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Program Evaluation • Consultation • Market Research

Making Stuff
Summative Evaluation

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EXECUTIVE SUMMARY

WGBH and the Materials Research Society (MRS) collaborated to create *Making Stuff*, a multi-faceted project about the all-encompassing role that materials play in shaping our lives. The project included a four-episode NOVA mini-series originally broadcast in January, 2011 that was hosted by *NY Times* columnist David Pogue, a large-scale national outreach campaign with collaborating partnerships funded in 20 locations, web pages on the NOVA website, and an online contest promoted and hosted on Facebook.

Across all project components, the overarching goals were to enhance the general public's engagement with materials science and appreciation of its effects on society, and to enhance collaborations among professional audiences (e.g., educators, scientists, community-based organizations) such that together they would reach a broader audience of adults, youth, and underserved populations than they could individually.

Goodman Research Group's (GRG) summative evaluation has focused on the process and outcomes of all of the project components, assessing the extent to which the various *Making Stuff* resources (e.g., television series, website, national outreach collaborations and community events) achieved their intended impacts on public and professional audiences. The multi-method evaluation study included recruiting different groups to use particular *Making Stuff* resources, along with surveying others after they used a particular resource on their own. In all, evaluation data were collected from the following:

- 120 viewing study participants completed online pre- and post-surveys and brief forms after watching each *Making Stuff* episode on TV.
- 87 NOVA website visitors completed an online survey after reviewing the *Making Stuff* pages on the site.
- 563 "*What's This Stuff? Ask David Pogue*" Facebook contest participants completed an online survey during the contest and 423 of them completed a one-month follow-up survey.
- 840 community outreach attendees completed paper survey feedback forms distributed at the events they attended.
- GRG conducted on-site observations at nine of the national community outreach events.
- 22 national outreach partners from 21 sites completed an online survey about the outreach and partnership collaboration experience.

Across all project components, evaluation participants reflected a relatively even mix of gender and a range of ages. Most participants were White and over half completed at least a Bachelor's degree. Relative to the majority of evaluation participants, Facebook contest survey respondents included slightly more men, and outreach event attendees included respondents who were younger and a slightly higher proportion of non-White participants.

This document summarizes key findings and recommendations from the summative evaluation. The full report includes methods, results, conclusions and recommendations, and appendices.

KEY FINDINGS

The *Making Stuff* project components successfully engaged a variety of members of the general public in materials science and increased their awareness and understanding of the content.

- Viewing study participants, who were occasional NOVA viewers before the study, engaged with *Making Stuff* resources by watching NOVA and NOVA scienceNOW on TV and visiting the NOVA website more frequently than they did before the study.

- Website visitors, who were already frequent NOVA viewers, engaged with *Making Stuff* by joining NOVA's Facebook page, using the interactive features on the *Making Stuff* web pages, and viewing the mini-series on TV.

- Facebook contest participants, also frequent NOVA viewers, engaged with *Making Stuff* by visiting the relevant pages on the NOVA website and watching the mini-series on TV.

- National partners were members of PBS stations and formal and informal learning institutions, and they engaged the public with *Making Stuff* by hosting community events for individuals, families, and educators. Family events in science museums, science cafés, and educator workshops were the most common event types.

- Community event attendees were families and school groups who were not necessarily aware of *Making Stuff* prior to attending. They engaged with *Making Stuff* resources through hands-on activities and interactive presentations and demonstrations that motivated them to seek out more information online and on TV.

***Making Stuff* resources motivated users to seek out more information and stay up-to-date about materials science content.**

After engaging with *Making Stuff* resources, participants discussed topics from each episode with friends and family, and sought out ways to stay up-to-date in the field. They read science articles in print and online, and watched additional programs on TV about science and current research.

***Making Stuff* resources were both informative and appealing to users.**

- Viewers of the full mini-series saw information that was new to them in each episode and they reported increased understanding of materials science content after viewing. They found the program overall to be interesting and engaging and they felt that host David Pogue contributed to their interest in the series. Already strong appreciation for the many aspects of their lives touched by current science research was sustained after viewing the full mini-series.

- Website visitors found the *Making Stuff* web resources, across all of the new NOVA web feature formats, to be quite informative and appealing. Facebook contest participants found the contest engaging and they appreciated the challenge of decoding clues for each material.

- Community outreach events were well-equipped with resources that engaged attendees and helped them learn about materials science and how it affects our daily lives. Collaborating partners reported that demonstrations, hands-on activities, and presenters were the key to helping attendees feel engaged in materials science. Attendees of community events reported they enjoyed the experience and learned about materials science.

National partners felt supported by WGBH staff and the resources as they planned and implemented their outreach events.

The outreach campaign overall met or exceeded collaborating partners' expectations. Partners found the support from WGBH was more helpful for planning events while the *Making Stuff* resources and materials were more useful when conducting their events.

Partners perceived their collaboration experiences positively and intended to maintain many of the partnerships.

Across the collaborating organizations, from 4 to 13 in each funded site, partners felt the roles and responsibilities for each organization were clearly defined, partners had a shared vision of the outreach events, and there was clear communication between the organizations. These are three elements known to be quite valuable to the success of partnerships among organizations in a community.

KEY RECOMMENDATIONS

In consideration of the summative evaluation findings and conclusions we have drawn from those findings, GRG makes the following recommendations for future similar projects and initiatives.

WGBH and MRS should take advantage of all the resources created for this project and capitalize on the different entry points that now exist.

Because different user groups will start with the resource that is most interesting and accessible to them, project developers will want to ensure there is enough content to keep users engaged as well as to inform them of all the other resources. With the goal of pulling in users (e.g., TV viewers, website visitors, event attendees) and then keeping them involved, developers should focus on making the content easily navigable and sustaining users' interest over time.

Based on the current project, we present the following examples of ways to attract users beyond the regular audience.

- Use of social media for active engagement, similar to the Facebook contest, will increase the range of potential users. A contest or game that specifically encourages participants to enlist the help of others will serve to expand further the project reach.

- A known personality may attract new audience members for a particular program and create cross-over. In this case, *NY Times* readers who followed David Pogue, but were not regular NOVA viewers, were encouraged to watch NOVA and NOVA scienceNOW.

- Hosting and promoting the program resources at a variety of different institutions, including formal and informal learning organizations, will increase the range of community members likely to participate. Community events then provide a good opportunity to raise awareness of other resources and to encourage attendees to share the information with others.

Going forward, an online contest should reflect some modifications to the current model, based on user feedback to increase use and satisfaction.

The organizational structure should parallel the medium on which it is housed. For example, for the "What's this Stuff?" Facebook contest, users clicked on and "Liked" different pages for each material. However, care should be taken to avoid making the game too cumbersome to the point that users may opt out. Additionally, use of social networking media should reflect current trends, so as to ensure the largest potential user base.

If producers have a goal of significantly changing attitudes, then popular misconceptions should be identified and addressed in a very concrete manner and the project as intervention should be expanded.

Similar to the *Mythbuster* format, producers can state a common misconception about a topic and then walk users through the process of understanding the reality of that content.

Another approach to modifying attitudes would be to create a larger and longer-term intervention. Producers can create opportunities for a large-scale community event that would engage a wider range of the public. Promote and hold a community experience where residents are encouraged to watch a program in their homes, with friends, or at few centralized locations in the community (i.e., common point of entry). Hold discussions leading up to and following the viewing. Implement family activities such as festivals that continue the interactions and learning over time.

Because of the redesign of the NOVA website overall, producers should put deliberate thought and planning into ongoing promotion of the web resources.

Regular visitors may see changes to the NOVA site, but not realize the reasons WGBH has made deliberate changes. The web team should consider adding to the site information about the new features along with descriptions of the purpose

of each. Website visitors should be encouraged to explore the new features on the site as well as all of the other *Making Stuff* resources.

Logistical changes to the national outreach campaign process and procedures would likely enhance everyone's experience, from partners to event staff and volunteers to event attendees.

Outreach developers should create a clear planning guide, using an interactive online platform, on which prospective partners can see an outline of expectations for participation and on which they can describe in detail their own plans for community events if they are selected for funding. The same platform can be used to list all requirements including tasks, timing, and deliverables throughout the duration of the outreach campaign. Partners and campaign organizers can use the platform to provide consistent contact information for all participants, dates, titles, and descriptions of all events planned and completed, and to describe any changes or modifications throughout the process. Partners' use of a consistent form and format will likely increase the cohesion of the campaign nationally and decrease the likelihood of gaps in communication that may lead to delays or confusion.

Informational materials about all available *Making Stuff* resources should be posted by each collaborating organization and included at community events to attract a broad range of participants within and across communities.

Making Stuff outreach events attracted families with young children as well as school groups, educators, and scientists. Participants across a range of background experiences and science knowledge were engaged, learned new information, and had fun in the process. Provided with their own one-pagers, fact sheets, and *Making Stuff* promotional items, community members can bring in other users through their own word-of-mouth promotion.

INTRODUCTION

WGBH, the producer of NOVA, collaborated with Materials Research Society (MRS) to create *Making Stuff*, a multi-faceted project about the pervasive role that materials have always played and continue to play in shaping our lives. The four-episode NOVA mini-series, hosted by *NY Times* columnist David Pogue, described the human and scientific factors that gave rise to discovery and innovation in materials science and what these discoveries mean to people's everyday lives. Other project components included a national outreach campaign with collaborating partnerships funded through grants from WGBH in 20 locations, web pages on the NOVA website, and an online contest promoted and hosted on Facebook.

Producers intended for the *Making Stuff* resources to reach adults, youth, and underserved audiences, with goals to enhance the general public's engagement with materials science and appreciation of its effects on society. Additionally, producers aimed to enhance collaborations among professional audiences (e.g., educators, scientists, community-based organizations) such that together they would reach a broader audience.

GRG's summative evaluation goal was to assess the process and outcomes of all of the project components and to determine the extent to which the various *Making Stuff* resources – television series, website, national outreach collaborations and community events – achieved their intended impacts on public and professional audiences.

The overarching evaluation questions reflect the concerns of the broader informal science education stakeholder community, including the National Science Foundation. These questions are:

1. To what extent and in what ways does the overall project enhance public engagement in and awareness and understanding of materials science?
2. To what extent does the project help program users (e.g., viewers, website visitors, event attendees) appreciate the role of scientists and ingenuity in making "stuff" that we use every day?
3. To what extent and in what ways does the project promote collaboration among educators, scientists, and community-based organizations?
4. To what extent is the project effective for youth, as well as adult users?

The remainder of the report is organized as follows:

- The Methods section describes the data collection methods that corresponded with each program component
- The Results section presents findings by research questions in order to illustrate overall effectiveness of the *Making Stuff* project

- GRG's Conclusions and Recommendations, at the end, reflect findings from the entire summative evaluation.

METHODS

In order to address the key research questions, GRG designed a multi-method evaluation study. Different groups were recruited to participate in the research; some were invited to use particular *Making Stuff* resources, while others were surveyed after they came to use a resource on their own.

RECRUITMENT AND DATA COLLECTION

Viewing Study

GRG recruited participants for the *Making Stuff* mini-series **viewing study** with a goal that 100 viewers would complete a pre-survey, a short feedback form after each *Making Stuff* episode, and a post-survey. In early December 2010, we began recruiting participants for the study, using GRG's internal participant database. WGBH asked David Pogue to "tweet" about the study on his Twitter page, which attracted additional potential participants.

Beginning in January 2011, GRG sent the online pre-survey to 137 eligible participants. Each week, GRG sent email reminders for participants to watch the show and complete the brief online form the day after each episode aired. At different points throughout the viewing study, GRG gathered data on participants' prior levels of engagement with science and media, their TV viewing habits, perceived usefulness of and interest in science, engagement with NOVA and NOVAscience NOW, and their interest in the content for each episode. Ultimately, 120 participants completed the series viewing study in its entirety.

National Outreach Campaign

GRG collected data throughout the *Making Stuff* outreach campaign, in order to assess the process (i.e., number and type of events implemented and number of attendees) and outcomes (i.e., attendees' satisfaction and learning) from the perspectives of the collaborating partners and attendees of their community events. Based on estimates provided by collaborating partners, in all, 135 national outreach events were conducted and they were attended by over 87,000 community members.

GRG collected data from **collaborating partners**, at the end of the outreach period, about their experiences with the *Making Stuff* outreach including the support and resources provided by WGBH. Questions on the online survey focused on the number and types of event that each site hosted, their perceptions of the resources and support received, their experiences working with partnering organizations, and outcomes associated with the collaborations. The online survey was completed by 22 partners from 21 collaborating sites.

We developed a survey for **outreach event attendees** and sent it to all *Making Stuff* partners. Partners printed the surveys and distributed them at their outreach events and then mailed the completed surveys back to GRG. The event survey

included questions about participants' enjoyment of the event in general, what they learned, and the likelihood that they would interact with *Making Stuff* or materials science resources in the future. In all, GRG received 840 surveys from 18 collaborating sites, representing outreach events held between January and March 2011.

In addition, GRG completed **on-site observations** at nine community events around the country. To ensure a representative sample of events, GRG selected sites for observation based on size, target audience, and type of outreach event. See Table 1 for a complete listing and description of each event.

Table 1
GRG's On-Site Observations at Community Events

Site	Location	Description	Date
Boston, MA	Museum of Science	*Making Stuff* Day	1/23/2011
Philadelphia, PA	Drexel University UPENN/WHYY	Materials Science Day	2/5/2011
Rochester, NY	Rochester WXXI	Online Chat	1/19/2011
New York, NY	Science Café and Biobus	Hands-on activities	2/11/2011
Gorham, ME	Maine Discovery Center	Nano Demos	2/19/2011
Gainesville, FL	University of Florida	E-week Demo Tables	2/22/2011
Charlotte, NC	Discovery Museum	*Making Stuff* Weekend	2/25/2011
Dayton, OH	Boonshoft Discovery Center	Nano Days	3/26/2011
New Haven, CT	Yale University	Large Scale Public Outreach Event	3/26/2011

Online Resources

GRG collected data during the **online Facebook contest**, "'*What's this Stuff?' asks David Pogue.*" Working together, GRG developed and WGBH distributed an invitation and link to an online survey to all contest participants shortly after the contest began. WGBH sent the link to the 2,500 registrants during the first week of the contest. Survey questions asked contestants about their experiences, including the extent to which they interacted with the contest and the likelihood that they would interact with *Making Stuff* or materials science in the future. GRG received responses from 563 participants; 423 of them provided their contact information, allowing GRG to send a follow-up survey. One month later, 345 participants completed the follow-up survey.

GRG also collected data about the ***Making Stuff* portion of the NOVA website**. GRG developed the online survey and WGBH posted the link on the NOVA Facebook page and sent it out in NOVA's e-newsletter. Interested participants were directed to the *Making Stuff* pages on the NOVA website and asked to review those, specifically, before completing the survey. Survey questions asked about how appealing and informative the resources were, use of the different components of the website, other science websites visited, and likelihood of using the NOVA site in the future or recommending it to others. After four weeks, we received 87 responses.

See Appendix A for annotated copies of all data collection instruments (i.e., all survey responses included).

RESULTS

In this section, we present evaluation findings organized by overarching research questions and intended impacts of use. For each component evaluated, we summarize who used the component and the ways in which they engaged with the *Making Stuff* resources. This is followed by the science-related behaviors users reported after engaging with *Making Stuff* resources, and the outcomes of use: interest, learning, and attitudes about materials science and its effects on our daily lives. The final section of results summarizes the effectiveness and perceived outcomes of the collaborations that were established for the national outreach campaign.

Across the various data collection methods and samples – with the exception of outreach event attendees – participants in of the *Making Stuff* summative evaluation reflected a relatively even mix of gender and a range of ages. Most participants were White and over half completed at least a Bachelor's degree. There were slightly more male contest participants (65% compared to about 50% in other samples).

In contrast, most of the outreach event attendees were younger than respondents to other evaluation components; 37% were younger than 17 years old compared to about 5% of contest and website participants (GRG did not recruit children under 18 for the viewer study). In addition, there were slightly more African American and Latino event attendees compared to other samples of participants (25% attendees vs. about 11% in other samples).

See Appendix B for the demographic profiles of participants in each evaluation component.

PUBLIC ENGAGEMENT WITH MATERIALS SCIENCE

The extent and outcomes of engagement with materials science were examined with each evaluation component's sample of participants: those in the viewing study, visitors to the *Making Stuff* web pages, Facebook contest participants, and attendees at community outreach events. This section describes who used the *Making Stuff* resources and the ways in which they engaged with those resources.

Viewing study participants learned about the research primarily from David Pogue's websites. They then engaged with *Making Stuff* resources by watching NOVA and NOVA scienceNOW[1] on TV and visiting the NOVA website more frequently than they had prior to the study.

The majority of participants in the viewing study were between 25 and 44 years of age, had a Bachelors' or Masters degree and were White. There were slightly more men (57%) than women (43%). In all, the sample represented 34 different states, with a majority (21%) from California (See Appendix A for full list of states represented).

In comparison to findings from a 2008 survey of the NOVA website, the current viewing study sample included more women, and more participants were in the age range of 25-44 years, than were the NOVA web visitors (WGBH Research, 2008).

Nearly three quarters (73%) of viewing study participants learned about our evaluation from David Pogue's website and/or Twitter page. Relative to the audience composition for the *Making Stuff* mini-series, study participants were similar in terms of gender (slightly more male than female viewers/study participants). Study participants were younger than the typical *Making Stuff* viewer:

- 40% of participants were between 18-34 years of age, compared to 11% of the viewers of *Making Stuff*: Stronger.
- Only 2% of the study participants were 65 years or older, compared to 26% of the *Making Stuff*: Stronger viewers.

Similar to the participants in our evaluation of NOVA scienceNOW season 5 (GRG, 2011), even though fewer than one quarter of the participants (20%) studied or worked in a science-related field (see Table 2), most of the sample were interested in learning about science, both in general and specifically about current events in science, even before the study began[2]. Mean ratings were 3.70

[1] Although not the focus of this evaluation, we refer in this section to NOVA scienceNOW viewers and viewing behaviors, as the two programs are related and aired back to back during the season.

[2] Participants in GRG's evaluation of NOVA scienceNOW reported stronger interest in science before and after their study than did participants in the current *Making Stuff* evaluation. This likely reflects differences in the sample composition; more of the NSN participants learned about the study via NOVA (e.g., Facebook page, e-newsletter), whereas more of the participants in the *Making Stuff* evaluation learned about the study from David Pogue (e.g., his website or Twitter feed).

(learning about science in general) and 3.86 (learning about current events in science), on a scale from 1 (*Not at all interested*) to 5 (*Extremely interested*).

Table 2
Science-Related School or Employment

	% of Respondents
Studying part-time in a science-related field	1%
Studying full-time in a science-related field	3%
Working part-time in a science-related field	2%
Working full-time in a science-related field	14%
Neither working nor studying in a science-related field	80%

N=120

Participants in the viewing study were the least frequent NOVA viewers across all of the Making Stuff *components evaluated.*

Before they began the viewing study, most participants (83%) had seen NOVA in some format (i.e., TV or web). Among those (n=114), most watched "occasionally, but not often" (64%); the majority (70%) had never streamed NOVA online. By the end of the study, more participants reported watching more frequently, both on TV and online than they had before the study.

Fewer of the viewing study participants (39%) had watched NOVA scienceNOW on TV or online before the study began, with a significant increase to 68% who had done so after the study. Similar to their experiences with NOVA, participants also watched NSN with more frequency after participating in the *Making Stuff* viewing study. See Table 3.

Table 3
How often Viewing Study Participants Watched NOVA scienceNOW on TV

	% of Participants	
	Before N=54	After N=92
I have never watched NOVA scienceNOW on TV	6%	2%
I have watched NOVA scienceNOW on TV once	20%	7%
I watch NOVA scienceNOW on TV occasionally, but not often	50%	62%
I frequently watch NOVA scienceNOW on TV	15%	22%
I almost never miss an episode of NOVA scienceNOW on TV	9%	6%

About half of the viewing participants (55%) reported they watched the NOVA scienceNOW episode that either preceded or followed (depending on the market) at least one *Making Stuff* episode during the course of the viewing study. The remaining 45% did not.

Before the viewing study, nearly (61%) had never visited the NOVA website and the majority of those who had viewed it reported visiting only once or typically less than once a month. After the study, more participants had visited the site; fewer than one third (29%) said they had never visited. Visits to the site remained fairly infrequent, with half reporting they visited only one time or less than once a month. See Table 4.

Table 4
Frequency of NOVA Website Visits Before and After the Viewing Study

	% of Participants	
	Before	**After**
I have never visited the NOVA website	61%	29%
I have visited once	20%	23%
Rarely (less than once a month)	11%	32%
Occasionally (1-3 times a month)	7%	13%
Frequently (once a week or more)	1%	3%
Daily	–	–

N=120

When visiting the website, both before and after the study, most participants spent their time reading articles (TEXT) and watching video clips (VIDEO). Fewer of them reviewed the blogs or teacher resources or joined the NOVA Faceboook or Twitter groups.

Website visitors, who completed the survey of *Making Stuff* web resources, were frequent NOVA viewers and they engaged with *Making Stuff* by joining NOVA's Facebook page, using the interactive features on the Making Stuff web pages, and viewing the mini-series on TV.

Website survey respondents were recruited and directed specifically to the *Making Stuff* pages on the NOVA website. These respondents were typical NOVA enthusiasts. Two thirds of them watched NOVA on TV either "frequently" (33%) or "never missed an episode" (31%). Just under two thirds (64%) had watched at least one episode of *Making Stuff* on TV.

The sample was split almost evenly by gender, with slightly more men (51%) than women (44%); 5% chose not to share their gender. Most (72%) were White, and nearly half were between 45 and 64 years of age. Half held a Bachelors or Master's degree; 13% were currently in high school.

Compared to typical NOVA web visitors, the current sample was similar in age, ethnicity, and highest education level completed, and had slightly more women (44% of our sample vs. 36% of the WGBH's 2008 sample).

Before reviewing and commenting on the *Making Stuff* web pages, visitors typically had visited the NOVA website about "once a week" or more. About one third of visitors each reported they had either "never" streamed NOVA online (30%), had done so "occasionally, but not often" (34%), or did so very "frequently" (28%).

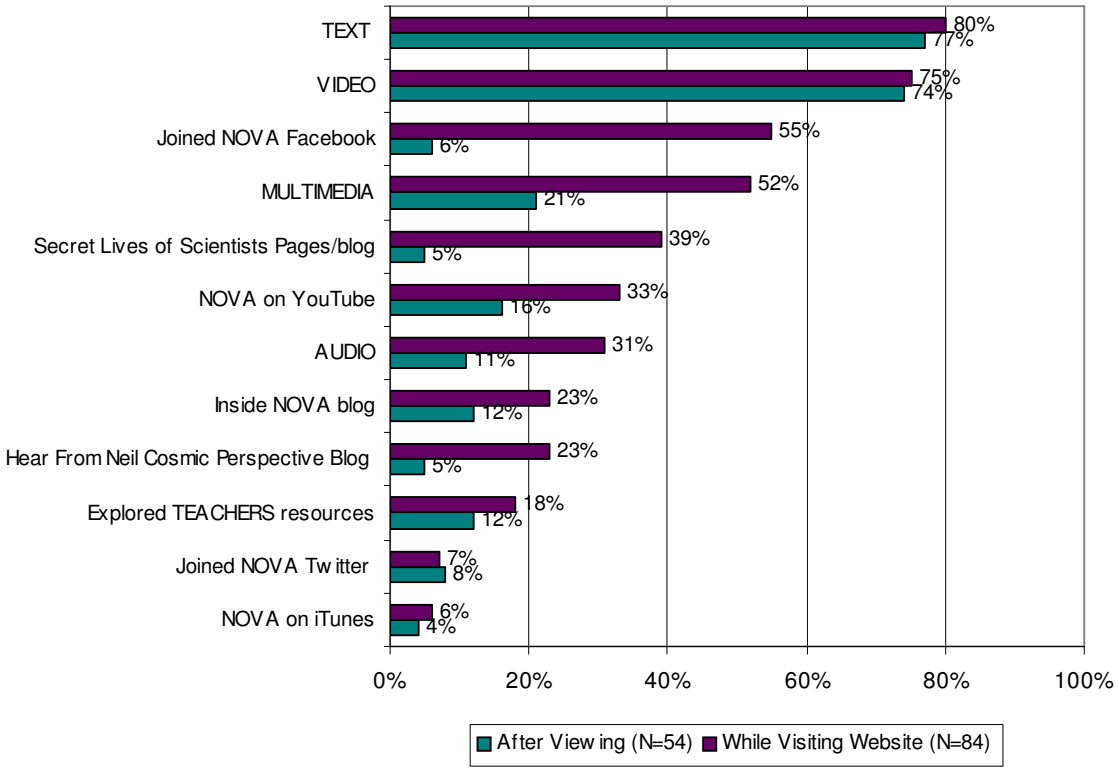
About half had (44%) and half had not (47%) previously visited any of the *Making Stuff* pages on the NOVA website. The remaining 9% were not sure whether they had or not. Among those who had, 16 of the 35 had reached the *Making Stuff* pages via Facebook, Twitter, or their own web search.

When looking for interesting and engaging science content online, a majority of website visitors have, in the past, visited NOVA (including NOVA scienceNOW), National Geographic, NASA, and Discovery Channel. Various other sites have been visited by less than half of the respondents. See Appendix A for the full list of websites visited for engaging science content.

In contrast to viewing study participants, more of the respondents to the website survey joined NOVA's Facebook page and used the interactive (MULTIMEDIA) features on the site.

As described in the prior two sections, overall, participants in the website survey engaged with more of the *Making Stuff* website features than did participants in the viewing study. This was true even with the increased web use from viewing study participants after they viewed the full *Making Stuff* mini-series. Findings suggest that users of the *Making Stuff* resources need the "extra push" to visit the web pages, with explanation of the various features they should expect to see. Figure 1 shows use of the various web features by participants in the viewing study, after the study, and respondents to the website survey.

Figure 1
Making Stuff Web Features Reviewed by Viewing Study Participants and Website Survey Participants



Facebook contest participants were frequent NOVA viewers and they engaged with *Making Stuff* by visiting the relevant pages on the NOVA website and watching the mini-series on TV.

Part of the *Making Stuff* outreach and promotion was an online Facebook contest designed to engage NOVA Facebook users with the *Making Stuff* mini-series before it began. The contest ran from January 12-26 and challenged contestants to identify ten materials based on clues provided each day. Each material had its own Facebook page, on which contestants could find clues about its identity. Once they could identify the material, participants entered their answer on the contest web page to see if they were correct.

Contest participants were typical NOVA enthusiasts: about one-third of participants watched NOVA "frequently." Two-thirds were male, 77% were White and 76% had at least a Bachelor's degree.

Participants learned about the contest mainly online through the pbs.org website, the *New York Times* website, and David Pogue's Twitter and Facebook pages. Just over one third of participants (39%) had visited the contest site 10 or more times when they completed the survey. During a typical visit, contestants reviewed clues (85%), searched the web for answers (79%), watched a video (78%), and input their answer(s) (75%).

At the time they completed the survey, 92% of the Facebook content participants had heard of the *Making Stuff* mini-series and 53% had watched at least one episode; 70% had visited the *Making Stuff* pages on the NOVA website.

National partners were members of PBS stations or affiliated with formal or informal learning institutions, and they engaged the public with *Making Stuff* by hosting community events for individuals, families, and educators.

The *Making Stuff* national outreach campaign brought together partnering organizations in 20 sites to collaborate and create community outreach events over the course of six months (i.e., beginning about two months before the first *Making Stuff* episode airdate and continuing through the spring, for four months after the last episodes aired). An additional 11 sites created partnerships, albeit without WGBH funding.

Across all sites, the types of organizations that collaborated for the National outreach campaign included:

- Universities (n=27)
- Science centers (n=12)
- Schools (Elementary, middle, high schools) (n=7)
- School districts (n=6)
- Public TV stations (n=6)
- Afterschool programs (4H Clubs, Girls Clubs) (n=5)
- Laboratories (n=5)
- Community groups (n=5)

- Public libraries (n=3)

Based on partners' estimates, in all, there were about 122 collaborating organizations involved in the national outreach campaign.

At the end of the outreach period, partners summarized their community events over the course of the project. The most common types of events conducted were

- Family events in science museums (n=17)
- Science cafes (n=15)
- Educator workshops (n=14)

Table 5
Community Events Hosted Nationally

Event Type	Number of sites that hosted	Average Number of Events	Range of # of Events	Average Number of Attendees	Average Number of Scientists
Science Cafés	10	2	1-5	70 (32-150)	4 (1-8)
Teacher Workshops	18	1	1-2	26 (4-70)	--
Scientist Workshops	6	1	1-2	21 (8/52)	--
Community Events	25	5	1-20	3524 (30-49926)	--

Ten sites conducted family events in places other than a museum and ten others conducted in-school events; and fewer than 10 conducted afterschool events or scientist training workshops. Most sites reported plans to continue hosting similar events. This was particularly true for science cafés: 18 of the 19 sites that held a science café planned to continue.

Across all collaboration sites, the most common activities included in their key events (i.e., up to three described on the survey) were demonstrations, hands-on activities, and opportunities for attendees to interact with scientists or engineers.

Table 6
Included at Community Outreach Events

	Event 1 (n=21)	Event 2 (n=20)	Event 3 (n=17)
Demonstrations for attendees	16	13	14
Hands on activities for attendees	15	15	15
Opportunities for attendees to interact with scientists/engineers	14	14	13
Presentations by scientists or engineers	12	13	12
Screening clips of *Making Stuff* episodes	11	11	7
Presentations by educators	7	10	11
Professional development/Training for educator	2	5	3
Presentations by PBS station staff	2	2	1
Training for scientists or engineers	–	2	1

GRG's on-site observations at community events revealed success in promoting events and attracting visitors of all ages.

Across the nine outreach events that GRG observed, *Making Stuff* activities were promoted and integrated differently at each location. Some *Making Stuff* events were one component of a larger event. For instance, the PBS station in Gainesville, Florida set up demonstration tables at the University of Florida's annual Engineering Week Event, which attracts elementary, middle and high school students and after school groups interested in learning more about science and engineering. Other events were promoted as a unique, stand-alone event such as "*Making Stuff* weekend" at an established science center. The Museum of Science Boston held two *Making Stuff* events (of which GRG attended one) that brought in graduate students and other science professionals to lead activities around the museum with typical museum visitors.

Collaborating partners engaged visitors of all ages, including families, individuals, and school and afterschool groups. Each site was successful at promoting the events and attracting their described intended audience. Of the nine events that GRG observed, all of them were well attended; spaces provided were filled, presentations were attended, and visitors interacted with activities, demonstrations, and during presentations where relevant.

The majority of partners (17 out of 22) reported they made at least some changes to their original plans for outreach events in their communities, with one of those 17 reporting that their plans completely changed. Most of the changes described by the 17 were rescheduling of events, due to weather, changes to the *Making Stuff* airdates, and different partnerships than planned. Others described minor changes such as adding events, modifying slightly to *"fit the needs of our visitors*", and replacing some of the demonstrations and/or presentations with different ones.

Community event attendees were families and school groups who were not previously aware of *Making Stuff*. They engaged with *Making Stuff* resources through hands-on activities, interactive presentations, and demonstrations that motivated them to seek out more information online and on TV.

GRG received a total of 840 surveys from event attendees across 18 collaboration sites. Nearly two thirds (64%) of outreach event attendees were White, and they were split evenly by gender: 49% female, 46% male (5% did not provide this information).

Aside from the event at the Lower East Side Girls Club in New York City (which was promoted to girls and their families), events GRG observed were attended by approximately half men and half women. Depending on the event and location, ages ranged. For instance, at museums, we observed a mix of age ranges (e.g., some children, teens, young adults, adults, etc.). At universities, the audience was slightly older (undergraduate and graduate students as well as faculty). Similarly, race depended on the event and location. At the Lower East Side Girls Club, GRG observed primarily Black or African American and Hispanic or Latina girls. At the Maine Discovery Center in Gorham, ME, the majority of attendees were White.

After attending community events, participants were motivated to use additional Making Stuff *resources.*

Most participants attended the event with family (42%), friends (21%), or classmates (24%) and reasons most gave for coming to the event included: general interest in science (49%) or an interest in the topic of the event (36%).

Prior to participation in their respective events, only 16% of all attendees who completed a survey had visited the *Making Stuff* website. After attending the *Making Stuff* outreach event, 81% of attendees were *somewhat* to *extremely* likely to visit the website, while 67% were *very* or *extremely* likely to watch an episode of the show.

As described above (by the partners who hosted them), most events included hands-on activities, interactive demonstration, and activity tables. Not surprisingly, 78% of attendees handled/manipulated materials. In addition, 91% of attendees reported that they interacted with a science professional.

Aside from the online chat hosted by WXXI in Rochester, NY, all events that GRG observed had demonstration/activity tables at which attendees could interact directly with materials and, in some cases, with science professionals. See Table 7 for the types of activities and target audience at event GRG observed in-person.

Table 7

Site	Presentations	Science Professional Present	Activity Tables	Viewing Area	Target Audience
Museum of Science Boston	✓	✓	✓		General Museum Population (families)
Drexel University, UPENN, WHYY, Philadelphia	✓	✓	✓		General Public: promoted on the radio and local PBS station
Rochester, NY WXXI	✓	✓			WXXI PBS Viewers
Biobus, New York, NY	✓	✓	✓	✓	Girls ages (8-23); held at Lower East Side Girls Club
Maine Discovery Center Gorham, ME		✓	✓	✓	University students and general public
University of Florida Gainsville, FL			✓	✓	Elementary, middle and high school students as well as UFL students
Discovery Museum Charlotte, NC	✓	✓	✓		General museum population (families)
Boonshoft Museum Dayton, OH	✓	✓	✓	✓	General Museum Population (families)
Yale University New Haven, CT	✓	✓	✓	✓	General public

At five of the nine outreach events attended by GRG, viewing stations were set up for attendees to watch a clip or an episode of the show. Trying to show segments of the episodes presented difficulty at some events (e.g., poor internet connection, lack of adequate electrical outlets, etc.). GRG observed that very few attendees watched the clips, especially at a larger event or museum where there were many other things to do and see.

Making Stuff events were well-staffed and well-attended.

Depending on the venue, events GRG observed were either contained in one general area or spread throughout a larger space. No matter how the *Making Stuff* events were set up, GRG observed that designated areas were well staffed and well attended. In general, it was easy for attendees to move from one area of the event to the other. The images below reflect a sampling of the *Making Stuff* events we observed.

Image 1

University of Florida Engineering Week: this section of the room was designated for WUFT and the Making Stuff outreach.

Image 2

Yale University Public Lecture: Making Stuff demonstration and activity tables were set up in a contained space throughout the hallway prior to the lecture.

Image 3

Discovery Place, Charlotte, NC: Demonstration and Activity Tables were set up throughout the museum.

Boonshoft Museum, Dayton, OH: Demonstration and Activity Tables were set up in a large reception room in the front of the museum.

GRG observed that at every outreach event, attendees were participating, listening, watching and interacting with *Making Stuff* activities. Overall, participants were engaged with the materials, science professionals, and content presented at the events. Volunteers engaged visitors as they walked by the different activity tables and visitors stayed at each table for several minutes. During larger group demonstrations, visitors watched with interest and asked and answered questions. Presenters also interacted with participants and kept them engaged in the content by asking and answering questions and using creative analogies.

SCIENCE-RELATED BEHAVIORS AFTER ENGAGING WITH *MAKING STUFF*

Viewing *Making Stuff* episodes led to discussions with others and interest in learning more about materials science topics.

During or after watching the mini-series, a large majority of viewing study participants discussed materials science topics with friends, family, or colleagues (82%), and nearly three quarters (73%) recommended the program to others. Most of those who had not yet done so were planning to. In contrast, half or more of the participants had not, and had no plans to, join one of NOVA's social media offerings (e.g., Facebook or Twitter), or to attend a science related presentation. Shown in Table 8, about one third to one half each had plans to seek out more information about science and materials science via television and the web.

Table 8
Viewing Participants' Science-Seeking Behaviors Since Beginning the Study

	No, and I don't plan to	Not yet, but I plan to	Yes, I did this
Discuss materials science topics with family, friends, or colleagues?	7%	12%	82%
Recommend the NOVA: *Making Stuff* program to others?	11%	16%	73%
Look for more information about materials science topics?	18%	39%	43%
Try to stay up-to-date on cutting edge science topics in general?	8%	54%	38%
Watch science-based television programs more often than in the past?	20%	48%	33%
Visit other websites to learn about a materials science topic?	36%	41%	33%
Read a book about a topic from *Making Stuff*?	55%	36%	9%
Start to follow NOVAonline on Twitter?	62%	30%	8%
Join the NOVA Facebook group?	66%	27%	7%
Participate in PBS' *Making Stuff* contest on Facebook	68%	26%	7%
Attend a Science Café?	70%	23%	7%
Attend a presentation on a science topic other than a Science Café?	65%	29%	6%
Participate in NOVA's "What's This Stuff?" online contest on Facebook?	67%	28%	6%

N=120

Compared to the three months before the study, more viewers had watched, listened to, or read a science-related story or article and attended a local science event or visited an informal science exhibit after watching the full mini-series. See Table 9.

Table 9
Activities Before and After the Viewing Study

	% had done this in 3 months before the study	% had done this since the study began
Talk about a current event in the news with a friend or a family member.	96%	99%
Talked about a current science topic or story with a friend or family member.	80%	96%
Read a science or technology article or blog (in a magazine, newspaper, or on the web).	77%	93%
Visited a library.	76%	85%
Watched a history program on TV.	68%	76%
Watched a science program on the Internet (YouTube, hulu, etc.)	47%	70%
Watched a science program on TV or DVD.	41%	67%
Attended a local music, art or drama performance.	58%	66%
Listened to a science program or story on the radio or podcast.	42%	55%
Visited a science museum, aquarium, ecotarium, or other science exhibit.	28%	39%
Attended any local science activities or events (e.g., science festivals, science cafes, lectures).	11%	24%
Visited a zoo.	16%	23%
Participated in a science, math, or computer group or club.	12%	19%
Led informal science activities for youth or adults.	6%	17%

N=120

Visiting the Making Stuff web pages led to an increase in discussions – online and in-person – about materials science topics and interest in staying up to date about the content.

During or after their review of the *Making Stuff* web pages, the majority of respondents had joined NOVA's Facebook page, discussed materials science topics with family, friends, and colleagues, and had watched more science-based TV programs than they had in the past. More than half also recommended the *Making Stuff* program to others and had made efforts to stay current on materials science topics. In contrast, few respondents planned to follow NOVAonline on Twitter, and nearly half did not plan to seek out and attend a science café. See Table 10.

Table 10
Website Visitors' Science-Seeking Behaviors During or After Viewing

	No, and I don't plan to	Not yet, but I plan to	Yes, I did this
Join NOVA's Facebook page?	20%	10%	70%
Discuss materials science topics with family, friends, or colleagues?	14%	22%	64%
Watch science-based television programs more often than in the past?	17%	16%	64%
Recommend the NOVA *Making Stuff* program to others?	12%	23%	59%
Try to stay up-to-date on materials science topics in general?	12%	25%	57%
Look for more information about *Making Stuff* topics?	20%	33%	46%
Visit other websites to learn about a NOVA *Making Stuff* topic?	27%	30%	37%
Read a book about a topic from NOVA *Making Stuff*?	41%	37%	16%
Attend a presentation on a science topic other than a Science Café?	41%	37%	14%
Start to follow NOVAonline on Twitter?	71%	11%	13%
Attend a Science Café (informal live event, in a casual setting like a coffeehouse or pub that involves a face-to-face conversation with a scientist about current science topics)?	49%	35%	11%

N=84

Participation in the Facebook contest led to reading and watching stories about science and technology and discussing science topics with others.

About a month following the first contest survey, most Facebook contest participants (76%) had watched an episode of *Making Stuff*, compared to 53% at the time the contest survey was administered. Those who viewed it rated the *Making Stuff* mini-series as *very good* or *excellent* (82%). Only 5% of contest participants (i.e., frequent NOVA viewers before the contest) reported that *Making Stuff* was less appealing than the usual NOVA programs.

Since the contest, the overwhelming majority of participants had read an article or blog about science or technology, discussed topics with family and friends, and watched science programs on TV. See Table 11.

Table 11
Activities after Facebook Contest Participation

	% had done this since contest participation
Read a science or technology article or blog (in a magazine, newspaper, or on the web).	96%
Talk about a current event in the news with a friend or a family member.	91%
Talked about a current science topic or story with a friend or family member.	91%
Watched a science program on TV or DVD.	83%
Watched a history program on TV.	77%
Watched a science program on the Internet (YouTube, hulu, etc.)	74%
Visited a library.	73%
Listened to a science program or story on the radio or podcast.	62%
Attended a local music, art or drama performance.	59%
Visited a science museum, aquarium, ecotarium, or other science exhibit.	46%
Attended any local science activities or events (e.g., science festivals, science cafes, lectures).	36%
Led informal science activities for youth or adults.	28%
Participated in a science, math, or computer group or club.	28%
Visited a zoo.	13%

N=122

OUTCOMES OF ENGAGEMENT WITH *MAKING STUFF*

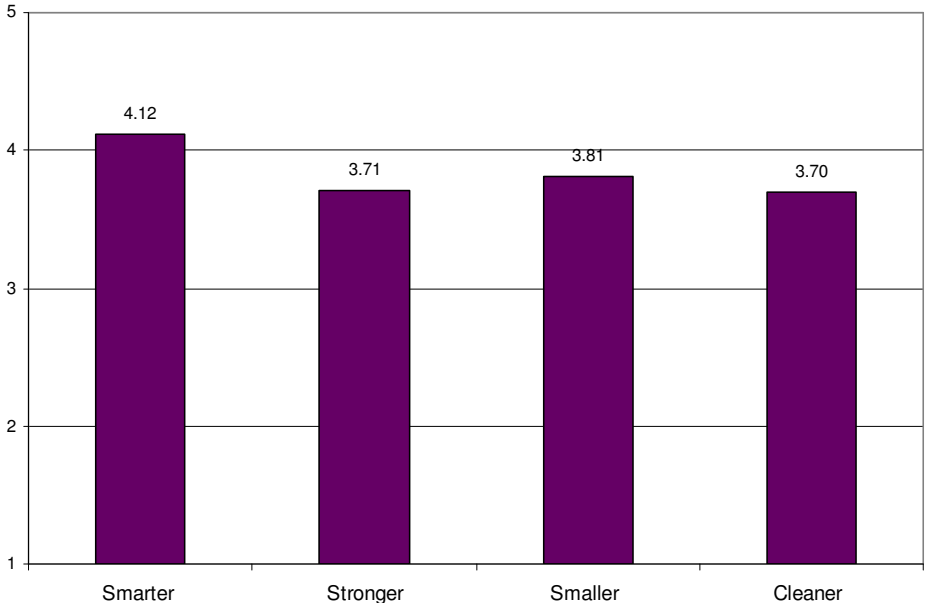
Producers hoped that after engaging with *Making Stuff* resources, users would have a greater understanding of what materials can be (e.g., natural or synthetic) and that materials science is all around us in things we use everyday. In this section, we summarize learning outcomes of the various project components. Most outcomes revealed no significant differences between gender, age, or ethnicity. Where differences were revealed at a statistically significant level, they are described.

Each episode had information that was new to viewers. Moreover, they perceived significantly higher understanding of materials science content after viewing.

Viewers of the full mini-series reported increased understanding of materials science content and found the program, by and large, interesting and engaging.

All four episodes presented information that was new to participants in the viewing study. After viewing each episode, participants rated the extent to which the content was new to them using a scale from 1 (*None of it*) to 5 (*All of it*). Figure 2 shows average ratings; *Smarter* presented the most new information to viewers.

Figure 2
How Much Content was New to Viewers



N=120
Scale: 1 (*None of it was new to me*) to 5 (*All of it was new to me*)

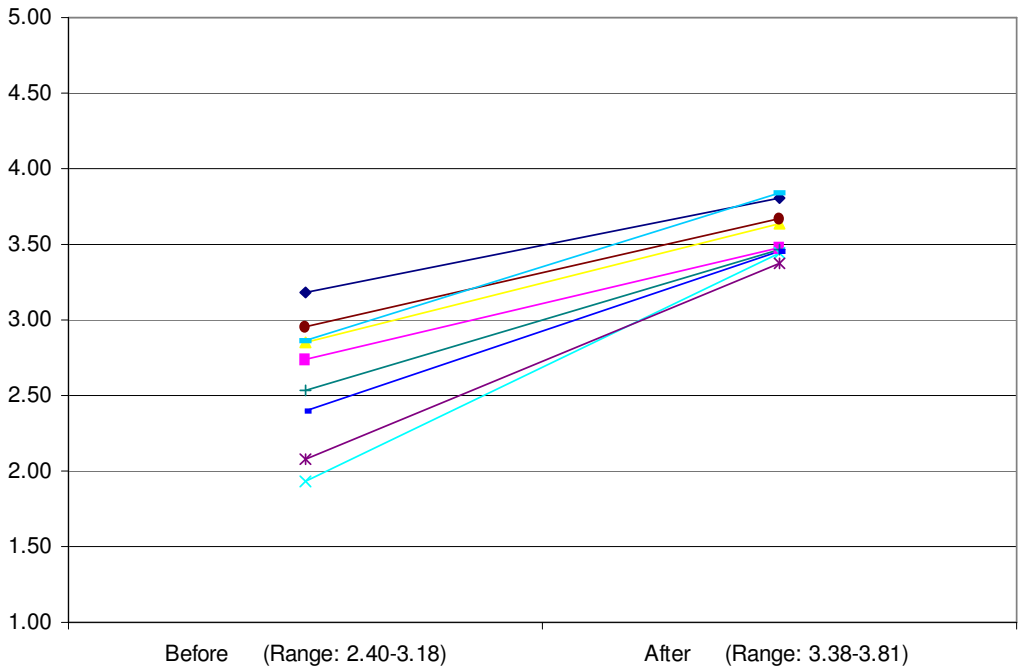
Before viewing, participants reported *a little* to *some* understanding of the various topics presented in the mini-series. Average ratings were between 2 and 3 on a scale from 1 (*I don't understand it at all*) to 5 (*I understand it extremely well*). After viewing, average ratings increased and were between 3 and 4 (I understand it *somewhat* to *very well*). Table 12 and Figure 3 show the statistically significant increase in ratings on all items.

Table 12
Understanding of Materials Science Content Before and After Viewing

How well do you understand:	**Mean (1-5)**	
	Before Viewing	**After viewing**
what it means for a material to be "strong"?	3.18	3.81
what the strongest material is?	2.74	3.48
what nanotechnology is?	2.85	3.64
the uses for carbon nanotubes?	1.93	3.44
why carbon and silicon are used in nanotechnology?	2.08	3.37
clean energy sources such as hydrogen, bio-based fuels, and solar energy?	2.96	3.67
clean ways of storing and distributing energy?	2.53	3.47
materials that can react to their environment, change, or learn?	2.40	3.45
how nature can inform and inspire man-made materials?	2.86	3.84

N=120

Figure 3
Viewers' Understanding of Materials Science Content Before and After Viewing



N=120

Additionally, participants reflected back after viewing, rating how well they understood these topics before they viewed the four episodes. This retrospective pre-test line of questioning is a research technique that is considered useful when participants are likely to overestimate their knowledge before exposure to a topic. In this case, analyses indicated that participants had overestimated their knowledge before viewing for the following topics:

- What it means for a material to be "strong"
- What the strongest material is
- What nanotechnology is
- Clean energy sources such as hydrogen, bio-based fuels, and solar energy
- How nature can inform and inspire man-made materials

After viewing all four episodes, viewers perceived they learned a lot from the series overall, with an average rating of 5.73 out of a possible 7 (*I learned a great deal*). Shown in Table 13, each episode received strong average rating, close to 4 on a scale of 1 (*Poor*) to 5 (*Excellent*). The mini-series overall was rated highest; average was 4.30 out of 5.

The series overall was received very well by viewers, with strong ratings for each episode and high interest in the mini-series overall.

Table 13
Program Ratings

	Average Rating (Scale: 1-5)
Smarter	4.08
Stronger	3.81
Smaller	3.98
Cleaner	3.89
Mini-series Overall	**4.30**

N=120
Scale: 1 (Poor) to 5 (Excellent)

Viewers reported that the stories in each episode were interesting and they had high interest in the mini-series overall, with an average rating of 6.08 out of a possible 7 (*Extremely interesting*). Compared to the typical NOVA programs, the majority of viewers found *Making Stuff* to be more appealing (59%) or about the same (27%). Those who found *Making Stuff* to be more appealing than typical NOVA programs (n=71) were "occasional" to "frequent" NOVA viewers and they described that what made *Making Stuff* more appealing to them was the host, the humor, and the way the information was presented.

For a majority of viewing participants, no one episode stood out more than others as most interesting. Relatively more viewers selected *Stronger* (33%) and fewer selected *Cleaner* (15%); *Smarter* and *Smaller* were each selected by 26%. In explanation of why an episode stood out, the largest proportion of responses were about the real-life applications that made the information "*accessible and relevant"* and "*juxtaposed real world answers with scientific ones."* Some examples of these real-life applications included:

- Environmental applications: Episodes stood out, "*because of the importance of materials toward the environment."* The stories were considered very timely with respect to *"today's energy crisis and rising oil prices."* One viewer explained, "*I care about my impact on the environment, so learning about ways to lessen that impact are important to me."*

- Medical applications: Particularly related to the nanotechnology content, viewers listed the "*medical uses of small technology"* and the value with respect to various "*health-related materials."*

- Military applications: Specifically with respect to the strength of Kevlar, a handful of viewers referred to their own interest and/or past experience with the military and noted the value of Kevlar in the equipment, as well as importance of "*inventions such as self-sealing gas tanks."*

Some viewers preferred a particular episode most because of specific parts that were most compelling to them. For instance, one viewer noted, "*I liked when he stood on the seashell at the beach. That portion made a great impact on me."* Another described a segment that their four year old son enjoyed, "*He loved the aircraft carrier and car crash. He would rewind and watch this over and over."*

A few noted that the topic, in general, was interesting to them. In particular, several described their fascination with nanotechnology that is both smaller and smarter.

> "*I think microscopic technology that is also smart is a fascinating concept."*
>
> *"The idea that the properties of materials could be exploited to replace mechanical structures at a nano-scale was really fascinating."*
>
> *"It was amazing how technology these days are made with little tiny storage cells that 10 years ago could barely fit in the items they were used for."*

Several viewers preferred an episode that they "*learned the most from,"* found the most interesting, or that they already "*have fascination with"* based on their own background and experiences.

> *"I really like the idea of biomimicry. For me those are the parts that stuck in my mind the most because I can identify more with animals."*
>
> *"It seems like this episode had some of the most awe-inspiring stuff in it, things that boggled the mind, like the artificial gecko feet."*

Viewing study participants were satisfied with David Pogue as host of the mini-series.

The majority of viewing study participants (92%) reported that David Pogue made the series at least a little more engaging for them; 50% reported he made the series "*a lot more*" engaging. They felt Pogue was on the screen "just the right amount" of time (81%) and the level of scientific explanation he provided was "just right" (84%). Very few felt he was on screen "too much" (12%) or that his scientific explanations were "too low level" (10%).

The animation graphics made the content "easier to understand" for more than half (58%) and did not affect understanding for 39%. Very few (3%) felt the animation made the content confusing.

Viewers perceived the mini-series effectively motivated their interest in science, particularly current events, and inspired them to want to learn more. Shown in Table 14 below, they were more motivated to seek out more information and relatively less inclined to think differently about what it means to be a scientist.

Table 14
Effects of *Making Stuff*

	Mean (1-5)
Increasing your motivation to learn more about current events in science	3.44
Increasing your interest in science	3.37
Increasing the extent to which you seek out science-related learning experiences	3.20
Expanding your perspective of what it means to be a scientist	3.15

N=120
Scale: 1 (Not at all) to 5 (Extremely)

Website visitors found the *Making Stuff* web resources, which reflected all of the new NOVA web feature formats, to be quite informative and appealing.

Nearly all Website survey respondents (92%) would likely recommend the NOVA website to others, and 59% had already recommended the *Making Stuff* program to others. Respondents found the resources on the *Making Stuff* pages to be both informative and appealing; in fact, across all resources, there were no differences in ratings on these two attributes. Video clips and articles were rated relatively higher than other offerings on the site, while blog posts and the Facebook contest were rated relatively lower, for both attributes. See Table 15.

Table 15
Ratings of the *Making Stuff* Web Pages and Features

	Mean (1-7)	
	Informative	**Appealing**
Making Stuff: Smaller (program video)	5.81	5.83
Making Stuff: Smarter (program video)	5.75	5.78
Making Stuff: Stronger (program video)	5.81	5.76
The Art of Nanotech (slide show)	5.67	5.72
The World's Strongest Stuff (article)	5.49	5.69
Materials That Changed History (article)	5.80	5.67
Making Stuff: Cleaner (program video)	5.70	5.64
Nature's Super-Materials (slide show)	5.54	5.58
Chemical Bonds Quiz (quiz)	5.47	5.60
Series Overview	5.66	5.55
The Stuff of Smart Phones (interactive)	5.53	5.48
The Dangers of Nanotech (audio story)	5.60	5.49
Taking the Heat (video short)	5.32	5.38
What's This Stuff (Facebook contest)	4.80	5.00
Inside NOVA: Adventures in *Making Stuff* (blog posts)	4.77	4.73

N=78

Scale: 1 (Not at all appealing/informative) to 7 (Extremely appealing/informative).

Facebook contest participants found the contest engaging and they appreciated the challenge of decoding clues for each material.

Over half of participants had never entered a contest such as this before. Of the contestants who had (n=243), 64% reported that the " 'What's this Stuff?' asks David Pogue" contest was more engaging than others like it. On a scale of 1 (*I did not enjoy it at all*) to 5 (*I enjoyed it quite a bit*), two-thirds of participants rated the contest either 4 or 5, demonstrating their satisfaction with the overall experience. Most participants liked the challenge of the contest clues and the race against the clock to figure out the correct answer. The one piece of constructive criticism stated by participants was that they wanted to be made aware of when clues would be announced in order to level the playing field.

Outreach events were well-equipped with resources that engaged attendees, helping them learn about materials science and how it affects our daily lives.

Partners' Perspective:

On average, partner respondents felt the overall outreach campaign met or exceeded their expectations; average rating was 4.05 out of a possible 5 (*Exceeded my expectations*). In explanation of their ratings, most mentioned how pleased they were with the "*supplied activities"* and resources provided for the events: "*The materials in the activity guides and toolkits were fantastic!"* Others attributed their positive experiences to working with partners and "*connecting*

with local organizations to plan events." One partner noted that "*had we a less wonderful [PBS] station, it would never have worked."*

Collaborating partners were quite satisfied with the resources and materials provided. A few were dissatisfied with delays in timing and gaps in communication.

Those who reported expectations not being fully met cited delays in timing and gaps in communication with organizers and staff at WGBH. For example, "*We received supplies and funding last minute and didn't receive a lot of feedback from the organizers."* A couple noted they had expected to receive more demos and access to the full *Making Stuff* series. Without access, partners "*found it difficult to make connections to the program after it had already aired."*

Attendees' Perspective:

Eighty-six percent of the over 800 outreach event attendees rated the overall event as either *Good* or *Very Good* and 92% enjoyed the events *Quite a Bit* or *A Great Deal*. The top three words used to describe the event were "*fun*" (N=294), "*interesting*" (N=266), and "*informative*" (N=162).

Attendees also reported that the events made science learning fun and enjoyable (4.21 out of 5) and helped them learn something new about materials science (4.06 out of 5), while also helping them see its everyday relevance. Shown in Table 16, attendees rated all of the listed potential outcomes similarly; ratings for each item were positively correlated with one another. For example, the more they perceived they saw how materials science impacts their lives, the more they also perceived they learned something new.

Table 16
Event Attendees' Perceived Outcomes

	Mean (1-5)
Make science-learning fun and enjoyable?	4.21
Help you learn something new about materials science?	4.06
Help you see how materials science impacts your everyday life?	3.90
Increase your awareness of the *Making Stuff* NOVA mini series?	3.86
Encourage you to seek out more information about materials science?	3.84
Increase your curiosity about materials science?	3.83

N=792-807
Scale: 1 (Not at all) to 5 (Extremely)

The most interesting or surprising things attendees learned at the *Making Stuff* outreach events were specific scientific facts that were presented. Examples were:

- *Certain types of magnets can cause other substances to float.*
- *Hydrogen is a by-product of chlorine.*
- *Cotton is not very strong.*
- *Robots can be made with no internal parts.*

Event attendees also commented on the experience of interacting with science professionals during and after their presentations, and described what they enjoyed most from the experience.

- *Interacted with the professors.*
- *Great connections between research and real world applications.*
- *I liked the demos.*
- *Watching my children experience science.*

APPRECIATION FOR SCIENCE AND SCIENTISTS

Viewers' already strong appreciation for ways in which current science research touches their lives was sustained after viewing the full mini-series.

At the beginning of the research, viewing study participants already felt strongly about the importance and relevance of science research, leaving little room for change after engaging with *Making Stuff* over the course of the study. As shown in Table 17, for example, participants already believed in the ways in which science can help people understand things that affect their health and their body. Their belief ratings remained consistent six to eight weeks later.

Table 17
Beliefs about Science and Science Research: Before and After Viewing Study

	Mean Rating (Scale: 1-5)	
	Before	**After**
Collecting evidence is an important part of making a decision.	4.40	4.30
Learning science can help me understand about things that affect people's health.	4.20	4.18
Science can help me to make better choices about various things in my life (e.g., food to eat, car to buy).	4.23	4.18
Science helps me to make decisions that could affect my body.	4.03	4.03
Science helps me to make sensible decisions.	3.68	3.78
Learning science enables me to explain my thoughts better to others.	3.68	3.67
Making decisions can be difficult without reliable science.	3.54	3.66
Much of what I learn about science research is useful in everyday life today.	3.29	3.43

N=120
Scale: 1 (Not at all true) to 5 (Completely True)

In addition, there was already strong agreement with statements about how science and technology influence and benefit society, with no significant change in attitudes after viewing the four episodes of *Making Stuff*. Before and after

viewing, participants agreed on the need for science and technology for innovation, to make life easier, and to create more opportunities (See Table 18).

Table 18
Beliefs about how Science and Technology Influence Society

	Mean Rating (Scale: 1-5)	
	Before	**After**
A country needs science and technology to innovate and compete in our global economy.	4.76	4.75
Science and technology make our lives healthier, easier, and more comfortable.	4.58	4.49
Thanks to science and technology, there will be greater opportunities for future generations.	4.50	4.41
Scientific theories develop and change all the time.	4.35	4.39
New technologies will make work more interesting.	4.37	4.33
The benefits of science are greater than the harmful effects it could have.	4.03	4.11

N=120
Scale: 1 (Strongly Disagree) to 5 (Strongly Agree)

Participants in the viewing study also showed stability over time in their perceptions of the reliability of various sources of science-related information. For example, both before and after the study, participants tended to accept information as true *most of the time* when it came from TV documentaries about science and from informal science institutions such as museums or science centers. However, as shown in Table 19, participants' perceived reliability of some sources decreased significantly after they viewed the four *Making Stuff* episodes. In particular, after the study, they perceived information as less reliable when it came from TV news, friends, and family. This may reflect a tendency to be more critical viewer of science information after viewing.

Table 19
Perceived Reliability of Sources of Science-Related Information

When you learn about science content or information from each of the following places, how often do you accept the information as true?	Average Rating (Scale: 1-4)	
	Before	After
From a TV documentary about science?	2.85	2.83
From informal science institutions, such as museums or science centers?	3.13	2.82
From science leaders?[a]	--	2.74
From lecturers or presenters?	2.73	2.64
From print: magazine?	2.67	2.58
From the internet?	2.53	2.50
From teachers?	2.63	2.50
From print: newspaper?	2.57	2.49
From TV news? *	2.41	2.30
From colleagues?	2.29	2.20
From friends?*	2.20	2.11
From family?*	2.25	2.05
From a TV drama about science (e.g., a series about doctors)?	1.78	1.81

N=120

Scale: Accept the information as true: 1 (None of the time) to 4 (All of the time)

* p <.05

[a] Item not asked on pre-survey.

Outreach participants perceived that event attendees were engaged with materials science and learned about the effects on our daily lives.

Partner respondents described and commented on three key events. (See Appendix A for the full list of event titles and descriptions provided.) They perceived their events to be successful in achieving several goals of the outreach campaign overall, with the highest ratings given for the extent that attendees were **engaged in materials science**, as shown in Table 20.

While all ratings are very high, they indicate some discrimination among the events described and what those events included. For example, the first events partners described had relatively higher ratings for the extent attendees had opportunities to interact with materials, and most partners had reported that their first events included demonstrations and hands-on activities. In contrast, the third events they described included more opportunities to interact with scientist and engineers and fewer demonstrations; partners perceived more success with these events in terms of attendees learning that materials science is all around us in the things we use every day.

Table 20
Perceived Success of Three Key Events

	Mean (1-5)		
	Event 1	**Event 2**	**Event 3**
Engaged attendees in materials science	4.75	4.68	4.69
Provided attendees opportunities to interact with materials	4.59	4.17	4.56
Helped attendees learn that materials science is all around us, in the things we use every day	4.45	4.47	4.80
Helped attendees learn that materials can be natural or synthetic	4.10	4.42	4.46
Provided attendees opportunities to interact with scientists or engineers	4.00	4.56	4.40

N=17-21

Scale: 1 (Not at all successful) to 5 (Extremely successful)

The majority of partners reported that **demonstrations**, **hands-on activities**, and **presenters** were the key to helping attendees feel engaged in materials science. The demonstrations and hands-on activities, for example, "*helped kids get an understanding… and gave them a chance to understand the challenges."* Several partners used the combination of demonstrations and hands-on activities to reach and engage as many visitors as possible.

> *"A hands-on demo allowed each student to make their own nanometer-sized thin film coating on paper to take home with them."*
>
> *"Having both a demonstration for groups [and] an activity that could engage the audience individually worked very well."*
>
> "*Hands-on activities were crucial to maintaining the students' interest and enthusiasm."*

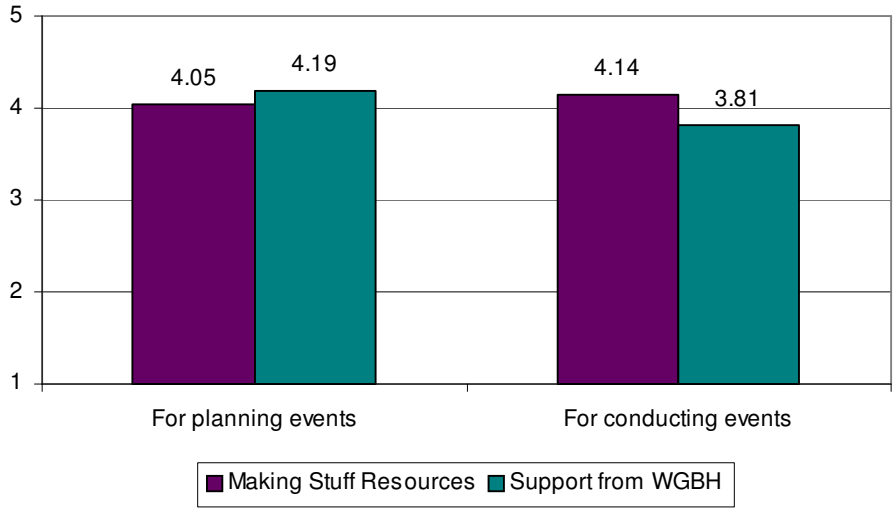
In addition, dynamic presenters who shared real-world applications and connections added to visitors' experiences. One partner described, "*The talks were presented by faculty, people from industry, and one hip-hop/science entertainer."* Others noted that after an interesting presentation, speakers gave visitors a chance to interact with materials. For example, "*Following the presentation, some people got to come up and hold the unique guitars, which was quite a treat for the aficionados"* and "*Following a 15 minute interactive presentation, [speaker] invited visitors to build an actual solar cell. Participants were actively engaged with nanoscience materials."*

COLLABORATION AMONG PROFESSIONALS

Partners felt supported by WGBH staff and the resources as they implemented their outreach events.

Among the support received for their outreach collaborations and events, partners perceived the support from WGBH (including email and phone correspondence, training webinars, and Dropbox.com account) to be more helpful for **planning** events than for conducting events. As would be expected, partners found the *Making Stuff* resources (including Toolkits, video clips, Activity Guides, and flyers) to be more useful when **conducting** their events.

Figure 4
Usefulness of WGBH Support and *Making Stuff* Resources



N=21
Scale: 1(Not at all) to 5 (Extremely)

Partners' perceived their collaboration experiences positively and intended to maintain many of the partnerships.

The key intended outcome for professional audiences was enhanced collaboration among educators, scientists and community-based organizations in their efforts to reach a broad audience through the *Making Stuff* outreach events. On average, each organization partnered with 5 organizations, with a range from 4 to 13 organizations working together in each site. All were very likely to continue collaborating with most of the partners after the *Making Stuff* outreach campaign.

Collaborations employed for this outreach campaign included both existing partnerships that were enhanced through the project (n=16 out of 19 respondents) and new partnerships formed for the project (n=14 out of 19). Two respondents

(not from the same site) reported they re-established an inactive partnership for this outreach campaign.

Partners elaborated, as they described up to five separate partnerships. Shown in Table 21, within each location, some partnerships were current and others were established for the project. For example, among the 20 partners' first partnership they listed, eight were new and 12 were ongoing. Ten partners described a fifth partnership and among those, three were new, six were ongoing, and one had been re-established for this project.

Table 21
Status of Partnerships for the Outreach Campaign

	Partner 1 (n=20)	**Partner 2 (n=20)**	**Partner 3 (n=18)**	**Partner 4 (n=14)**	**Partner 5 (n=10)**
New	8	12	7	4	3
Ongoing	12	7	9	9	6
Re-established for this project	0	1	2	1	1

Respondents described their collaboration experiences with up to five of the organizations with which they partnered. On average, partners reported their partnering organizations were quite active as they implemented their events, relatively more so than in the planning and promoting phases.

Table 22
How Active Partners were Throughout the Outreach Campaign

	Partner 1 (n=20)	**Partner 2 (n=20)**	**Partner 3 (n=19)**	**Partner 4 (n=14)**	**Partner 5 (n=10)**
How **active** was this partner as you implemented your events?	4.45	4.25	4.26	4.60	4.50
How **active** was this partner as you planned your events?	4.20	3.80	3.37	4.13	4.00
How **active** was this partner as you promoted your events?	4.10	3.75	3.67	3.80	3.90

Scale: 1 (Not at all) to 5 (Extremely)

Across the five partners they described, on average, partners felt the roles and responsibilities were very clearly defined, partners had a shared vision of the outreach events, and there was clear communication among the organizations. These are three elements known to be quite valuable to the success of partnerships among organizations in a community. See Table 23.

Table 23
Perceived Success of Partnerships

	Partner 1 (n=20)	Partner 2 (n=20)	Partner 3 (n=19)	Partner 4 (n=15)	Partner 5 (n=10)
To what extent were **roles and responsibilities defined clearly** between this partner and your own organization?	4.65	4.35	4.11	4.60	4.60
To what extent was there **clear communication** between this partner and your own organization?	4.55	4.30	4.16	4.53	4.50
To what extent did this partner **share your vision** for the *Making Stuff* community outreach?	4.42	4.40	4.32	4.33	4.50

Scale: 1 (Not at all) to 5 (Extremely)

Overall, collaborators rated the experience of partnering with various organizations throughout the *Making Stuff* outreach campaign very high, with an average rating of 4.55 out of a possible 5 (*Excellent*). If they had the chance, all but one would be interested in participating in another project of similar scope and content.

CONCLUSIONS AND RECOMMENDATIONS

Based on the data collected in our evaluation of each *Making Stuff* component, GRG concludes the project overall effectively achieved its overall goals and intended impacts on public and professional audiences.

- Through the various project components, the general public engaged with and increased their understanding of materials science and its effect on society.

- Existing collaborations were enhanced and new collaborations were formed among professionals who together reached broad audiences, nationally, with materials science information and demonstrations.

The variety of *Making Stuff* resources afforded different opportunities for a wide range of people nationally to engage with materials science.

- The Facebook contest effectively promoted the program and the website to viewers beyond the typical NOVA viewing audience.

- The TV programs effectively motivated interest and discussion and viewers sought more information through various media.

- The community outreach events effectively attracted a range of people -- including children and adults, men and women, underrepresented minority groups -- and motivated their interest to learn more by watching the program and visiting the web.

- The web pages were appealing and informative and motivated users to seek out further interaction and discussion around materials science.

GRG recommends that WGBH and Materials Research Society (MRS) take advantage of all the resources that have been developed through this project and capitalize on the different entry points that now exist. Because different user groups will start with the resource that is most interesting and accessible to them, project developers will want to ensure there is enough content to keep users engaged as well as to inform them of all the other resources. With the goal of pulling in users (e.g., TV viewers, website visitors, event attendees) and then keeping them involved, developers should focus on making the content easily navigable and sustaining users' interest over time.

Based on the current project, we present the following examples of ways to attract users beyond the regular audience.

- Use of social media for active engagement, similar to the Facebook contest, will increase the range of potential users. A contest or game that specifically encourages participants to enlist the help of others will serve to further expand the project's reach.

- A known personality, such as David Pogue, may attract new audience members for a particular program. For a future program, hosts should be considered based on program topic and intended and expanded audience base. For example, a host with knowledge in one area who shows excitement and enthusiasm for learning about a slightly new area is likely to draw in different group of viewers interested in joining that journey of discovery. Moreover, the host may bring about cross-over – in this case, from *NY Times* readers who were David Pogue followers but not regular NOVA viewers.

- Hosting and promoting the program resources at a variety of different institutions, including formal and informal learning organizations, will increase the range of community members likely to participate. Community events then provide a good opportunity to raise awareness of other resources and to encourage attendees to share the information with others. For instance, specifically promoting the television series more strongly at community events, by showing clips from each episode, could lead to increased interest and use of other project components. As another example, sample web pages could be projected and/or on computers for attendees to use.

A personality-driven programming format can interest and inform viewers outside of a series' typical viewing audience.

A wide range of viewers were drawn to the *Making Stuff* mini-series because of the various promotion methods, including David Pogue and the cutting-edge visual style of clips shown on TV, online, and via social media. Once engaged, all viewers were interested in the content and felt they learned new information about materials science.

Additionally, viewers were motivated to learn more. They visited the website, engaged in discussions with friends and family about the topics, and watched more NOVA and NOVA scienceNOW programming during and after participation in the evaluation than they had prior to the study.

Current social media networking platforms allow for promotion to a growing audience base, with the possibility for viral exposure.

The "What's this stuff? Asks David Pogue" Facebook contest attracted thousands of participants in the first week, with more joining each day.

> ***GRG recommends*** that, going forward, an online contest should reflect some modifications to the current model, based on user feedback. The organizational structure should parallel the medium on which it is placed. For example, the format for the "What's this Stuff?" Facebook contest was not all on one page; users clicked on and "Liked" different pages for each material, matching typical Facebook usage patterns. However, care

should be taken to avoid making the game too cumbersome to the point that users may opt out.

Additionally, use of social networking media should reflect current trends so as to ensure the largest potential user base. In the current evaluation, more participants used Facebook than Twitter; in the future, research into the most popular social media may suggest a different or additional platform (e.g., Google +).

Highly appealing and informative, *Making Stuff* program components did not produce significant change in users' already positive attitudes about the effect that materials science has on our daily lives.

Attitudes are notoriously difficult to change and typically a short-term intervention is not enough to cause a notable shift. In this case, even without a deep understanding of exactly how materials may be affecting society before viewing, *Making Stuff* users already appreciated the value of science and technology innovation.

GRG recommends that if producers have a goal of significantly changing attitudes, then popular misconceptions should be identified and addressed in a very concrete manner. Similar to the *Mythbuster* format, producers can state a common misconception about a topic and then walk users through the process of understanding the reality of that content.

GRG recommends another approach to modifying attitudes would be to create a larger and longer-term intervention; a wide-scale community event could engage a wider range of the public. For instance, promote and hold a community experience where residents are encouraged to watch a program in their homes, with friends, or at few centralized locations in the community (i.e., a common point of entry). Hold discussions leading up to and following the viewing. Implement family activities such as festivals that continue the interactions and learning over time.

Web pages created specifically for *Making Stuff* are on par with the overall NOVA website.

Web visitors were directed to the *Making Stuff* pages deliberately, as the new format of the NOVA website organizes information by topic rather than by program. They were quite satisfied with the information and the various presentation formats, and they were motivated to seek out further interaction and discussion with the topics.

GRG recommends producers put deliberate thought and planning into promotion of the web site. Regular, long term visitors may see changes to the NOVA site but not realize the reasons WGBH has made deliberate changes. The NOVA web team should consider the following:

- Highlight the different types of features (Text, Video, Multimedia, Audio), that now comprise the website and describe what is included in each section and the reasons it is new and different.
- Encourage current and prospective website visitors to explore the new features. Add tie-ins to encourage back and forth use of the all *Making Stuff* resources.

The national outreach collaboration model resulted in elements that are key to successful community partnerships; roles and responsibilities were clearly defined, partners had a shared vision, and there was clear communication between the organizations.

Despite noted delays and communication gaps during the outreach campaign, both new and existing partnerships were strong; moreover, the data suggest they will be sustained over time. Partners expressed interest in continuing to work together to engage members of their communities in future events.

GRG recommends several logistical changes to any future national outreach planning. These changes would likely enhance everyone's experience, from partners to event staff and volunteers to event attendees.

- Develop a clear planning guide for community partners to use during the planning process.
- Provide clear expectations for the timing of trainings, delivery of materials, and the period during which all community events should occur.
- Provide a complete list that describes exactly what is required including tasks, timing, and any deliverables.
- Use these guidelines for applicants to describe how and what they will do if selected for funding.
- Require consistent wording for titles, descriptions, and intended outcomes to increase cohesiveness of the initiative nationally.
- Require applicants to provide complete and consistent contact information including dates, names and types of event(s) planned.
- If any amendments need to be made during the outreach, require selected sites to complete forms indicating the changes and reasons for change.
- If any changes occur, inform all selected partners of what the change is, how it might affect the remaining requirements, and what the change means to their site.
- Provide access for all partners to an electronic platform where they can update their planned events and give feedback about them immediately after they happen. Some recommended sites are Google Calendar, Ning, and Central Desktop.

Inclusion of a wide variety of types of collaborating organizations helps to attract a broad range of participants within and across communities.

Making Stuff outreach events attracted families with young children as well as school groups, educators, and scientists. Participants across a range of background experiences and science knowledge were engaged, learned new information, and had fun in the process.

> ***GRG recommends*** including specific materials to inform attendees about the myriad other resources available and tips and strategies for sharing the information with others.

In summary, overall, the combination of electronic and in-person resources and events created for the *Making Stuff* project effectively engaged professionals and the general public while raising awareness of the omnipresence of materials science. WGBH was successful in the creating of a wide scale outreach campaign that drew in community members who were enthusiastic and interested in learning more about the field.

APPENDIX

Appendix A: Annotated surveys with all responses included

Appendix B: Demographic profiles of participants in each evaluation component

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