

30. Since watching *Absolute Zero*, have you discussed science-related issues with friends or family outside of school?
 Yes No Not yet, but I plan to
31. Since watching *Absolute Zero*, have you noticed stories in the news about science?
 Yes No Not yet, but I plan to
32. Since watching *Absolute Zero*, have you read a book about a science topic?
 Yes No Not yet, but I plan to
33. Since watching *Absolute Zero*, have you watched a science-related television program?
 Yes No Not yet, but I plan to
34. Since watching *Absolute Zero*, have you visited a Web site to learn about a scientific topic?
 Yes No Not yet, but I plan to
35. Since watching *Absolute Zero*, have you visited a museum or science center?
 Yes No Not yet, but I plan to
36. Since watching *Absolute Zero*, have you participated in a science club or group?
 Yes No Not yet, but I plan to
37. Since watching *Absolute Zero*, have you done science experiments at home?
 Yes No Not yet, but I plan to
38. Since watching *Absolute Zero*, have you participated in another science-related activity?
 Yes No Not yet, but I plan to
If yes, what activity? _____

Post-Viewing Survey, High School Students (Evaluation of Broadcast)

1. In one or two sentences, please describe your overall impressions of *Absolute Zero*:

2. How would you describe the content presented in *Absolute Zero*?

- It was very easy to understand.
- It was fairly easy to understand.
- It was fairly difficult to understand.
- It was very difficult to understand.

3. Overall, how would you rate *Absolute Zero*?

- Poor
- Fair
- Good
- Very good
- Excellent

4. How interesting was *Absolute Zero*?

- Not at all
- A little
- Somewhat
- Very
- Extremely

5. How clear was the information presented in *Absolute Zero*?

- Not at all
- A little
- Somewhat
- Very
- Extremely

6. How visually appealing was *Absolute Zero* (e.g., the images on screen, the “look” of the show)?

- Not at all
- A little
- Somewhat
- Very
- Extremely

7. How much of the information presented in *Absolute Zero* was new to you?

- Almost none of the information presented was new to me.
- Some of the information presented was new to me.
- Most of the information presented was new to me.
- Almost all of the information presented was new to me.

8. Please write 1 – 2 sentences to describe one new thing you learned from watching *Absolute Zero*.

9. How much has your awareness of each of the following topics changed since you watched the *Absolute Zero* program?

	I'm less aware now.	My awareness is the same.	I'm slightly more aware now.	I'm somewhat more aware now.	I'm a lot more aware now.
Science in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chemistry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Races among scientists towards a scientific breakthrough (e.g., competition to be the first to find cure for a disease)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Competing scientific theories (e.g. whether the Earth or sun is the center of the universe)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
History of science (e.g., the development of a scientific event life story of a scientist)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The science of cold, also called low-temperature physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. How interested are you in learning more about the following topics?

	Not at all interested	A little interested	Somewhat interested	Very interested	Extremely interested
Science in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chemistry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Competing scientific theories (e.g., whether the Earth or sun is the center of the universe)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
History of science (e.g., the development of a scientific event or life story of a scientist)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The science of cold, also called low-temperature physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. Since watching *Absolute Zero*, how likely are you to pay attention to a story or news piece about the following topics (for example, on the news, on TV, at a movie, in a book, on the Internet, at an event)?

	Not at all likely	A little likely	Somewhat likely	Very likely	Extremely likely
Science in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chemistry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Races among scientists towards a scientific breakthrough (e.g., competition to be the first to find a cure for a disease)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Competing scientific theories (e.g., whether the Earth or sun is the center of the universe)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
History of science (e.g., the development of a scientific event or life story of a scientist)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The science of cold, also called low-temperature physics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. Since watching *Absolute Zero*, have you:

	Yes	No	Not yet, but I plan to
Discussed science-related issues with friends or family outside of school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Noticed stories in the news about science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Read a book about a science topic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Watched a science-related television program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visited a Web site to learn about a scientific topic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visited a museum or science center	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participated in a science club or group	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Done science experiments at home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participated in another science-related activity: If yes, what activity? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Teacher Survey (Evaluation of Outreach Materials)

Welcome to the *Absolute Zero* teacher survey!

Thank you for participating in the evaluation of the NOVA program *Absolute Zero* and its associated resources and outreach activities. The survey should take less than 25 minutes to complete. As you move through the survey, use the “back” and “next” buttons at the bottom of the screen. Do NOT use your browser’s buttons as this may result in lost data.

You may find it useful to have a copy of the *Absolute Zero Community Education Outreach Guide* and *The Absolute Zero Science Educator’s Guide* nearby as you complete the survey. Also, please have available the checklists you completed during the student Web site activity session.

To begin the survey, enter the ID number from your email invitation in the box below and press “next.”

Community Education Outreach Guide Activity 1: Making Things Cold (p. 10)

The beginning of the survey asks about each demonstration activity you conducted from the *Absolute Zero Community Education Outreach Guide*. You may find it useful to have the guide and any notes you took when conducting the activities available in front of you.

The first set of questions focuses on the demonstration activity, “**Making Things Cold,**” (page 10 in the *Absolute Zero Community Education Outreach Guide*). [Repeat questions 1 – 17 for activity 2 and optional activity 3]

Please rate the following for the demonstration activity, Making Things Cold.

1. In your opinion, how effective is this activity at supplementing the content featured in the *Absolute Zero* program?
 - Not at all effective
 - A little
 - Generally
 - Very
 - Extremely effective
2. In your opinion, how useful is it to show the *Absolute Zero* program to students with whom you conduct this activity?
 - Not at all useful
 - A little
 - Generally
 - Very
 - Extremely useful
3. Compared to the materials necessary for the activities you typically conduct in science class, do the materials necessary to complete THIS activity require:
 - More effort to obtain
 - Less effort to obtain
 - About the same amount of effort to obtain

4. In preparing to lead the activity, did you:
- Read only the demonstration instructions in the box.
 - Read the neighboring content in that section of the guide.

5. How easy was it to conduct the activity?
- Not at all easy
 - A little
 - Generally
 - Very
 - Extremely easy

6. Did you modify the activity from how it was presented in the guide?
- Yes
 - No

If yes, please explain how you modified the activity: _____

7. Did you incorporate any of the “Additional Ideas” on page 10 as a part of the activity? [this question and the next one will not be repeated in activities 2 and 3; modified questions instead]
- Yes
 - No

8. [If yes] Which “Additional Ideas” did you incorporate? *Check all that apply.*
- Asked students to bring an ice cube to class
 - Challenged students to identify ways heat turns into mechanical energy and vice versa
 - Asked students to research historical scientists who helped devise the theories of caloric and thermodynamics.

9. How easy to follow were the activity directions contained in the outreach guide?
- Not at all easy
 - A little
 - Generally
 - Very
 - Extremely easy

10. In your opinion, for which grade level(s) is this activity appropriate? *Check all that apply.*
- | | |
|--|---|
| <input type="checkbox"/> 5 th | <input type="checkbox"/> 9 th |
| <input type="checkbox"/> 6 th | <input type="checkbox"/> 10 th |
| <input type="checkbox"/> 7 th | <input type="checkbox"/> 11 th |
| <input type="checkbox"/> 8 th | <input type="checkbox"/> 12 th |

11. For which of the following types of classes do you think this activity is appropriate? *Check all that apply.*
- Chemistry
 - Physics
 - General Science
 - Other; _____

12. Did this activity:
- Enhance your science curriculum, by building off of material already included in the curriculum.
 - Enrich your science curriculum, by focusing on topics outside of your regular curricular content.
 - Neither

13. In your opinion, how engaging was this activity for your students?
- Not at all engaging
 - A little
 - Somewhat
 - Very
 - Extremely engaging

14. What do you think your students liked most about this activity?

15. What do you think your students liked least about this activity?

16. In your opinion, how effective was the activity at:

	1: Not at all effective	2	3	4	5: Extremely effective
Helping students learn science content	○	○	○	○	○
Helping students learn science process skills	○	○	○	○	○

17. How likely would you be to use this activity again in your classroom (either this year or in future years)?
- Not at all likely
 - A little
 - Somewhat
 - Very
 - Extremely likely

Community Education Outreach Guide Activity 2 (repeat Activity 1 questions, #1-17)

The following questions focus on the second demonstration activity you conducted from the *Absolute Zero Community Education Outreach Guide*.

18. Which was the second demonstration activity you conducted with your students? [drop-down menu]
- Build a bulb thermometer (p. 3)
 - Thermometer scales (p. 4)
 - Properties of matter (p. 5)
 - Light and dense water (p. 6)
 - Steamin' popcorn (p. 7)
 - Heat flow (p. 8)
 - Mechanical equivalent of heat (p. 9)
 - Heat flow (p. 11)
 - Evaporation (p. 12)
 - Freezing fun (p. 14)
 - Making popsicles (p. 15)
 - Brittle flowers (p. 17)
 - Liquid air (p. 17)
 - Rockets (p. 18)
 - Ice cream (p. 18)
 - Ring flinger (p. 20)

- Cold ring flinger (p. 20)
- Meissner effect (p. 21)
- Absolute dark (p. 22)
- Absolute zero (p. 23)

Please rate the following for the second demonstration activity. [Repeat Activity 1 questions, #1-17 here, omit #7 and 8]

19. Why did you choose to conduct this activity? *Check all that apply.*

- I had access to the required materials
- I thought my students would find it interesting
- It seemed most similar to the content featured in the *Absolute Zero* program
- It focused on content I was familiar with teaching
- It focused on content that was new to my teaching repertoire
- It fit into the class time I had available
- Other; _____

20. Of the reasons why you chose to conduct this activity, which one was the MOST important in your decision?

- I had access to the required materials
- I thought my students would find it interesting
- It seemed most similar to the content featured in the *Absolute Zero* program
- It focused on content I was familiar with teaching
- It focused on content that was new to my teaching repertoire
- It fit into the class time I had available
- Other; _____

21. Some activities include a separate text box with “Additional Ideas.” Did you incorporate any of these ideas when conducting your activity?

- No, this activity did not have “Additional Ideas” listed.
- No, I did not incorporate any of the suggested “Additional Ideas.”
- Yes, I incorporated one or more of the suggested “Additional Ideas.”

Community Education Outreach Guide Optional Activity 3

If you conducted an optional third demonstration activity from the *Absolute Zero Community Education Outreach Guide*, you will have the opportunity to provide feedback about that activity in the next set of questions.

22. Did you conduct a third (optional) demonstration activity with your students?

- Yes
- No

23. [If yes] Which was the third demonstration activity you conducted in your classroom? [drop-down menu, repeat list in #18]

Please rate the following for the third demonstration activity you conducted. [Repeat Activity 1 and 2 questions here]

Community Education Outreach Guide, Overall Questions

The next set of questions asks for your feedback on your overall experience with and opinions about the *Absolute Zero Community Education Outreach Guide*.

24. In your opinion, how useful is the Community Education Outreach Guide overall?
- Not at all useful
 - A little
 - Somewhat
 - Very
 - Extremely useful
25. In your opinion, how effective is the Community Education Outreach Guide at supplementing the content featured in the *Absolute Zero* program?
- Not at all effective
 - A little
 - Generally
 - Very
 - Extremely effective
26. Did you:
- Primarily skim the guide
 - Read only certain sections of the guide
 - Read the entire guide

27. Please rate the following features of the Community Education Outreach Guide.

	1: Poor	2	3	4	5: Excellent
Format	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Readability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Illustrations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Content	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

28. How relevant was the guide to your teaching?
- Not at all relevant
 - A little
 - Generally
 - Very
 - Extremely relevant
29. How well did the guide fit with your curriculum?
- Not at all well
 - A little
 - Generally
 - Very
 - Extremely well
30. What sections of the guide did you find most useful? *Check all that apply.*
- Thermometers (starting on p. 3)
 - States of Matter (starting on p. 5)
 - Understanding Heat and Energy (starting on p. 8)

- Refrigeration (starting on p. 11)
- Cold Animals (starting on p. 13)
- Cryogenics and technology (starting on p. 16)
- Superconductivity (starting on p. 19)
- The Quest for Absolute Zero (starting on p. 22)

31. Which features of the guide did you find most useful? *Check all that apply.*

- Sections called “Get Students Involved”
- Sections called “The Main Show”
- Demonstration text boxes
- Materials lists
- Additional ideas text boxes

32. How familiar were you with the guide’s content?

- Not at all familiar: Most of the content was new to me
- A little
- Somewhat
- Very
- Extremely familiar: I already knew most of the content

33. How likely would you be to use the *Absolute Zero Community Education Outreach Guide* again in your classroom (either this year or in future years)?

- Not at all likely
- A little
- Somewhat
- Very
- Extremely likely

Absolute Zero Science Educator’s Guide

The next section of the survey focuses on the *Absolute Zero Science Educator’s Guide*. Please have that guide available as you complete the following questions.

34. In your opinion, how useful is the *Absolute Zero Science Educator’s Guide*?

- Not at all useful
- A little
- Somewhat
- Very
- Extremely useful

[If answered *not at all useful*, skip the next question.]

35. In your opinion, how effective is the *Absolute Zero Science Educator’s Guide* at complementing the material featured in the *Absolute Zero Community Education Outreach Guide*?

- Not at all effective
- A little
- Generally
- Very
- Extremely effective

36. Which of the following statements best describes your reaction to the content of the *Absolute Zero Science Educator's Guide*?

- The content was mostly new to me
- The content was familiar to me, but it was a good refresher
- The content was quite familiar to me; I did not learn anything new

37. Did you:

- Primarily skim the guide
- Read only certain sections of the guide
- Read the entire guide

38. Did you use the *Absolute Zero Science Educator's Guide* to help you prepare for the demonstration activities you conducted?

- Yes
- No

[If yes] Please describe how you used the guide: _____

[If no] Please describe why you did not use the guide: _____

[If no, skip the next 2 questions]

39. Which sections of the guide did you find most useful? *Check all that apply.*

- Introduction
- Science Inquiry: Teaching More Than Facts
- Talking the Talk
- Safety
- Especially for New Educators: Advance Work
- Especially for New Educators: Seeking Speaking Opportunities

40. How likely would you be to consult the *Absolute Zero Science Educator's Guide* again?

- Not at all
- A little
- Somewhat
- Very
- Extremely

Absolute Zero Campaign Web site

The following questions pertain to the *Absolute Zero Campaign Web site*

(<http://www.absolutezerocampaign.org/>).

41. Did you consult the *Absolute Zero Campaign website* in conjunction with using the guides (e.g., to help you prepare for the demonstration activities you conducted)?

<http://www.absolutezerocampaign.org/>

- No [If no, skip to "Web site Activities" section]
- Yes

42. In your opinion, how useful is the campaign Web site?

- Not at all useful
- A little
- Somewhat
- Very
- Extremely useful

43. Which areas of the site did you visit? *Check all that apply.*
- | | |
|--|--|
| <input type="checkbox"/> About Absolute Zero | <input type="checkbox"/> Ask the Experts |
| <input type="checkbox"/> Get Involved | <input type="checkbox"/> Press Room |
| <input type="checkbox"/> National Partners | <input type="checkbox"/> Discussion Boards |
44. Which sections of the “Get Involved” area of the site did you visit? *Check all that apply.*
- Low-Temp Basics
 - Resources, Activities and Experiments
 - Historical Timeline
 - Pictures and Biographies
 - Absolutely Real
 - Nobel Laureates
 - Absolute* Fun and Games: Trivia Quiz
 - Absolute* Fun and Games: Sudoku Puzzles
 - Absolute* Fun and Games: Crossword Puzzles
 - Absolute* Fun and Games: More Cool Links
 - I did not visit this area of the site [If checked, skip next ___ questions]
45. Which sections of the “Get Involved” area of the site did you find most useful? *Check all that apply.*
- Low-Temp Basics
 - Resources, Activities and Experiments
 - Historical Timeline
 - Pictures and Biographies
 - Absolutely Real
 - Nobel Laureates
 - Absolute* Fun and Games: Trivia Quiz
 - Absolute* Fun and Games: Sudoku Puzzles
 - Absolute* Fun and Games: Crossword Puzzles
 - Absolute* Fun and Games: More Cool Links
46. How likely would you be to encourage your students to visit the *Absolute Zero* Campaign Web site?
- Not at all likely
 - A little
 - Somewhat
 - Very
 - Extremely likely
47. How likely would you be to visit the *Absolute Zero* Campaign Web site again?
- Not at all likely
 - A little
 - Somewhat
 - Very
 - Extremely likely

PBS/NOVA Web site Activities

The following questions pertain to the activities your students conducted on the PBS/NOVA *Absolute Zero* Web site (<http://www.pbs.org/wgbh/nova/zero/>). Please consult your class checklists as you answer the following questions.

48. How many classes visited the Web site? _____

[Survey will branch to an appropriate number of classes for next 4 questions]

Class 1

49. What is the grade level of the students in this class?

- | | |
|--|---|
| <input type="checkbox"/> 5 th | <input type="checkbox"/> 9 th |
| <input type="checkbox"/> 6 th | <input type="checkbox"/> 10 th |
| <input type="checkbox"/> 7 th | <input type="checkbox"/> 11 th |
| <input type="checkbox"/> 8 th | <input type="checkbox"/> 12 th |

50. How many students participated in exploring the Web site? _____

51. Which areas of the *Absolute Zero* Web site did your students in class 1 visit? *Check all that apply.*

- | | |
|--|--|
| <input type="checkbox"/> Absolute Hot | <input type="checkbox"/> How Low Can You Go? |
| <input type="checkbox"/> A Sense of Scale | <input type="checkbox"/> States of Matter |
| <input type="checkbox"/> Milestones in Cold Research | <input type="checkbox"/> A Matter of Degrees |
| <input type="checkbox"/> The Conquest of Cold | <input type="checkbox"/> Anatomy of a Refrigerator |
| <input type="checkbox"/> Ultracold Atoms | <input type="checkbox"/> The Ice Trade |

52. Which areas of the *Absolute Zero* Web site did your students in class 1 enjoy the most? *Check all that apply.*

- Absolute Hot
- A Sense of Scale
- Milestones in Cold Research
- The Conquest of Cold
- Ultracold Atoms
- How Low Can You Go?
- States of Matter
- A Matter of Degrees
- Anatomy of a Refrigerator
- The Ice Trade

Please explain your answer, based on your students' comments:

53. Which areas of the *Absolute Zero* Web site did your students in class 1 enjoy the least? *Check all that apply.*

- Absolute Hot
- A Sense of Scale
- Milestones in Cold Research
- The Conquest of Cold
- Ultracold Atoms
- How Low Can You Go?
- States of Matter
- A Matter of Degrees
- Anatomy of a Refrigerator
- The Ice Trade

Please explain your answer, based on your students' comments:

54. If you have any additional notes from the checklist for this class, please type them here.

Class 2

[Repeat questions from class 1 for all remaining classes]

PBS/NOVA Web site Overall

Please answer the following questions considering students across all classes with which you used the PBS/NOVA Web site.

55. In your opinion, how effective is the Web site at:

	1: Not at all effective	2	3	4	5: Extremely effective
Supplementing the content featured in the <i>Absolute Zero</i> program	○	○	○	○	○
Providing science content (e.g., temperature scales)	○	○	○	○	○
Providing content about the history of science (e.g., milestones in cold research)	○	○	○	○	○
Helping students practice scientific processes (e.g., observation, experimentation)	○	○	○	○	○

56. In your opinion, how engaging was the site overall for your students?

- Not at all engaging
- A little

- Somewhat
- Very
- Extremely engaging

57. How likely would you be to use the *Absolute Zero* Web site again with your students?

- Not at all likely
- A little
- Somewhat
- Very
- Extremely likely

About You

58. For how many years have you been teaching? _____

59. For how many years have you been teaching science? _____

60. Which best describes your science education and training background? (*Check all that apply.*)

- Science degree – undergraduate
- Science degree – graduate; Describe (degree/concentration) _____
- Science certification
- Some Science course work, no formal degree or certification
- No formal Science training

61. Prior to participating in this classroom study, how familiar were you with the following topics?

	1: Not at all familiar	2	3	4	5: Extremely familiar
Races among scientists towards a scientific breakthrough	○	○	○	○	○
Competing theories, current or historic, about a scientific phenomenon	○	○	○	○	○
History of science	○	○	○	○	○
The science of cold (low-temperature physics)	○	○	○	○	○

62. Prior to participating in this classroom study, had you taught any of the following topics?

Check all that apply.

- Races among scientists towards a scientific breakthrough
- Competing theories, current or historic, about a scientific phenomenon
- History of science
- The science of cold (low-temperature physics)
- None of the above

63. What interested you in participating in this classroom study of *Absolute Zero* and its outreach guides? *Check all that apply.*

- The topic of low temperature physics

- The opportunity to participate in research
- Free DVDs of the *Absolute Zero* program
- Ideas for classroom activities
- Interest in NOVA or PBS programs in general
- Other; _____

64. How interested are you in learning more about the following topics?

	1: Not at all interested	2	3	4	5: Extremely interested
Races among scientists towards a scientific breakthrough	◦	◦	◦	◦	◦
Competing theories, current or historic, about a scientific phenomenon	◦	◦	◦	◦	◦
History of science	◦	◦	◦	◦	◦
The science of cold (low-temperature physics)	◦	◦	◦	◦	◦

65. How likely are you to teach the following topics to future students?

	1: Not at all likely	2	3	4	5: Extremely likely
Races among scientists towards a scientific breakthrough	◦	◦	◦	◦	◦
Competing theories, current or historic, about a scientific phenomenon	◦	◦	◦	◦	◦
History of science	◦	◦	◦	◦	◦
The science of cold (low-temperature physics)	◦	◦	◦	◦	◦

66. If you have any additional comments about either of the guides or the Web sites, please type them below: _____

Teacher Checklist for Web site Activities (Evaluation of Outreach Materials)

Please use a separate sheet for each class.

Grade level of students in the class: _____

Number of students in the class: _____

As your students are exploring the web site, please check off the areas of the site they visited:

- | | |
|--|--|
| <input type="checkbox"/> Absolute Hot | <input type="checkbox"/> How Low Can You Go? |
| <input type="checkbox"/> A Sense of Scale | <input type="checkbox"/> States of Matter |
| <input type="checkbox"/> Milestones in Cold Research | <input type="checkbox"/> A Matter of Degrees |
| <input type="checkbox"/> The Conquest of Cold | <input type="checkbox"/> Anatomy of a Refrigerator |
| <input type="checkbox"/> Ultracold Atoms | <input type="checkbox"/> The Ice Trade |

Please gather the following information as students are exploring the site or in group discussion afterwards:

Which areas of the *Absolute Zero* website did your students enjoy the MOST? *Check all that apply.*

- | | |
|--|--|
| <input type="checkbox"/> Absolute Hot | <input type="checkbox"/> How Low Can You Go? |
| <input type="checkbox"/> A Sense of Scale | <input type="checkbox"/> States of Matter |
| <input type="checkbox"/> Milestones in Cold Research | <input type="checkbox"/> A Matter of Degrees |
| <input type="checkbox"/> The Conquest of Cold | <input type="checkbox"/> Anatomy of a Refrigerator |
| <input type="checkbox"/> Ultracold Atoms | <input type="checkbox"/> The Ice Trade |

Why did they enjoy those areas the MOST?

Which areas of the *Absolute Zero* website did your students enjoy the LEAST? *Check all that apply.*

- | | |
|--|--|
| <input type="checkbox"/> Absolute Hot | <input type="checkbox"/> How Low Can You Go? |
| <input type="checkbox"/> A Sense of Scale | <input type="checkbox"/> States of Matter |
| <input type="checkbox"/> Milestones in Cold Research | <input type="checkbox"/> A Matter of Degrees |
| <input type="checkbox"/> The Conquest of Cold | <input type="checkbox"/> Anatomy of a Refrigerator |
| <input type="checkbox"/> Ultracold Atoms | <input type="checkbox"/> The Ice Trade |

Why did they enjoy those areas the LEAST?

Additional notes/comments: _____

Survey for National Partners & Participants (Evaluation of Outreach)

Welcome to the *Absolute Zero* outreach survey!

This survey is a component of the summative evaluation of *Absolute Zero* being conducted by Goodman Research Group, Inc. The survey focuses on the *Absolute Zero* national outreach campaign, which took place over a 2 year period and culminated around the premiere of *Absolute Zero* in January 2008.

The survey should take less than 15 minutes to complete. As you move through the survey, use the “previous” and “continue” buttons at the bottom of the screen. Do NOT use your browser's buttons as this may result in lost data.

To begin, enter the ID number from your email invitation in the box below and press “next.”

Process of Partnership: Involvement in the National Campaign

The following questions will ask you about your organization’s involvement in the *Absolute Zero* outreach campaign.

1. Was your organization a:
 - National Partner
 - National Participant

2. Were you a member of the *Absolute Zero* National Awareness Advisory Committee?
 - Yes
 - No

3. What was the main reason your organization became an *Absolute Zero* National Partner/Participant? (If you do not know, please indicate that). [text box]

4. Did any of your members serve as an *Absolute Zero* Expert?
 - Yes
 - No
 - I don’t know

5. Were you or your organization involved in the development of the two *Absolute Zero* outreach guides (the *Absolute Zero Community Education Outreach Guide* and the *Absolute Zero Science Educator’s Guide*)?
 - Yes [If yes, proceed to questions 6 and 7]
 - No [If no, skip to question 8]
 - I don’t know [If don’t know, skip to question 8]

6. If yes, in what capacity? [text box]

Process of Partnership: Strengths and challenges

For the following questions, please reflect on how the outreach campaign unfolded, including strengths and challenges of the outreach campaign and partnership process. [this intro text will appear, even if participants are skipped over #7]

7. How satisfied are you with each of the following aspects of the outreach partnership process? Please use a 1 to 5 scale, where 1 = “not at all satisfied” and 5 = “extremely satisfied.” Please check “Don’t know” only if you have no basis to judge the objective.

	1	2	3	4	5	Don't know
The process used in developing the <i>Absolute Zero</i> outreach guides.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My organization’s role in developing the <i>Absolute Zero</i> outreach guides.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. How satisfied are you with each of the following aspects of the outreach partnership process? Please use a 1 to 5 scale, where 1 = “not at all satisfied” and 5 = “extremely satisfied.” Please check “Don’t know” only if you have no basis to judge the objective.

	1	2	3	4	5	Don't know
The goals of the outreach campaign	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The project’s pace toward its goals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Receiving relevant project-related information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Responsiveness of outreach campaign organizers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Opportunity for communication with other partner/participant organizations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Expectations for participation in the campaign	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Support for participation in the campaign	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My overall experience as a National Partner/ Participant in the <i>Absolute Zero</i> outreach campaign	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. Please elaborate on any of your responses above. [text box]

10. In your view, how successful was the national outreach campaign at fulfilling each of its goals (listed below)? For each item in the table, please rate success on a scale from 1 (Not at all successful) to 5 (Extremely successful).

	1	2	3	4	5	Don't know
Engage the American audience in a story that touches their lives in innumerable ways while generating the greatest possible audience for Absolute Zero.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stimulate active learning by the general public and students about low temperature physics and the science of cold, including new technological advances involving cold temperature.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Introduce some of the most important scientific breakthroughs and human achievements in this relatively unknown field of low temperature physics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Serve as a catalyst for community-based collaboration and partnerships with science museums, libraries, schools, PBS stations and related organizations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Actively engage science professionals, researchers and technicians in public outreach and education.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Outreach campaign overall	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11. Please list and describe up to three features of the outreach campaign process that you feel went extremely well. [text box]

12. Please describe up to three features of the outreach campaign process that you found particularly challenging. [text box]

13. Please indicate how much you agree or disagree with the following statements about the outreach campaign partnership on a scale from 1 (Strongly disagree) to 5 (Strongly agree).

	1	2	3	4	5
This was a joint endeavor worth doing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The project established trust and respect among Partners and Participants.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall, appropriate partners were included in the campaign.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The outreach campaign allowed us to underscore a subject that is not well known or appreciated by the students and the American public	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The outreach campaign allowed us to do what cannot be done by one organization alone.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The campaign allowed us to become involved in an important public broadcasting endeavor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. Please elaborate on any of your responses above. [text box]

Process of Partnership: Suggestions and plans for future partnerships associated with series and/or outreach initiatives

15. If you had the choice now, would you recommend that your organization serve as an *Absolute Zero* National Partner/Participant?
- Yes
 - No
16. What are your recommendations for potential future outreach partnerships similar to the *Absolute Zero* Campaign? [text box]

Outreach Activities: Outreach Guides and Campaign Web site

The rest of the survey focuses on the materials and activities resulting from the outreach campaign.

The following questions concern the *Absolute Zero Community Education Outreach Guide* (which contains activities and experiments), the *Absolute Zero Science Educator's Guide* (which gives formal and informal educators tips on how to engage students), and the *Absolute Zero* Campaign Web site. The guides were developed in conjunction with the National Awareness Advisory Committee.

17. Approximately how many of the 500 printed outreach guides that your organization received were distributed? (If you do not know, please indicate that). [text box]
18. To whom were the printed outreach guides distributed?
- My organization's members
 - Other
- If you indicated "other," please describe to whom the guides were distributed. [text box]

The following questions refer specifically to the *Absolute Zero Community Education Outreach Guide*.

19. In your opinion, how useful is the *Absolute Zero Community Education Outreach Guide* to teachers and informal educators of middle school students?
- Not at all useful
 - A little
 - Somewhat
 - Very
 - Extremely useful
 - Don't know
20. In your opinion, how effective is the *Absolute Zero Community Education Outreach Guide* at supplementing the content featured in the *Absolute Zero* program?
- Not at all effective
 - A little
 - Somewhat
 - Very
 - Extremely effective
 - Don't know

21. Please rate the following features of the *Absolute Zero Community Education Outreach Guide*.

	1: Poor	2	3	4	5: Excellent	Don't know
Format	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Readability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Illustrations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Content	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Guide overall	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following questions refer specifically to the *Absolute Zero Science Educator's Guide*.

22. In your opinion, how useful is the *Absolute Zero Science Educator's Guide* to teachers and informal educators of middle school students?

- Not at all useful
- A little
- Somewhat
- Very
- Extremely useful
- Don't know

23. In your opinion, how effective is the *Absolute Zero Science Educator's Guide* at complementing the material featured in the *Absolute Zero Community Education Outreach Guide*?

- Not at all effective
- A little
- Somewhat
- Very
- Extremely effective
- Don't know

24. Please rate the following features of the *Absolute Zero Science Educator's Guide*.

	1: Poor	2	3	4	5: Excellent	Don't know
Format	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Readability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Illustrations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Content	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Guide overall	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following questions refer to the *Absolute Zero Campaign Web site*.

www.absolutezerocampaign.org

25. Have you visited the *Absolute Zero Campaign Web site*?

- Yes
- No [If no, skip the table that comes next]

26. How useful was the Web site:

	1: Not at all useful	2	3	4	5: Extremely Useful
To your work as a National Partner/Participant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To teachers and informal educators of middle school students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Promotion of *Absolute Zero* Broadcast and Outreach campaign

27. Did your organization use any of the following *Absolute Zero* press materials (found on the campaign Web site: http://www.absolutezerocampaign.org/press_room/press_kit.htm)?

Check all that apply.

- Press release
- Backgrounder
- Fast Facts
- Q & A w/ Russ Donnelly
- Q & A w/ Tom Shachtman
- Promotional flyer
- Poster (18" x 24")
- None of the above

28. Did your organization promote the *Absolute Zero* BROADCAST, which premiered in January on NOVA, in any of the following ways? *Check all that apply.*

- Via my organization's magazine, newsletter, or bulletin
- Via a message to a member listserv
- Via my organization's Web site
- At a professional conference
- At an event my organization hosted/attended (e.g., an open house, a networking event)
- Other; please describe: _____
- None of the above

29. Did your organization promote the *Absolute Zero* OUTREACH (e.g., outreach guides, Web site) in any of the following ways? *Check all that apply.*

- Via my organization's magazine, newsletter, or bulletin
- Via a message to a member listserv
- Via my organization's Web site
- At a professional conference
- At an event my organization hosted/attended (e.g., an open house, a networking event)
- Other; please describe: _____
- None of the above

Outreach Activities: Additional Educational Outreach

30. Did your organization or your members conduct any *Absolute Zero* outreach activities, in a formal or informal setting, of which you are aware?

- Yes [If yes, proceed to next question]
- No [If no, skip next question]
- I don't know [If checked, skip next question]

31. Were those outreach activities conducted:
- Solely by your organization
 - In collaboration with other *Absolute Zero* Partner/Participant organizations
 - In collaboration with other organizations that were not *Absolute Zero* Participants/Partners
32. Did your organization work with any local PBS stations?
- Yes
 - No
 - I don't know
33. Are you aware of your members' opinions regarding either the broadcast or the outreach campaign?
- Yes [If yes, proceed to next question]
 - No [If no, skip next question]
34. What was the response of your members to the program and/or outreach campaign? [text box]
35. What do you feel was most significant about the outreach campaign? [text box]

Final Questions

36. Would you be willing to participate in a brief (15 minute) follow-up telephone interview regarding the *Absolute Zero* outreach campaign and activities?
- Yes
 - No [If no, skip next 1 question]
37. Thank you! Please provide your name and email so a GRG researcher can follow up with you to arrange an interview time:
First and last name: [text box]
Email address: [text box]
38. Please take a moment to write any final comments about the outreach activities or your experiences as a National Partner/Participant in the *Absolute Zero* campaign. [text box]

Thank you! Your responses have been submitted.

Follow-Up Interview Protocol: National Partners/Participants and Experts (Evaluation of Outreach)

Process of partnership: reasons for partnering / becoming an expert

1. Why did your organization choose to become a national partner or participant? (Experts: Why did you choose to become an *Absolute Zero* Expert?) *If they indicate more than one, ask about the most important reason*
2. Please describe your/your organization's role in the outreach campaign.

Outreach activities

3. Please describe any outreach activities conducted by your organization. (Experts: outreach activities you conducted.) Probes: what activities, audience, setting, how recruited, reactions of participants.
4. Are you aware of any additional *Absolute Zero* outreach activities (i.e., beyond those conducted by your organization)? If yes, probe for description, reactions.
5. Is there anyone we might contact about their responses to the activities?

Initiative Feedback

6. How would you describe the contributions of the outreach initiative to the field of informal science education?
7. If you were to think of another potential initiative like the *Absolute Zero* campaign, what would you suggest be the same? What would you suggest be different?
8. Is there anything I've missed that you'd like to share?

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