NISE network™
NANOSCALE INFORMAL SCIENCE EDUCATION

NISE Net Public Impacts Summative Evaluation

Pilot Nanoawareness Study, Year 4 Report

By Brett Kiser and Marcie Benne

August 26, 2009

Acknowledgements

Thank you to the employees and volunteers of the four participating NISE Network institutions and their partner organizations for hosting NanoDays, collecting e-mail addresses, and completing questionnaires for this study: Discovery Center Museum, McWane Science Center, Saint Louis Science Center, and ScienceWorks Hands-On Museum. And thank you to the hundreds of visitors who participated in this study. We would also like to thank *Data Squad* members Brandon Lane – for his review of the statistics and numbers in this report, and Rochelle Henninger – for her thoughtful review and critique of this entire report.

This report was based on work supported by the National Science Foundation under Grant No. ESI-0532536. Any opinions, findings, and conclusions or recommendations expressed in this report are those of the authors and do not necessarily reflect the views of the Foundation.

Marcie Benne, PhD
Oregon Museum of Science and Industry
1945 SE Water Avenue
Portland, Oregon 97214
mbenne@omsi.edu
503.797.4612

Table of Contents

NISE Network Summative Evaluation

Executive Summary

Nanoawareness Year 4 pilot study
Summary of findings

The Nanoawareness Study is designed to answer the question *What, if any, impact do NISE Net activities delivered at Tier 1 and Tier 2 institutions have on the nanoawareness of the public audiences that experience those activities?* The Nanoawareness Study was initially conducted in Year 3 and then replicated in Year 4 with some methodological changes and a different sample of participants. The plan is to replicate the study in Year 5. The following report describes the Nanoawareness Study findings from Year 4 in comparison to findings from Year 3.

While the Year 3 and Year 4 nanoawareness studies had some differences in methodology, the instrument and design were very similar. The instrument was an online survey with a Treatment Group (visitors exposed to NISE Net activities) and a Control Group (a comparable audience not exposed to NISE Net activities). An obvious difference between the Year 3 and Year 4 studies was that Year 3 participants were sampled from four Tier 1 institutions and Year 4 participants were sampled from four Tier 2 institutions. Also, in Year 3, Treatment Group participants were recruited from NISE Net activities that occurred before, during, and after NanoDays. In Year 4, Treatment Group participants were recruited from activities that occurred during NanoDays only. Other important differences related to survey design and implementation are meaningful for the interpretation of results and they are described in the full report.

The Year 3 and Year 4 online survey results were different. In Year 3, the survey results suggested that a significantly higher proportion of the Treatment Group had greater awareness of *nanotechnology* and nanotechnology *applications*, *risks*, and *benefits* than the Control Group. In Year 4, the same survey questions resulted in fewer significant differences between Treatment and Control Groups. The only similarity to Year 3 is that the Year 4 survey results suggested that a significantly higher proportion of the Treatment Group had greater awareness of nanotechnology *benefits*. The Year 4 results revealed no significant differences between the percentage of Treatment and Control Group participants with regard to their awareness of nanotechnology in general or applications and risks of nanotechnology.

We explored whether the differences in findings across years were the result of differences in survey design, history effect, sample size, or treatment. Our exploration suggests the sample size was a major factor in the failure to detect significant differences between the percentage of Treatment and Control Group participants on several of the items indicating nanoawareness. That is, the sample size in Year 3 supported an 80% chance of detecting a *small*, *medium*, or *large* difference between the percentage of Treatment and Control Group responses; however the sample size in Year 4 supported an 80% chance of detecting only a *medium* or *large* difference in percentages (the chance of detecting a small difference in percentages in Year 4 was less than 30%). This suggests that an effect did exist, but it was small according to industry standards and the larger Year 3 sample had the power to detect the small effect.

Our close inspection of sample size, effect size, and power to detect effect sizes suggested that, as a group, the NISE Net activities were able to increase the percentage of the public that report

indications of nanoawareness, although that increase was small and the potential for an even greater percentage increase remained. For this reason, we reviewed some of the factors that NISE Net could manipulate to possibly increase the percentage of the public positively influenced by the NISE Net activities (that is, increase the size of the effect – which in this case represents extent of reach). Our review suggests that the relationship between activities provided and the messages within the activities, and the relationship between exposure to activities and the results on survey items (indicators of influence) are meaningful to consider when planning nanoawareness treatments. Given these meaningful relationships, NISE Net leaders could help partners understand how to create and plan activities and experiences with greater influence, greater reach.

Post-NanoDays pilot study

Summary of findings

In order to explore the persistence of any NanoDays influence (about two months after attending the event) we conducted a pilot study using a phone interview method (Appendix A). We spoke with visitors about their exposure to nanotechnology information since NanoDays, their confidence talking about nanotechnology since NanoDays, whether they talked to anyone about their experience with NanoDays, and if, in retrospect, they felt like their experience at NanoDays had any lasting impression on their lives.

This was a pilot study with a sample of fifteen visitors who acknowledged they had engaged with nanotechnology activities at the museum, reported increased awareness as a result of that experience, and volunteered to participate in the phone interview. At least for this select group, the pilot results suggest that the NanoDays influence was still present when we contacted them about two months later. That is, as a group, the majority of these respondents reported that their confidence talking about nanotechnology had increased since NanoDays, they talked to others about their experience with nanotechnology or NanoDays (primarily about applications or the museum), and they felt their experience at NanoDays had a lasting impression on their lives (primarily looking for applications). These influences persisted, even though they did not, as a group, see much information about nanotechnology through other media such as news, TV, or internet, since their visit to NanoDays.

NISE Network summative evaluation
Nanoawareness Year 4 pilot study

Part 1 Nanoawareness Year 4 pilot study methods

NISE Net leadership has stated a primary goal to "increase awareness of nanoscale science, engineering and technology and its multiple, potential benefits and impacts on lives and communities." We refer to this awareness as "nanoawareness." The nanoawareness study looks directly at the impact of NISE Net on public nanoawareness across multiple museum sites, including both Tier 1 and Tier 2 institutions. The question driving this study is: *What, if any, impact do NISE Net activities delivered at Tier 1 and Tier 2 institutions have on the nanoawareness of the public audiences that experience those programs?*

The nanoawareness study is a three-year progression of work. The Year 3 pilot study (2008) and the Year 4 pilot study (2009) combine to inform the design and interpretation of the Year 5 study (2010). This report describes the Year 4 study in comparison to the Year 3 study.

Methods

Year 3 methods

In Year 3 Multimedia Research conducted a study of public nanoawareness at four Tier 1 institutions to determine if visitors exposed to activities developed and delivered by NISE Net institutions had greater nanoawareness than visitors not exposed to NISE Net activities. During the Year 3 study, nanoawareness was examined at: Museum of Science Boston, North Carolina Museum of Life and Science, Oregon Museum of Science and Industry, and the Science Museum of Minnesota (see Table 1). These museums were a convenience sample of the 14 Tier 1 institutions that existed during Year 3.

The Year 3 study compared the nanoawareness of museum visitors exposed to a NISE Net deliverable between February and May 2008, to the nanoawareness of museum members who were not exposed. Both visitors and members were e-mailed a link to an online questionnaire that contained items designed to capture the level and content of nanoawareness among respondents. The following items representing nanoawareness had corresponding items within the online questionnaire:

1. Self-reported awareness of the term "nanotechnology"
2. Unaided "top of the mind" verbal associations
3. Breadth of nanotechnology information sources
4. Awareness of applications of nanotechnology
5. Awareness of benefits
6. Awareness of risks
7. Awareness of or participation in nano-topic activities
8. Self-reported changes in awareness from nano-topic activities

For an in-depth description of Year 3 methods, refer to the Flagg and Knight-Williams (2008) final report, which is available for review on nisenet.org, in the catalogue, within the research and evaluation section.

Year 4 methods

In Year 4 the Oregon Museum of Science and Industry conducted a pilot study of public nanoawareness at four Tier 2 institutions for the same purpose as in Year 3, to determine if visitors exposed to activities developed and delivered by NISE Net institutions had greater nanoawareness than visitors not exposed to NISE Net activities. In Year 4, a decision was made to specifically sample Treatment Group visitors from those exposed to NanoDays activities. This decision was made based on the understanding that the majority of NISE Net activities are delivered during NanoDays.

Selection of Year 4 participating institutions

In Year 4, the objective was to sample from Tier 2 institutions in order to study the influence of NISE Net in institutions beyond those most highly involved in the network (Tier 1). Four Tier 2 institutions were selected as a convenience sample from the same four regions as the four Tier 1 institutions that participated in the Year 3 study (Northeast, West, Southeast, and Midwest). To aid in the process of choosing four Tier 2 institutions, the four regional node leaders were contacted and asked to provide a short list of science museums they felt would be good candidates (a science museum with staff members who demonstrated active interest in NISE Net by attending a workshop, communicating with the node leader, and providing public programs).

Once a rank-order short list of institutions was formed, the evaluators started at the top of the list and called the primary NISE Net contact for each institution. The contact was asked: 1) if they were conducting NanoDays this year; and 2) if they would be willing to collect e-mail addresses during two different time periods (175 e-mails prior to NanoDays and 175 e-mails during NanoDays). Institutions were called starting at the top of the list, then moving down the list until an institution agreed to collect e-mails.

During the Year 4 study, nanoawareness was examined at: Discovery Center Museum; McWane Science Center; ScienceWorks Hands-On Museum; and Saint Louis Science Center. These four museums represent a small convenience sample (2%) of the approximately 200 institutions that received a NanoDays Kit and held NanoDays events.

The first four columns of Table 2 contain the Tier 2 museums' NISE Net region, annual attendance, membership, and the number of NanoDays hosted. For comparison, the first four columns of Table 1 list the same information for the Tier 1 museums selected for the Year 3 study.

Participating individuals

Staff at participating institutions were asked to collect at least 175 e-mails from visitors in each of two groups: 1) the Control Group , adult visitors to their museum during the 3-weeks prior to NanoDays; and 2) the Treatment Group, adult visitors who experienced a NanoDays activity. Staff members who collected e-mails recorded visitors' group type (e.g., family, school group) and the name of the NanoDays activity the visitor attended (if applicable). As an incentive, visitors were told that if they completed the survey, they would be offered a chance to win one of ten (about a 1 in 20 chance) $25 gift certificates to Amazon.com.

The intention was for each institution to collect 175 Control Group emails and 175 Treatment Group emails, however, uncontrollable factors (e.g., limited staff, low visitation) contributed to lower and unequal numbers of e-mails collected. Combined, the four Tier 2 institutions collected 585 Control e-mails and 323 Treatment e-mails. The 323 potential respondents represented a

very small sample (0.1%) of the 350,000+ people believed to have participated in NanoDays during 2009 (refer to 2009 NISE Net Counting Study Report, (Year 4, Study 3)).

On April 24, 2009, the first e-mail solicitation (Appendix B) was sent to every e-mail address collected by all four institutions. Those 908 visitors were e-mailed the online survey, of which 502 Control surveys and 279 Treatment surveys were successfully delivered (after bounces and unsubscribers were subtracted).

Since the initial e-mail database had more Control e-mails, second and third solicitations were sent only to Treatment visitors. Four days after the first solicitation, a second solicitation was sent to Treatment visitors who had not yet completed the online survey. One week after the second solicitation, a third and "final" solicitation was sent to those Treatment visitors that had not yet completed the survey. Data were collected through May 17, 2009.

Of the surveys successfully delivered, 118 Control surveys and 105 Treatment surveys were completed. This resulted in a 24% and 38% response rate, respectively. Gift certificate winners were randomly selected from all eligible respondents (those respondents that offered their name and e-mail to be eligible) and sent a gift card through Amazon.com on July 1, 2009.

The last four columns of Table 2 list the number of e-mails sent, surveys successfully delivered, and surveys completed for each Tier 2 institution in the Year 4 pilot study. For comparison, the last four columns of Table 1 provide the same information for each Tier 1 institution in the Year 3 study. Although the overall number of responses is smaller for the Year 4 study (as planned, because these Tier 2 institutions are generally smaller than the participating Tier 1 institutions), the Year 4 response rate is slightly higher than the Year 3 response rate.

Instrument
All of the NISE Network deliverables were developed under six main ideas: 1) Nano is in many realms and is both everyday and cutting edge; 2) Where will nano go? 3) Nano means working at super small scales to manipulate materials to exhibit new phenomena; 4) It's different down there! 5) Nano is a people story; and 6) Will nano affect you?

While developing the online survey for Year 4, the evaluators worked with the NISE Network NanoDays Kit development team to develop questions that would ask respondents about their awareness and knowledge of four big ideas: Nano is in many realms and is both everyday and cutting edge; Nano means working at super small scales to manipulate materials to exhibit new phenomena; It's different down there; and Will nano affect you?

Ultimately, the online survey used in Year 3 was adapted for Year 4. All of the questions that were asked during the Year 3 study were asked for the Year 4 study and two open-ended questions were added to probe for knowledge of nanoscale and material properties at the nanoscale. The following questions were asked in the survey:

- *How much have you heard about nanotechnology?*
- *Write any thoughts, ideas, emotions, questions, or definitions that you associate with the term "nanotechnology."*
- *In which of the following do you clearly remember reading, seeing, or hearing about nanotechnology.*
- *Please describe, as best you can, the scale (size) of nanotechnology.*
- *Please list any properties that you have heard might be different at the nanoscale.*
- *Are you aware of any benefits or potential benefits of nanotechnology?*

- *Please explain any benefits or potential benefits of nanotechnology.*
- *Are you aware of any risks or potential risks of nanotechnology?*
- *Please explain any risks or potential risks of nanotechnology.*
- *Have you heard of nanotechnology being used in the following applications?*
- *Have you heard about or experienced any of the activities that were offered at the museum during NanoDays?*
- *Did the experience influence your awareness of nanotechnology?*
- *Please describe how the experience influenced your awareness of nanotechnology.*

All of the online survey questions required categorical, qualitative, or ordinal responses. The survey was administered using *SurveyGizmo* and a copy of the survey is available in Appendix C.

Data Analysis
Three kinds of responses were collected: categorical, qualitative, and ordinal. Qualitative responses were analyzed for key words, phrases, and topics. Two evaluation assistants who were blind to respondent type independently coded randomly ordered open-ended responses. Once codes were developed by each coder for each question, the lead evaluator analyzed these codes for consistency and overlapping themes. These themes were deductively collapsed into more descriptive categories for purposes of analysis by the lead evaluator. For the few instances in which the assistants' codes did not agree, the lead evaluator further analyzed the responses to decide the appropriate category. Thus, two kinds of data were quantitatively analyzed or discussed as descriptives: categorical and ordinal.

Where appropriate, categorical comparisons were made using non-parametric chi-square tests to determine if differences between the percentage of Treatment Group respondents and Control Group respondents were statistically significant (note: in the report, categorical responses are reported as rounded percents so totals may not always sum to 100%). Ordinal data were analyzed using an independent t-test of significance. For both the chi-square and the t-tests, items were considered significant if the p-value was less than 0.05 and statistics are reported when this is the case.

Demographics of respondents
Demographics of both Control and Treatment Group respondents are presented in Appendix D (age, membership status, gender, education, ethnicity, race, and presence of a permanent or temporary disability). Chi-square tests revealed no significant differences between the Year 4 Treatment and Control Groups on any of these categories. Chi-square tests revealed significant differences between Year 3 Control Group respondents and Year 4 Control Group respondents on these categories: Year 3 Control respondents were more likely to be younger, while Year 4 Control respondents reported higher education levels. Chi-square tests also revealed significant differences between Year 3 Treatment Group respondents and Year 4 Treatment Group respondents on these categories: Year 3 Treatment respondents were more likely to be Asian or Black; Year 4 Treatment respondents were more likely to be females and have reported higher education levels.

Congruent with expectations, when *Control* Group participants were asked whether or not they had heard about or experienced NanoDays or nanotechnology-related activities offered at the museum, zero reported they had experienced nanotechnology-related activities and only 12% reported they had heard about nanotechnology-related activities.

Counter to expectations, when *Treatment* Group participants were asked whether or not they had heard about or experienced NanoDays or nanotechnology-related activities offered at the

museum, only 48% reported they had experienced the nanotechnology-related activities and only another 25% of respondents reported they had heard about the nanotechnology-related activities at the museum (for a total of 73%). This is important because Treatment Group participants were intercepted at the museum after the data collector saw the visitor experience a nanotechnology-related activity. Thus, ideally, 100% of the Treatment Group members would have recalled experiencing or at least hearing about the activities. Only 48% of the Treatment Group reported they had experienced the nanotechnology-related activities offered during NanoDays, but 90% of the Treatment Group said they remembered "reading, seeing, or hearing about nanotechnology" at a museum when asked, *In which of the following do you clearly remember reading, seeing, or hearing about nanotechnology*. Regardless of whether participants did not notice an activity was about nanotechnology or whether they forgot an activity was about nanotechnology, this could be valuable for NISE Net institutions to consider.

Table 1. Description of *Year 3* sample sizes by Control and Treatment categories across *Tier 1* museums (including museum attendance and membership size).

Museum (Region)	Annual Attendance [a]	Members [b]	Number of activity types offered [b] February – May 2008	Control e-mails sent	Control surveys completed	Treatment e-mails sent	Treatment surveys completed
Museum of Science (NE)	1,973,220	44,000	13	~400	45	~400	101
Oregon Museum of Science and Industry (W)	823,946	28,000	7	~100	10	~100	27
North Carolina Museum of Life and Science (SE)	274,416	6,800	8	~100	52	~100	54
Science Museum of Minnesota (MW)	1,237,000 [c]	35,000	17	~400	79	~400	128
			Total e-mails sent	1039		1039	
			Total e-mails minus bounces and unsubscribers	1015	**187**	945	**309**
			Response rate		**21%**		**33%**

[a] Based on numbers reported in the 2007 ASTC Sourcebook of Statistics and Analysis (2008).
[b] Based on numbers reported in Multimedia Research's final report (2008).
[c] Based on SMM's 2007 Annual Report (2007).

Table 2. Description of *Year 4* sample sizes by Control and Treatment categories across *Tier 2* museums (including museum attendance and membership size).

Museum (Region)	Annual Attendance [a]	Members [a]	Number of NanoDays offered [a] March 28 – April 5, 2009	Control e-mails sent	Control surveys completed	Treatment e-mails sent	Treatment surveys completed
Discovery Center Museum (NE)	110,000	2,000	1	82	17	25	7
ScienceWorks (W)	40,000	1,600	2	144	22	41	13
McWane Science Center (SE)	350,000	8,500	9	177	38	75	24
St. Louis Science Center (MW)	1,200,000	25,000	2	182	41	182	61
			Total e-mails sent	585		323	
			Total e-mails minus bounces and unsubscribers	502	**118**	279	**105**
			Response rate		**24%**		**38%**

[a] Based on numbers given by museum staff.

Part 2 Nanoawareness Year 4 pilot study results

Year 4 full results

The nanoawareness Year 4 pilot study results are described in the following sections:

1) Self-reported awareness of the term "nanotechnology"
2) Associations with nanotechnology
3) Breadth of nanotechnology information sources
4) Awareness of nanotechnology applications
5) Awareness of benefits
6) Awareness of risks
7) Knowledge of the nanoscale
8) Knowledge of material properties that are different at the nanoscale
9) Awareness of or participation in nano-topic activities
10) Self-reported changes in awareness from nano-topic activities.

Results for section 1 involved a t-test for significant differences in Treatment and Control Group mean responses and a chi-square test for significant differences between the percentage of Treatment and Control Groups responses in each of the categories. Results for section 2–8 use chi-square tests for significant differences between the percentage of Treatment and Control Group responses within categories. Results for section 9 and 10 simply involve descriptive statistics. The full results are followed by a summary that compares the Year 4 findings to the Year 3 findings.

While reviewing these results, it is prudent to remember that this is simply one perspective on the NISE Net public impacts. These results represent a particular sample of the entire NISE Network using a particular study method. These results should be considered in the context of information from other sources and perspectives.

Self-reported awareness of the term "nanotechnology"

Respondents were asked *How much have you heard about nanotechnology?* Respondents were asked to indicate how much they had heard on a scale from 1 (heard nothing at all) to 10 (heard a lot) with the option to check "not sure."

This question is identical to a question asked in Year 3, but the response type is different. In Year 3, respondents were asked to indicate how much they had heard in five categories: not sure, heard nothing at all, heard a little, heard some, and heard a lot.

The response type was modified to a 10-point scale in Year 4 to yield ordinal data for potentially deeper analysis. While the mean level of awareness for the Treatment Group appears higher than the mean level of awareness for the Control Group, a t-test conducted on the data indicated no statistical difference (Table 3).

Table 3. Awareness of nanotechnology – percent responses and means across a 10-point scale

	Treatment (n=105)	Control (n=118)
Heard a lot 10	4%	3%
9	2%	3%
8	8%	8%
7	16%	4%
6	6%	5%
5	10%	12%
4	6%	9%
3	15%	9%
2	11%	12%
Heard nothing at all 1	22%	32%
Not sure	2%	4%
Mean [a]	4.3 ± 2.7	3.7 ± 2.7

[a] T-Test: t (N=214) = -1.685, p = 0.093. Note: "Not sure" responses were not included in this analysis.

For convenient comparison with the Year 3 results, the scale was collapsed into two categories: 1) those that had heard something about nanotechnology (ratings 2–10) and 2) those that had heard nothing at all about nanotechnology (rating of 1). A chi-square test applied to these data also revealed that Treatment respondents were not significantly more likely to have heard about nanotechnology than Control respondents (Table 4).

Table 4. Heard about nanotechnology – percentage of responses when 10-point scale is collapsed into two categories

	Treatment (n=103)	Control (n=113)
Heard something (2-10)	78%	66%
Heard nothing at all (1)	22%	34%

Significant differences were not observed with chi-square tests.
Note: "Not sure" responses were not included in this analysis.

Respondents who indicated that they had heard nothing at all about nanotechnology (a rating of 1 or "not sure") were directed to the end of the survey. Only those respondents who had heard something about nanotechnology (a rating of 2 or higher) were asked the remainder of the questions.

Associations with nanotechnology

Respondents were prompted to *Write any thoughts, ideas, emotions, questions, or definitions that you associate with the term nanotechnology*. This open-response item was identical to an item in the online survey in Year 3.

About one-third of both Treatment and Control Group respondents did not write any associations; a chi-square test indicated that the percentages of the respondent groups that left the response blank were not significantly different.

Associations that were offered as responses were coded into the following 14 categories (see Appendix E for examples of responses in each category):

- Tiny, very small, or microscopic
- Application or implications for future potential
- Medical benefits or applications
- New technology or smaller computers
- Positive emotional responses (e.g., interesting, exciting)
- Science fiction
- Tiny robots or machines
- Mentioned museum or museum experience
- Molecules or atoms were mentioned, or cellular level
- Mentioned one billionth or the difference in the laws of physics
- iPod nano or cellular phone
- New science, should use caution
- Negative emotional response (e.g., fear, worry, or confusion)
- Other responses
- Left blank or wrote don't know

The percentage of responses in each of the 14 categories is presented in Table 5. Chi-square tests revealed no significant differences except that the Treatment Group members (8%) were more likely than the Control Group members (0%) to mention the museum or their museum experience. While this is the only significant difference, a comparison of the descriptives reveals some interesting differences. The percentage of Treatment Group responses (31%) in the category "tiny, very small, microscopic" is higher than the percentage of Control Group responses (19%) in this category. The percentage of Control responses (16%) in the category "tiny robots or machines" is higher than the percentage of Treatment Group responses (9%). Not surprisingly, the percentage of Treatment Group responses (8%) in the category "mentioned museum or museum experience" is higher than the percentage of Control Group respondents (0%).

Table 5. Thoughts ideas, emotions, questions, or definitions that you associate with the term "nanotechnology" – percent of responses in each of 14 coded open-response categories

	Treatment (n=80)	Control (n=75)
Left blank/No idea	34%	39%
Tiny, very small, microscopic	31%	19%
Applications or implications for future potential	18%	20%
Medical benefits/applications	16%	19%
New technology or smaller computers	13%	15%
Positive emotional responses	11%	15%
Science fiction	8%	4%
Tiny robots or machines	9%	16%
Mentioned museum or museum experience [a]	8%	0%
Molecules or atoms, cellular level	5%	5%
Mentioned billionth measurement or difference in laws of physics	4%	3%
iPod nano or cellular phone	3%	1%
New science, should use caution	3%	1%
Negative emotional response	1%	5%
Other	6%	4%

[a] χ^2 (1, N=155)= 5.852, p = 0.016.

Breadth of nanotechnology information sources

Respondents were asked *In which of the following do you clearly remember reading, seeing, or hearing about nanotechnology? Please check* [No, Yes, or Not sure] *for each*: *movies; consumer product labels; Internet; television; word of mouth: family, friends, coworkers; print: newspaper, magazines, journals, books; museums, science centers; radio.*
The list was electronically presented in random order to avoid order bias. This item is identical to an item in the online survey in Year 3.

According to a chi-square test, the percentage of Treatment Group respondents (91%) that checked "museums" was significantly higher than the percentage of Control Group respondents (43%) that checked this category (Table 6). Not only was the percentage of Treatment Group responses higher than the Control, but the actual percentage of 91% was quite high when simply viewed as a descriptive. These findings are congruent with expectations since Treatment Group respondents were recruited at nanotechnology-related activities at the museums (although, on another survey item only 73% of the Treatment Group members could recall hearing about or experiencing nano-topic activities).

Table 6. In which of the following do you clearly remember reading, seeing, or hearing about nanotechnology? – percent Yes responses to each category listed

	Treatment (n=80)	Control (n=75)
Museums [a]	91%	43%
Print [b]	61%	73%
Television [c]	45%	69%
Internet	56%	49%
Movies	38%	45%
Word of mouth	34%	42%
Radio	14%	20%
Consumer products	14%	4%
Other (please specify)	4%	4%

[a] χ^2 (2, N=148) = 40.450, $p < 0.001$.
[b] χ^2 (2, N=149) =6.605, $p = 0.037$.
[c] χ^2 (2, N=148) = 14.366, $p = 0.001$.

Awareness of nanotechnology applications

Respondents were asked *Have you heard of nanotechnology being used in 1) clothing, fabric; 2) cosmetics, skin lotion; 3) solar technology; 4) computing technologies; 5) sports equipment; 6) air and water purifiers; 7) medical diagnostics and treatment; 8) washing machines; 9) paints, coatings; 10) insulation.* For each item, respondents were asked to check Yes, No, or Don't know. The list was electronically presented in random order to avoid order bias. This item is identical to an item in the Year 3 survey.

The chi-square test indicated no significant difference between the percentage of Treatment and Control Group respondents that checked "Yes" [they had heard of nanotechnology being used] for each application (Table 7).

The greatest percentage of respondents from both groups was aware of nanotechnology in *medical diagnostics and treatment*, with almost three-quarters of respondents reporting awareness of nanotechnology in these applications.

Table 7. Awareness of applications – percent Yes responses to each category listed

	Treatment (n=80)	Control (n=75)
Medical diagnostics and treatment	73%	75%
Computing technologies	61%	74%
Air and water purifiers	34%	31%
Solar technology	42%	27%
Clothing; fabric	37%	25%
Cosmetics; skin care	33%	21%
Paints; coatings	27%	21%
Sports equipment	20%	10%
Insulation	12%	4%
Washing machines	8%	4%
Other (please specify)	1%	3%

Significant differences were not observed with chi-square tests (included "Yes," "No," and "Don't know" responses).

Awareness of benefits

Respondents were asked *Are you aware of any benefits or potential benefits of nanotechnology?* Respondents were asked to check Yes or No. This item was identical to an item in the survey in Year 3.

A chi-square test indicated a significant difference in the percentage of Treatment (65%) and Control Group (47%) that answered Yes (Table 8).

Table 8. Awareness of benefits – percent responses to Yes and No

	Treatment (n=80)	Control (n=75)
Yes	65%	47%
No	35%	53%

χ^2 (1, N=153) = 5.442, p = 0.020.

Those respondents who indicated Yes, they were aware of benefits or potential benefits of nanotechnology were then prompted to *Please explain, as best you can, any benefits or potential benefits of nanotechnology*. This open-response item was identical to an item in the survey in Year 3.

In Year 4, each response was coded into the following seven categories (see Appendix F for examples of responses in each category):

- Medical benefits
- Broad benefits for a specific industry
- Benefits to machines, computers, or the use of robots
- Environmental benefits

- Other specific examples of benefits
- Other responses
- Left blank

A chi-square test suggested the percentage of Treatment and Control Group responses were not significantly different across categories except that the percentage of Control Group responses in the category of "machines/computers/robots" was significantly higher than the percentage of responses from the Treatment Group in this category (Table 9). A review of response categories and percentages indicates that breadth of response categories did not differ by respondent group.

Table 9. Benefits suggested – percent responses in each coded category

	Treatment (n=51)	Control (n=35)
Medical	65%	74%
Specific industry mentioned or broad benefits (e.g., help humanity)	24%	29%
Machines/computers/robots [a]	22%	29%
Other specific examples	20%	11%
Left blank	12%	9%
Environmental	8%	11%
Other	8%	0%

[a] χ^2 (1,N=86) = 5.293, p = 0.020.
Note: Percentage is taken out of those respondents that reported that they had heard about benefits or potential benefits of nanotechnology, not out of those respondents that gave a response to this open-ended question.

Awareness of risks

Respondents were asked *Are you aware of any risks or potential risks of nanotechnology?* Respondents were asked to check Yes or No. This item was identical to an item in the survey in Year 3.

A chi-square test suggested no significant difference between the percentage of Treatment and Control Group respondents who answered Yes to this question (Table 10).

Reviewing the percentages as descriptives, it appears that a lower percentage of Treatment and Control Group respondents indicated an awareness of risks (about one-fourth) than indicated an awareness of benefits (about one-half to two-thirds) (Tables 8 and 10).

Table 10. Awareness of risks – percent responses to Yes and No

	Treatment (n=80)	Control (n=75)
No	74%	77%
Yes	26%	23%

Significant differences were not observed with chi-square test.

Respondents who reported awareness of risks were prompted to *Please explain, as best you can, any risks or potential risks of nanotechnology*. This item is identical to an item on the survey in Year 3.

In Year 4, each response was coded into the following eight categories (see Appendix G for examples of responses in each category):

- Harmful to humans
- Used for intentional harm or toxins
- Loss of control or unintended consequences
- Environmental risks
- It's a new science and there hasn't been enough testing yet
- Privacy breach or security issues
- Other responses
- Left blank

The small number of responses to this question prevented the use of a chi-square test, however, when the percentages are reviewed as descriptives, it appears a slightly higher percentage of Treatment Group responses were in the category, "Harmful to humans" and "Environmental risks" than Control Group responses. Also, it appears a slightly higher percentage of Control Group responses were in the category, "Loss of control/unintended consequences" than Treatment Group responses (Table 11).

Table 11. Risks suggested – percent responses in each coded category

	Treatment (n=21)	**Control** (n=17)
Harmful to humans	43%	24%
Used for intentional harm or toxins	29%	29%
Loss of control/unintended consequences	24%	35%
Environmental risks	24%	6%
New science/not enough testing	19%	12%
Left blank	14%	6%
Privacy breach or security issues	10%	6%
Other	10%	29%

Significant differences were not observed with chi-square test.

Knowledge of nanoscale

Respondents were prompted to *Please describe, as best you can, the scale (size) of nanotechnology*. This open-response item was not on the Year 3 online survey.

Responses to the first question were coded into the following nine categories (see Appendix I for examples of responses in each category):

- Correct measurement: one billionth of a meter

- Tiny/very small
- Incorrect measurement
- Smaller than a specific object (e.g., hair, pencil tip)
- Microscopic
- Molecular or cell size
- Other responses
- No idea or don't know
- Left blank

A chi-square test suggested the percentage of Treatment and Control Group responses were not significantly different across categories (Table 12). A review of response categories and percentages also indicates that breadth of response categories did not differ by respondent group.

Table 12. Size of nanoscale – percent responses in each coded category

	Treatment (n=80)	Control (n=75)
One billionth of a meter	31%	20%
Left blank	21%	24%
Tiny/very small	20%	29%
Smaller than [some object] (e.g., hair, paper, pencil tip)	13%	5%
Microscopic	10%	12%
No idea/Don't know	9%	16%
Molecular level/cell size	5%	9%
Incorrect measurement	5%	3%
Other	1%	3%

Significant differences were not observed with chi-square tests.

Knowledge of material properties at the nanoscale

Respondents were prompted to *Please list any properties that you have heard might be different at the nanoscale*. This open-response item was not on the Year 3 online survey.

Responses were coded into the following five categories (see Appendix J for examples of responses in each category):

- An object or material was mentioned without a specific property
- A specific property was listed
- Other responses that wouldn't fit into the above categories
- Left blank
- Not sure or don't know

A chi-square test suggests that the percentage of Treatment Group responses and Control Group responses in these categories are not significantly different from each other. Note over 50% of

the Treatment and Control Group members left this answer blank or answered, *Don't know* [*of any properties that might be different at the nanoscale*]. This is a high percentage – higher than the percentage that left other open-response items in this survey blank (Table 13).

Table 13. Material properties that might be different at the nanoscale – percent responses in each coded category

	Treatment (n=80)	Control (n=75)
Left blank	34%	35%
Not sure/Don't know	19%	19%
Object or material mentioned, but no specific property (e.g., air, light, silver)	24%	19%
More than one of the above mentioned	5%	3%
Specific properties listed (e.g., magnetism, conductivity)	18%	15%
More than one of the above mentioned	9%	11%
Other	1%	1%

Significant differences were not observed with chi-square tests.

Awareness of or participation in nano-topic activities

Respondents were asked the following question (with information on the museum they visited):

> The [*museum name*] sponsored NanoDays on [*days of week and dates*]. NanoDays consisted of multiple activities, programs, exhibits, and/or forums about nanotechnology.
>
> Have you heard about or experienced any of the activities that were offered at the [*museum name*] during NanoDays?
>
> ☐ Neither heard about nor experienced
> ☐ Heard about the nanotechnology-related activities
> ☐ Experienced the nanotechnology-related activities

This question differed from the corresponding question in Year 3. In Year 3, respondents were provided a list of activity names offered by "their" museum and for each activity asked to check: Neither heard about nor experienced, Heard about, or Experienced. That is, while the Year 4 question asked respondents to check just one item which included any NanoDays activities, the Year 3 question asked respondents to check several specific activities.

Congruent with expectations, no Control Group respondents reported having experienced any of these activities and just over 10% had heard of the nanotechnology-related activities. Somewhat counter to expectations, less than half (48%) of the Treatment Group respondents reported having experienced these activities and only one-quarter of the additional respondents (25%) reported that they had heard about the activities.

Respondents who reported having experienced the nanotechnology-related activities were prompted to *Please tell us what nanotechnology-related activity(ies) you experienced at the [museum name].* Then, they were asked to respond to the question *Did the experience influence your awareness of nanotechnology* by selecting a number on a scale from 1 (Did not influence awareness) to 10 (Highly influenced awareness) (Table 14). A scale response type was used so that group means could be compared across the four participating institutions. However, since

the sample size was lower than expected for three of the museums, these means are not compared here. This item differed from a similar item on the Year 3 survey where respondents were asked whether or not they had experienced or heard about specific nanotechnology activities (e.g., *Sizing Things Down Demonstration*). Respondents who reported they had experienced one or more of the specific activities were asked to describe how the experience influenced their awareness of nanotechnology (open response).

Reviewing the means and percentages as descriptive data, it appears respondents rated the influence of the nanotechnology-related activities on their nanoawareness relatively high, with an average of almost 7. Half (50%) rated the influence of NanoDays a 7 or higher; fewer than one-quarter of respondents rated the influence of the NanoDays activities a 5 or lower (22%).

Table 14. Influence of nano-activities on awareness – percent responses and means across a 10-point scale

	Treatment (n=49)
Highly influenced 10	16%
9	8%
8	10%
7	16%
6	16%
5	8%
4	6%
3	4%
2	0%
Did not influence 1	4%
Not sure	10%
Mean	6.8 ± 2.4

Self-reported changes in awareness from nano-topic activities

Respondents who had recalled experiencing a NanoDays activity were prompted to *Please describe how the [nano-activity] experience influenced your awareness of nanotechnology*. This open-response item was identical to an item on the survey in Year 3.

Each response was coded into the following five categories (see Appendix H for examples of responses in each category):

- Increased my awareness of nanotechnology/wasn't aware of nanotechnology before
- Increased my knowledge of nanotechnology
- Increased my understanding of the applications
- Other responses
- Left blank

Over one-quarter (29%) of respondents did not answer this question. Other respondents reported that their nano-activity experience influenced their 1) *awareness* of

nanotechnology (28%), 2) *knowledge* of nanotechnology (22%), and 3) understanding of *applications* (18%) (Table 15).

Table 15. Describe how the experience influenced your awareness of nanotechnology – percent responses in each coded category

	Treatment (n=49)
Left blank	29%
Increased my awareness/wasn't aware of nanotechnology before	28%
Increased my knowledge	22%
Increased my understanding of the applications	18%
Other	27%

Summary of Year 3 and Year 4 results

The research question driving the nanoawareness study was *What, if any, impact do NISE Net activities delivered at Tier 1 and Tier 2 institutions have on the nanoawareness of the public audiences that experience those activities?* The nanoawareness study was first conducted in Year 3 and then replicated in Year 4 as a pilot study with some methodological changes and a different sample of institutions and participants. For the full Year 3 nanoawareness summative report refer to *Summative Evaluation of Awareness of Nanotechnology by the Museum Public*, which can be found on nisenet.org (Flagg and Knight-Williams, 2008).

Since the Year 4 study built on the Year 3 study, summaries of the Year 4 and Year 3 results are presented for comparison. Also, Table 16 offers an at-a-glance comparison of Year 4 and Year 3 results.

Self-reported awareness of the term "nanotechnology"

- In Year 4, Treatment Group respondents were no more likely to report having heard about nanotechnology than Control Group respondents.

- In Year 3, Treatment Group respondents were significantly more likely to report having heard more about nanotechnology than Control Group respondents.

Associations with nanotechnology

- In Year 4, Treatment Group respondents were no more likely than Control Group respondents to describe an association with nanotechnology.

- In Year 3, Treatment Group respondents were significantly more likely to describe an association with nanotechnology.

Breadth of nanotechnology information sources

- In Year 4, Treatment Group respondents were significantly more likely than Control Group respondents to report receiving nanotechnology information from museums. Control group respondents were significantly more likely than Treatment Group respondents to report receiving nanotechnology information through print media and television.

- In Year 3, Treatment Group respondents were significantly more likely than Control Group respondents to report receiving nanotechnology information from museums and consumer product labels.

Awareness of applications

- In Year 4, Treatment Group respondents were no more likely than Control Group respondents to have heard about nanotechnology in any of the applications listed in the questionnaire. About three-quarters of both groups felt that they were familiar with medical applications.

- In Year 3, Treatment Group respondents were more likely to have heard of nanotechnology in six of the 10 applications listed in the questionnaire: clothing or fabric, solar technology, air and water purifiers, paints or coatings, cosmetics or skin lotions, and insulation. About three-quarters of both groups felt that they were familiar with medical and computing applications.

Awareness of benefits

- In Year 4, Treatment Group respondents were significantly more likely than Control Group respondents to report an awareness of the benefits of nanotechnology. The groups did not differ in the categories of benefits most commonly reported; the most common category for both groups was medical.

- In Year 3, Treatment Group respondents were significantly more likely than Control Group respondents to report an awareness of the benefits of nanotechnology. The groups did not differ in the categories of benefits most commonly reported; the most common category for both groups was medical.

Awareness of risks

- In Year 4, Treatment Group respondents were no more likely than Control Group respondents to report an awareness of the risks of nanotechnology.

- In Year 3, Treatment Group respondents were significantly more likely than Control Group respondents to report an awareness of the risks of nanotechnology. The groups did not differ in the categories of risks most commonly reported.

Knowledge of the nanoscale

- In Year 4, Treatment and Control Group responses describing the nanoscale did not differ across categories.

- In Year 3, this question was not asked.

Knowledge of material properties that are different at the nanoscale

- In Year 4, Treatment and Control Group responses describing properties that might be different at the nanoscale did not differ across categories.

- In Year 3, this question was not asked.

Awareness of or participation in nano-topic activities

- In Year 4, 48% of the Treatment Group reported experiencing one or more nano-topic activity; an additional 25% reported hearing about nano-topic activities, but not experiencing them.

- In Year 3, 69% of the Treatment Group reported experiencing one or more nano-topic activity; an additional 16% reported hearing about nano-topic activities, but not experiencing them.

Self-reported changes in awareness from nano-topic activities

- In Year 4, 86% of the Treatment Group members who recalled their NanoDays experience reported at least a little positive influence on their awareness of nanotechnology (those rating influence as 2–10 on a scale of 1–10).

- In Year 3, 59% of the Treatment Group could describe some positive influence as a result of their exposure to nano-topic deliverables.

Table 16 provides an at-a-glance comparison of Year 4 and Year 3 findings.

Table 16. Comparison of findings on each item in Year 4 and Year 3.

	Year 4 **Tier 2 sample**	**Year 3** **Tier 1 sample**
Awareness of "nanotechnology"	No difference	Significant difference
Associations	No difference	Significant difference
Museum as information source	Significant difference	Significant difference
Awareness of applications	No difference	Significant difference
Awareness of benefits	Significant difference	Significant difference
Awareness of risks	No difference	Significant difference
Knowledge of nanoscale	No difference	
Knowledge of properties	No difference	
Awareness of nano-topic activities	Majority experienced or heard about	Majority experienced or heard about
Changes in awareness	Majority reported positive changes	Majority reported positive changes

While the Year 3 and Year 4 nanoawareness studies had some differences in methodology, the instrument and design were very similar. The instrument was an online survey with a Treatment Group (visitors exposed to NISE Net activities) and a Control Group (comparable audience members not exposed to NISE Net activities). An obvious difference between the Year 3 and Year 4 studies was that Year 3 participants were sampled from four Tier 1 institutions and Year 4 participants were sampled from four Tier 2 institutions. Also, in Year 3, Treatment Group participants were recruited from NISE Net activities that occurred before, during, and after NanoDays. In Year 4, Treatment Group participants were recruited from activities that occurred during NanoDays only.

The Year 3 and Year 4 online survey results were different. In Year 3, the survey results suggested that a significantly higher proportion of the Treatment Group had greater awareness of *nanotechnology* and nanotechnology *applications*, *risks*, and *benefits* than the Control Group. In Year 4, the same survey questions resulted in fewer significant differences between Treatment and Control Groups. The only similarity to Year 3 is that the Year 4 survey results suggested that a significantly higher proportion of the Treatment Group had greater awareness of nanotechnology *benefits*. The Year 4 results revealed no significant differences between the proportion of Treatment and Control Group participants with regard to their awareness of nanotechnology in general and nanotechnology applications and risks. In the following section, we explore why the results across Year 3 and Year 4 are so different.

Part 3 Exploration of differences between Year 3 and Year 4

As mentioned in the summary of results above, the Year 3 study with a participant sample from Tier 1 institutions resulted in more significant differences between Treatment and Control Groups than the Year 4 pilot study with a participant sample from Tier 2 institutions. Of particular interest are these three survey items:

- *How much have you heard about nanotechnology?*
- *Have you heard of nanotechnology being used in the following applications?*
- *Are you aware of any risks or potential risks of nanotechnology?*

On each of these items, the evidence gathered in Year 3 suggested that the Treatment Group was more aware of nanotechnology than the Control Group. However, on these same items, the evidence gathered in Year 4 suggested no difference in the level of nanoawareness between the Treatment and the Control Groups.

Are the differences in Year 3 and Year 4 findings the result of differences in:

1) The **design of survey items** across years?
2) A **history effect**?
3) **Sample sizes** across years?
4) **Effect of treatments**?

We explore each of these questions below. At the end of this exploration, a summary includes questions that might be studied in future research.

Design of survey items

The first question we explore is the following: are the differences in the results on these three items across years the result of differences in the design of these three survey items? Our answer to this question is we do not believe the design of the survey items is a factor in the different results across Years 3 and 4.

The design of the question and response type for two of these items was identical across years:

- *Have you heard of nanotechnology being used in the following applications?*
- *Are you aware of any risks or potential risks of nanotechnology?*

The design of the question for the third item was identical across years:

- *How much have you heard about nanotechnology?*

The design of the response type for this item only differed in the span of the response scale and the format for responding on the scale. As described in the results section, in Year 3, respondents were asked to indicate how much they had heard in five categories: not sure, heard nothing at all, heard a little, heard some, and heard a lot. In Year 4, the response type was modified to a 10-point scale. The Year 4 data were analyzed with a t-test as a 10-point scale and collapsed into two groups for analysis with a chi-square test. We do not believe this difference in response type explains the failure to detect a significant difference between the percentages of Treatment and Control Groups that were aware of the term nanotechnology.

History effect

The second question we explore is, are the differences in results across years the result of a history effect? That is, do the data suggest the percentage of the general public that is aware of nanotechnology increased from 2008 (Year 3) to 2009 (Year 4)? As described below, we do not believe a history effect is a factor in the different results found across Years 3 and 4.

Our exploration of this question involves a comparison between the Year 3 and Year 4 Control Group data. We reviewed the data as descriptives on the same three survey items reviewed above –awareness of the term nanotechnology, applications, and risks. If a very high percentage of the Year 4 Control Group is aware of the term, applications, and risks of nanotechnology, the likelihood that the percentage of Year 4 Treatment Group would significantly surpass the percentage of aware Control Group members is reduced.

When the percentages were reviewed as descriptives (Table 17), we found that the percentage of aware Control Group members in Year 4 was not higher than the percentage of aware Control Group members in Year 3. In fact, the percentage of aware Control Group members in Year 3 was higher than or comparable to the percentage of aware Control Group members in Year 4 on most of the items including: awareness of the term nanotechnology, seven of the ten applications, and the risks of nanotechnology. These data are counter to what we would expect if there was a history effect.

Table 17. Differences in percentages between Year 3 and Year 4 Control Groups.

Awareness of	Year 3 Control (n = 162)	Year 4 Control (n=75)
The term, nanotechnology		
Heard something	84%	76%
Applications		
Medical diagnostics and treatment	76%	75%
Computing technologies	61%	74%
Air and water purifiers	20%	31%
Solar technology	30%	27%
Clothing; fabric	31%	25%
Cosmetics; skin care	17%	21%
Paints; coatings	24%	21%
Sports equipment	19%	10%
Insulation	8%	4%
Washing machines	7%	4%
Other (please specify)	-	3%
Risks		
Yes	27%	23%

Sample sizes

The third question we explore is, are the differences in results across years the result of differences in sample sizes? In Year 3, working with Tier 1 institutions, Multimedia Research gathered an overall sample size of 496; in Year 4, working with Tier 2 institutions, we gathered an overall sample size of 223. Was the sample size in Year 4 too small to detect the effect? We believe that small sample size is the largest contributor to the failure to detect a significant difference between the Treatment and Control Groups in Year 4.

To explore the role of sample size, we tracked the same three items discussed above:

- *How much have you heard about nanotechnology?*
- *Have you heard of nanotechnology being used in the following applications?*
- *Are you aware of any risks or potential risks of nanotechnology?*

On these particular items, the sample size in Year 3 ranged from 446 to 496. The sample size in Year 4 ranged from 147 to 216.

Sample size is important in statistical analyses because the size of the sample is related to the likelihood of correctly detecting an effect (in this case, a difference in the percentage of Treatment and Control Group responses on survey items) if an effect exists. In our field, a likelihood of 80% (i.e., the power) is often considered a reasonable chance of detecting effects.

In this study chi-square tests are applied to percentages of the Treatment and Control Group responses and "effect size" is the number representing the relationship between the Treatment Group and the independent variable (exposure to NISE Net deliverables). An effect size of 0 would represent no relationship. An effect size of 1 would represent a perfect relationship. When using chi-square tests, effect sizes of .1 are considered small, effect sizes of .3 are medium, and effect sizes of .5 are large (Aron and Aron, 1999).

We studied the relationships between sample size, power, and effect size in the context of chi-square tests (Aron and Aron, 1999; Faul et al., 2007, in press). The Year 3 sample sizes ranging from 446 to 496, supported an 80% probability of detecting an effect size greater than .15 – *small*, *medium*, and *large* effect size (if such an effect existed). The Year 4 sample sizes ranging from 147 to 216 supported an 80% probability of detecting an effect size greater than .25 – *medium* and *large* effect size (if such an effect existed). The Year 4 sample size only supported a 30% probability of detecting a small effect size (if such an effect existed). Our study of these relationships suggested that the NISE Net deliverables probably resulted in a small effect on the Treatment Group that was not detected in Year 4 but was detected in Year 3 because the Year 3 sample size supported a higher probability of detecting the small effect than the Year 4 sample size.

Effect of treatments

The fourth question we explore is, are the differences in results across years the result of differences in the effect of treatments visitors experienced across institutions? This exploration includes a review of the relationship between exposure to activity, message within activity, and results on survey items. While we cannot conclude from this review that exposure to different treatments contributed to the differences in results across years, we do conclude that the relationship between *activities provided* and *messages within activity*, and the relationship between *exposure to activities* and *results on survey items* (indicators of effect) are meaningful to consider in planning nanoawareness treatments.

Relationship between activities provided and messages within activities

The list of activities provided by the four Tier 2 institutions that participated in the Year 4 nanoawareness pilot study is provided in Table 18. These activities primarily include activities from the NanoDays kit.

Activities developed by the NISE Network were developed under six main ideas: 1) *Nano is in many realms and is both everyday and cutting edge*, 2) *Where will nano go?* 3) *Nano means working at super small scales to manipulate materials to exhibit new phenomena*, 4) *It's different down there!* 5) *Nano is a people story*, and 6) *Will nano affect you?* Table 19 indicates the primary big idea(s) (based on specified learning goals in the NanoDays Kit guides) for each of the activities provided by the institutions participating in the Year 4 study.

Reviewed together, these two tables suggest that the activities offered by the group of institutions participating in the Year 4 study primarily conveyed the big ideas: *nano means working at super small scales to manipulate materials to exhibit new phenomena*, and *it's different down there*. The lack of activities conveying the big ideas, *Nano is in many realms and is both everyday and cutting edge* and *Will nano affect you?*, might be a contributor to the relatively low percentage of Treatment Group members that had heard about the applications and risks of nanotechnology. In fact, this raises a question, could the messages conveyed – or rather not conveyed – by these activities be a contributor to the relatively low percentage of Year 4 Treatment Group members that recalled experiencing a nano-related activity at their museum (as described in the results section above)?

Table 18. Number and types of activities offered during NanoDays across *Tier 2* museums in Year 4.

Tier 2 Institution	Nano Days	NanoDays Kit Activities	Live Demonstrations	Outside University Demonstrations/ Presentations	Exhibits	Other
Discovery Center Museum (NE)	1	5	Macroman and Nanoboy	Yes (at least 2)	-	Lecture by college professor
ScienceWorks (W)	2	8	-	-	-	Dragon Fly TV
McWane Science Center (SE)	9	7 + Giant balloon carbon nanotube	-	-		-
St. Louis Science Center (MW)	2	8	Small Things, Big Differences CO_2 and Nano, too	Yes (# unknown)	Nano Center	Nano podcasts; NanoQuest computer game

Table 19. Primary big ideas for each of the activities provided by the *Tier 2* museums in the Year 4 study.

Activity	Nano is in many realms and is both everyday and cutting edge	Where will nano go?	Nano means working at super small scales to manipulate materials to exhibit new phenomena	It's different down there!	Nano is a people story	Will nano affect you?
NanoDays Kit Activity 1 – Exploring Forces: Gravity			●	●		
NanoDays Kit Activity 2 – Exploring Materials: Ferrofluid				●		
NanoDays Kit Activity 3 – Exploring Materials: Liquid Crystal				●		
NanoDays Kit Activity 4 – Exploring Measurement: Human Body			●			
NanoDays Kit Activity 5 – Exploring Measurement: Ruler			●			
NanoDays Kit Activity 6 – Exploring Properties: Surface Area			●	●		
NanoDays Kit Activity 7 – Exploring Structure: Buckyballs			●			
NanoDays Kit Activity 8 – Exploring Tools: SPM	●		●			
Nanoquest computer game	●		●	●	●	●
DragonFly TV	●		●	●	●	●
Giant balloon carbon nanotube			●			
Nano podcasts	Unknown					
University demonstrations/presentations	Unknown					
Nano Center exhibits	Unknown					

Relationship between activity type experienced and results on survey items

The Multimedia Research Year 3 report of results includes an exploration of data that suggested different activity types experienced by visitors resulted in different effects on the nanoawareness survey items. Multimedia Research reported (pg. 30, Flagg and Knight-Williams, 2008),

> *"Although this summative evaluation was not designed to look at the differential influence of deliverable type on awareness of nanotechnology, some significant relationships were found between type of deliverable and categories of associations with nanotechnology, awareness of risks and benefits, and sources of information about nanotechnology."*

For example, "compared to those exposed to other deliverables, those who reported experiencing exhibits (n=23) were significantly

- more likely in their top-of-the-mind associations to note a risk or potential risk of nanotechnology,
- more likely in their associations to describe nanotechnology as a developing field, and
- more likely to note reading about nanotechnology on consumer product labels."

In the report of results, Multimedia Research describes that those exposed to forums, demos, and programs also had significantly different results on various survey items.

Considering these findings by Multimedia Research in combination with the information in Tables 18 and 19, which show that big ideas vary across activities, it is reasonable to assume that a specific activity experienced by a visitor might have a differential effect on their survey results. That is, it is reasonable to assume that some activities, or combination of activities, or execution of activities will have greater effect than others. These are all factors that can be attended to by NISE Net members if encouraged and supported to do so.

Summary of exploration and possible questions to study further

Our exploration of the differences in results across the Year 3 and Year 4 nanoawareness studies suggests that the smaller sample size in Year 4 most likely contributed to the failure to detect what was most likely a small effect. While future studies can aim for larger sample sizes in order to increase the likelihood of detecting small effects of exposure to NISE Net deliverables, the NISE Net members might view a small effect size as a motivator to refine and strengthen their deliverables for greater influence on the public's nanoawareness. For instance, we did not find a ceiling effect for either the Control Group or the Treatment Group on any survey item, indicating potential for the public's nanoawareness to continue to grow.

Moving forward, we recommend building on the methods and results generated in the Year 3 and Year 4 nanoawareness studies. We recommend continuing with the online survey method and the items within the survey including any required updates or adaptations. In addition, this exploration has generated these research questions which might be studied for better understanding the influence of NISE Net deliverables on the public's nanoawareness.

- What is the relationship between activity, message, execution, and nanoawareness? What are the factors that should be considered to communicate multiple messages using multiple activities?
- How can existing activities be strengthened for a greater effect on the public's nanoawareness?
- What is the delayed influence of nano-related activities on nanoawareness (Appendix A)?

References

Aron, A. and Aron, E. N. (1999). Statistics for Psychology, Second edition. Prentice Hall: Upper Saddle River, NJ.

Association of Science Technology Centers (2008). 2007 ASTC Sourcebook of Statistics and Analysis. ASTC: Washington, D.C.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (in press). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*.

Faul, F., Erdfelder, E., Lang, A.-G., and Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175-191.

Flagg, B and Knight-Williams, V. (2008). Summative Evaluation of Awareness of Nanotechnology by the Museum Public. Research Report No. 08-023. Multimedia Research: Bellport, NY.

Science Museum of Minnesota (2007). Annual Report 2007. Science Museum of Minnesota: St. Paul, MN.

Appendix A Exploration of post-NanoDays influence

Post-NanoDays pilot study

Introduction

A pilot study was conducted to gain a better understanding of the influence of NanoDays activities on participants. This pilot study consisted of a phone interview with a small sample of 15 visitors who acknowledged they had engaged with nanotechnology activities at the museum, reported increased awareness as a result of that experience, and volunteered to participate in the phone interview. The purpose of the phone interview was to explore the persistence of any NanoDays influence (about two months after attending the event). In particular, we talked with visitors about their exposure to information about nanotechnology since NanoDays, whether they talked to anyone about their experience with NanoDays, their confidence in talking about nanotechnology since NanoDays, if they heard or saw information on nanotechnology since NanoDays, and if, in retrospect, they felt like their experience at NanoDays had any lasting impression on their lives.

Methods

Participants

Respondents to the online survey who had experienced NanoDays activities (Treatment respondents only) at one of the participating museums were given the chance to opt in for a follow-up interview. The interview was conducted solely as a pilot of the protocol, method, and questions for use in Year 5. Respondents were offered a chance to win a $50 gift certificate to Amazon.com as incentive to complete the interview. Sixteen respondents opted to be called for the follow-up survey; one respondent was dropped from the sample due to inadequate responses (e.g., "my son was the one who walked through most of the displays"). Out of the 15 possible interviewee candidates, all 15 interviews were completed for a response rate of 30% among potential respondents who indicated that they had experienced NanoDays (50 online survey respondents). Interviews were conducted between June 18 and July 13, 2009.

Characteristics of self-selected interviewee candidates

Interviewee respondent demographics were very similar to the demographics of the entire online survey Treatment group. Interviewees were not significantly different on age, gender, or membership status. The distribution of interviewees across institution was similar to the distribution of Treatment respondents, although more Discovery Center respondents opted for the interview than ScienceWorks or McWane; two-thirds of interviewees and Treatment respondents were from Saint Louis. Interviewee respondents rated higher on how much they had heard about nanotechnology, compared to both the Treatment Group and the Control Group. Interviewee candidates also rated higher than the Treatment Group as a whole on how much the NanoDays activities influenced their awareness of nanotechnology.

Table 1. Institutional distribution of interviewee candidates.

	Interviewees (n=15)
Discovery Center Museum	20.0%
ScienceWorks	6.7%
McWane Science Center	6.7%
Saint Louis Science Center	66.7%

Table 2. Interviewee candidate demographics.

	Interviewees (n=15)
18–24 years old	6.7%
25–34 years old	6.7%
35–44 years old	46.7%
45–54 years old	20.0%
55–64 years old	6.7%
Members	13.3%
Females	80.0%
Males	20.0%

Table 3. Heard about nanotechnology.

	Interviewees (n=15)
Heard a lot 10	6.7%
9	0.0%
8	6.7%
7	33.3%
6	6.7%
5	13.3%
4	6.7%
3	26.7%
2	0.0%
Heard nothing at all 1	0.0%
Mean	5.7 ± 2.2

Table 4. Influence of NanoDays on nanoawareness.

	Interviewees (n=15)
Highly influenced 10	26.7%
9	13.3%
8	13.3%
7	6.7%
6	26.7%
5	6.7%
4	6.7%
3	0.0%
2	0.0%
Did not influence 1	0.0%
Mean	7.6 ± 2.0

Instrument

The phone interview instrument consisted of eight questions in addition to a think aloud response (see Supplement A at the end of this appendix). In particular, we talked with visitors about their exposure to information about nanotechnology since NanoDays, their confidence talking about nanotechnology since NanoDays, whether they talked to anyone about their experience with NanoDays, if they sought out information on nanotechnology since NanoDays, and if, in retrospect, they felt like their experience at NanoDays had any lasting impression on their lives. Interviews lasted between 15 and 25 minutes depending on responses, and were conducted by the two authors.

Results

Since this was a pilot study and was conducted with a very small sample size, responses were coded by the two authors to identify general common themes among responses. Results below do not include every theme or idea that was mentioned by respondents but is a starting point for what might emerge if a larger sample size was obtained in future studies (recorded responses can be found in Supplement B in this appendix).

Interview respondents were first prompted to *reflect out loud on some of the things that come to mind when you hear the term nanotechnology*. Respondents were most likely to respond with either some relation to the size of nanotechnology (e.g., *very tiny*; 9 respondents) or with an application of nanotechnology (e.g., *clothing* or *cancer drugs*; 8 respondents). Fewer than one-third (4) specifically mentioned the activity they experienced at the Tier 2 museum, and even fewer (3) mentioned how nanotechnology was *cutting edge* or a *new science*.

Table 5. Reflections on nanotechnology.

	Interviewees (n=15)
Size reference (e.g., very small)	9
Applications	8
Museum activity	4
Cutting edge technology	3
Other	2

Next respondents were asked specifically; *Does nanotechnology connect in any way to anything that they experience or think about* and *what about nanotechnology seems particularly relevant to your life?* One-third of respondents (5) felt that nanotechnology did not connect in any way to their life, although three of those five thought something was relevant. The most common connection respondents found was through applications of nanotechnology (9 respondents), such *as how nanotechnology might be used in clothing* or *socks that my son wears*. Similarly, the most commonly mentioned relevant parts of nanotechnology were also the applications of nanotechnology (9 respondents). Other responses to the relevance of nanotechnology to their life were the philosophical perspective (2 respondents) and that they knew something was relevant but could not think of anything (2 respondents). Only two respondents reported that nothing about nanotechnology seemed relevant to their life.

Table 6. Connections of nanotechnology to experiences and thoughts.

	Interviewees (n=15)
No connections	5
Applications	9
Past experiences with nanotechnology	3

Table 7. Relevant aspects of nanotechnology.

	Interviewees (n=15)
Applications	9
Philosophical	2
Yes, but don't know	2
Nothing	2

Respondents were asked, *Have you spoken to anyone about nanotechnology or your experience at [the museum] since you attended NanoDays?* They were specifically asked who they had talked to (i.e., family, friends, co-workers) and what they had told these people about their experience or nanotechnology. Only two respondents could not think of a time they had talked to someone about nanotechnology or their experience since NanoDays. Most respondents reported talking to family members (e.g., children or spouses, 11 respondents) or friends (6 respondents). Four respondents spoke with their co-workers about their experience, and one-third of respondents (5) talked with "others" (e.g., clients, students, teachers). Respondents most commonly talked about applications of nanotechnology (6 respondents) or the museum

activities they experienced (6 respondents). They also talked about specific properties of the nanoscale (e.g., *I spoke more about the properties of the components and what they could potentially do*, 4 respondents) or mentioned specifically that they had fun at the museum during NanoDays.

Table 8. Who did you tell about nanotechnology or your experience?

	Interviewees (n=15)
Family	11
Friends	6
Co-workers	4
Others	5
Clients	
Scouts	
Students	
Teachers	
No one	2

Table 9. What did you tell them about nanotechnology or your experience?

	Interviewees (n=15)
Applications	6
Mentioned museum activities	6
Properties on nanoscale	4
That they had fun	3

When asked, *Do you think your experience with nanotechnology activities at [the museum] affected your awareness of nanotechnology?,* all respondents reported that it had impacted their awareness in a positive way. Most respondents reported that they did not even know what nanotechnology was before their experience (6 respondents) or that it increased their knowledge much more than they already knew (5 respondents). Respondents were also asked, *Do you think your experience at [the museum] has made your more confident talking to others about nanotechnology?*; all but two respondents said it did.

Table 10. Do you think experience has affected your awareness of nanotechnology?

	Interviewees (n=15)
Yes	15
No	0
Don't know	0

Table 11. Do you think experience has made you more confident about talking to others about nanotechnology?

	Interviewees (n=15)
Yes	13
No	2
Don't know	0

Respondents were asked if they *noticed anything on TV, radio, or in the news that relates to nanotechnology*? One-third of respondents (5) noticed something pertaining to nanotechnology in one of these information sources; two-thirds had not noticed anything or could not remember if they had. Two respondents that noticed something in one of these sources could not remember specifically what was mentioned about nanotechnology in these sources.

Table 12. Have you noticed anything on TV, radio, or in the news?

	Interviewees (n=15)
Yes	5
No	10
Don't know	0

Lastly, respondents were asked if there was *any lasting impression of their nanotechnology experience on your life?* The most commonly mentioned impression had to do with the applications of nanotechnology on their life (8 respondents). These applications again included applications that are already in use (*antimicrobial socks*) or applications that are believed to be in the near future (e.g., *products that may be coming out that have been developed through nanotechnology*). Respondents also mentioned the increased awareness they had of nanotechnology (4 respondents) or the increased interest they had about the various aspects of nanotechnology (4 respondents).

Table 13. Any lasting impressions?

	Interviewees (n=15)
Applications	8
Interest	4
Awareness	4
Philosophical	2
Other	3

Summary and recommendations

At least for this select group, the pilot results suggest that the NanoDays influence was still present when we contacted interview participants two months later. That is, as a group, the majority of these respondents reported that their confidence talking about nanotechnology had increased since NanoDays. Respondents talked to others about their experience with nanotechnology or NanoDays (primarily about applications and the museum experience), and they felt like their experience at NanoDays had a lasting impression on their lives (primarily

looking for applications). These influences persisted even though they did not, as a group, see much information about nanotechnology through other media such as news, TV, or radio, since their visit to NanoDays (they did, however, participate in our online nanoawareness survey since NanoDays).

The phone interview method had some benefits and drawbacks. For this small sample size, the method was fairly easy to implement and allowed the interviewers to improvise and adapt questions to probe more deeply into participants' reflections and experiences related to NanoDays. However, if a larger sample size is needed for generalizability, this method is not realistic with NISE Net resources. And in fact, the method did not yield much depth from the participants. Rather, the strength of this method seems to have been the timing of implementation. That is, the timing of the method is of value for gathering data related to delayed impacts of NISE Net experiences. Therefore, it may be possible to use a less resource-intensive method, such as another online survey, to assess delayed impacts in future research. An online survey implemented *at least* two months after exposure to NISE Net activities could include Control Group and Treatment Group participants, not involved in the prior online survey.

Supplement A: Phone interview instrument

NISE Network Summative
Nanoawareness Year 4 Study Questions

Follow-up Phone Interview

Hello, my name is _____. I am calling on behalf of the [XX Museum] regarding your recent response to an online survey. You opted to be called for a follow-up interview. I have fewer than 10 questions and the interview will take about 5-10 minutes. If you complete this interview, you will be entered into a drawing to win a $50 gift certificate to Amazon.com; you have a 1 in 15 chance of winning. Is now a good time to talk or would you like to set an appointment for another time?

Great! First off, I need to cover some logistical things – The information you provide in this interview will not be recorded, nor attributed to you, nor made public. These interviews will be combined into one set of data for purposes of evaluating the impact of the [XX Museum].

Before we start, please take a moment to reflect out loud on some of the things that come to your mind when you hear the term nanotechnology.
If needed – *Go ahead and think out loud if that helps your stream of consciousness*.

Relevance
1. Does nanotechnology connect in any way to anything that you experience or think about?

What about nanotechnology seems particularly relevant to your life?

***2. You mentioned that you experienced/attended the NanoDay(s) activities at the museum on* [March 28th – April 5th].**

Please tell me which nanotechnology-related activity(ies) you experienced.

3. In your own words, what would you say this* [each NanoDays activity] *was trying to show visitors?

Prompt: *What did you find out about* [what this activity is about]?

Conversation

4. Have you spoken to anyone about nanotechnology or your experience at* [XX Museum] *since you attended NanoDay(s):

- □ **Family?**
- □ **Co-workers?**
- □ **Friends?**
- □ **Other: _____**

If so, ***what did you tell these folks about your experience or nanotechnology?***

Prompt: *This could be about anything related to nanotechnology: stories, experiences, thoughts, feelings, ideas, questions.*

5. Do you think your experience at* [XX Museum] *has made you more confident about talking to others about nanotechnology?

If so, ***In what way?***

6. Do you think your experience with the nanotechnology activities at* [XX Museum] *has affected your awareness of nanotechnology?

Prompt: *Did you learn something you didn't already know? Do you think it changed your perceptions of nanotechnology – if so, how?*

If so, ***please explain how you think it affected your awareness of nanotechnology?***

7. Have you noticed anything on TV, radio, or in the news in the past few weeks/months that relates to nanotechnology?

If so, ***Can you describe what you heard/saw and where you heard/saw it?***

8. Was there any lasting impression of your nanotechnology experience at* [XX Museum] *on your life?

If so, ***can you describe this lasting impression?***

Supplement B: Recorded responses to phone interview questions

Table SB1. Responses to the interview item, *Please take a moment to reflect out loud on some of the things that come to your mind when you hear the term nanotechnology.*

Response
Windows that clean themselves, metal that pops back when you heat it, gold and liquid, coating on space shuttle that insulates better.
Very tiny, medical uses, cutting-edge science, a job market that you can do something with a two-year degree, breaking particles, atoms, and protons, and neutrons into smaller pieces which we didn't know about years ago. I was very impressed that you could go into that with a two-year degree.
Particles that cannot be seen by the human eye; when technologies can not be used that are invasive or harmful [like in the medical field] nanotechnology can help -- is less harmful; and in everyday ways like making clothes odor-resistant.
Not a whole lot; little buckyballs that we made that they're trying to use to deliver medicine to treat cancer (little cars and trucks) little itty-bitty tiny miniscule kind of stuff.
Extremely small particles that humans are very interested in, potential to take human beings into next material technology age.
Very small technology that is being used in a variety of medicines and cancer drugs and paints
Cutting edge, I'm blank right now, break through technology
Think of the chains – the strength. I don't know beyond that.
Ok, it's a very interesting presentation that we did see at DCM – it was interesting – they had a full professor to do the discussion. The kids enjoyed it, but they enjoyed the first presentation more, they are 7-9 and the second half was a bit over their heads. As far as nanotechnology – I find it interesting, because I'm always interested in new developments and new science.
Small things, the feature, I don't know – I guess that's it.
Star Trek, very small things, deborgs (Star Trek) my husband is a Treky so I've watched too much of Star Trek. That's probably about it – sorry I'm not more helpful.
The little magnet that you got – you pull another magnet across it and the vibrations that occur –you can compare to nanotechnology. Cutting the paper exercise.
Very small, useful technology, clothing, other kinds of uses for it, silver socks - antimicrobial
I did this in writing not too long ago, but I think about mili hundredths of something, so so small, that you can't see it, atom size, on the metrics, but you can see it with a microscope. The tech. is used to benefit humanity, it's not just war tech. or theoretical – it's more than that. I don't think it's being used in medicine but maybe it is – well, I don't know. Also you guys were able to demonstrate this to my 6 year old so she could even understand part of it.
The uh… the pants that deflect water, the cancer setup thing where my son got to try different fake blood and they used the tech. to show if the person had cancer or not. It's been awhile.

Table SB2. Responses to the interview item, *Does nanotechnology connect in any way to anything that you experience or think about?*

Response
Yes. I don't know if it's yet, but I would assume that – I'm a dentist – the idea of having it help find cancer – like put a tracer on the chemo to go to the cancer – that sounds like something that could be applicable. The other thing is when they do implants they do something special to the titanium. Nothing that I'm sure right now, but I'd love to have windows that I'd love to wash.
The only connect I have with it because I'm not well-versed in it is that they are using it for medical delivery. I read about buckyballs years ago byt that was past my college time after I had graduated.
Yes – about the socks that my son wears because ever since we learned about that I keep saying that's what we're getting for you. I'm more interested in learning about other ways it can help. It makes life easier, more pleasant.
Not a whole lot.
I think about science quite a bit, and nanotetchnology is one of the hot button issues today. In as much as I think about science. Nanotechnology and carbon tubes could take us into the next age (like the bronze age, steel age, …).
Yeah – it's used [BTW -- I had a shoulder replacement and morphine overdose – and my memory has been shot, so I may not remember things I otherwise would have.] I work at Wash U and one of the chemistry professors is hugely big in nanotechnology and I know they use it as a way to deliver treatment for cancer cells – directly to the cells and not harm the healthy ones. And they use it in paint. Certain materials it can turn them into combustible materials and as a conductor in chips. In drugs – I know of mentioned that with chemo. The one thing that is really neat is that with NT substances that can turn into other phases substances and that is really neat.
I'm sure it does – things that I'm probably not even aware of. Nothing on my mind right now but I know it does.
Before I went to thing, no – after – we saw how it can be used practically. The light bulb demo – and how it applies to our life. That's interesting to me.
Well, just looking at some of the different applications – energy, medications – I can see it developing to applications in the future as well that will connect to me.
I'm a teacher – so I teach partly about nanotechnology at the beginning of the year. It's sort of the cutting edge of medicine, but hasn't personally affected me much, or that much that I know of.
I don't know – thinking about nanotechnology now and know thing what I learned at SW – it's a growing are of research – and there were the water drops and how it holds together so they don't drop out. It's not like I think about nano everyday.
No not really. Not that I think about on a regular basis.
I was really struck by the clothing technology and how nanotechnology might be used in clothing.
Yes, I know for a fact that it does, but I can't remember. McWane showed ways that it connected to regular human life – not just theoretical.
Yeah – my son is into computers and robots and the human body – he watches a lot of magic school bus and how they get small to enter the human body and such to view things – nanoscience. With the umbrellas and pants – that really made an impression on me with the clothes Computers and clothes.

Table SB3. Responses to the interview item, *What about nanotechnology seems particularly relevant to your life?*

Response
The only thing particularly relevant would be advances in medicine and the space shuttle thing. REspace shuttle – what they do for NASA – fixing the telescope and all that is good – and if the insulation they use because of nontechnology is good, that makes it safe for to go upthere.
The medical aspect. To be able to deliver medicine or treatment to cancer cells without harming good tissue around it.
See above.
The only thing that I really think of – I am a Christian and I strongly believe in God and I think about the vastness and minuteness and I am amazed that God can make something that small and then make these huge stars way out there. I work in a Christian camp and the way it ties in my everyday life –it has made my faith stronger in a way. That may sound strange. It makes me realize how big of a God I serve that he could make something so very little – opened my eyes to the minuteness of creation.
Not too much at this point in time. Not very relevant, but I wish it was more relevant. I see NT as something that will be held away from most people and any advantages will have to be purchased. It is only something I will have to buy—not something I can have in my hand. (**Checked --** Wants it to be more *accessible*). Products will be available to me, but the actual information and ability to manipulate them myself won't be.
Since I do research it's probably just the chemistry angle and the delivery of drugs. Because everybody is going to know somebody at some point that gets this I'm sure.
It will help civilization through medication or for health issues. It will be helpful that way for me.
Yeah – there's applications that eventually once they are used will be relevant to my life. I can't think of any applications though.
Things that are relevant – I believe some of the applications that were discussed – energy, application of sun screen – just different ways in how it could be used. Also good to introduce the kids to new developments – so they will remember this later on.
Mostly the medical aspect – in the future, the things they believe they think they can do – that seems relevant. Also the electronic technology and how things keep getting smaller
In the huge, big picture – when you are looking at (I don't want like I'm a true intellectual, because I have no real science background) but when you are looking at quantum physics – and how we keep going smaller, smaller, and smaller with everything that we do and study – and we will eventually realize that everything is a hallucinogen and we don't really exist. We are getting smaller and smaller with everything – philosophy and religion and life – everything gets smaller. But that's where we are heading.
I didn't go that in-depth into the display, so I don't think so.
Using nanotechnology in clothing seems particularly relevant – I could see it being used in my life.
See above
Clothes – the pants made a big impression on me – because it didn't get wet.

Table SB4. Responses to the interview item, *Please tell me which nanotechnology-related activity(ies) you experienced. In your own words, what would you say this* [each NanoDays activity] *was trying to show visitors?* (continued on next two pages)

Response
Macroman and Nanoboy My son did some hands-on things where he as folding papers to get an idea of how small nano was. We watched a guy who had some liquid and he had some nanoparticles in it – it was like nanogold or something – something with pickle juice. **Macroman and Nanoboy** – they did go into a lot of things where they NT is being used today or will be in the future. They did visual stuff to help people reembmer or ake an impression upon them. **Folding papers** – to demonstrate how very very small [Oh – I guess that NT is used in computers and I use that everyday] **Nanogold and pickle juice** – don't remember. I know it changed color and the acidic juice, but why would they do that? I do remember there was some NT with the LED lights – NT makes better birghtler longer faster lights for trains and police.
We did something with a mirror, I think, but the one that struck me the most was where there were different diseases and we were able to narrow down what treatment we could use to deliver medication. I just looked at those papers a couple of weeks ago at school. Medical treatment – basically that you have data – information that you need- and that there would be different ways to treat the situation and you could figure it out through the process of elimination. Or by getting into the cell you can cut out the extra testing – you could prescribe a specific treatment --- rather that what we do not which is broad-based and kills a lot of good cells.
The room that was dedicated to NT companies – they each had their own table and what they were working on. They made you realize how broad the effects were and how it could be used. The ice cube tray. Then outside that room we saw the presentation on NT of models basically that you put together – they were just like models of tiny, tiny particles. We also saw the demonstration upstairs with the clothing and how those pants appeared to be resistant to liquid. **NT companies** – trying to show potential NT has and how broad the potential is. It's not just some sort of scientific medicinal approach, but there could be an impact on their everyday life in many different ways. Here's all these different uses and it's not a narrow field it's a broad field and can address many different aspects of your life. **Buckyballs** – trying to familiarize people with what "it" is – what these particles are; bringing it to the larger scale so people can understand what their working with. **Clothing presentation** – to make it apparent – it's out there – it's already in your life and you just don't know it. Show that it affects everyday life.
I think the only one we did was to make the buckyballs, but we were like the first people that day and we were the only ones doing it so we spent a lot of time – the ladies spent a lot of time explaining it to us. Oh – and we spent time on the computers and we were trying to drive the trucks through an obstacle course – and I was really bad at it and my kids laughed at me. **Buckyballs** – structural make-up of buckyballs. **Truck through obstacle course –** At one point we made the trucks, so how they are put together. We put them together and I kind of got that they're so small that they have to be put together via computer. The driving got me confused – I wasn't sure if it was just for fun.

Response
A fellow with a table talking to people in the main area and he had some gold nanoparticles and some pickles and he said it could be a test instrument – I forget – salts – showing how the pickles had an element that the gold could detect. I also went to the seminar where showing current use of nanotechnology and how they might be used in the future and how the EPA has put roadblocks in the future right now. I tried to pay attention – but probably didn't catch everything. How it would help in the health field, being able to do different things with magnetic fields applied to them, how they could be super-insulators, how changing the size of the particle changes how it could be used in a lot of different areas – electronics, physical structures. Also, some younger kids doing something in the cafeteria, but I did not attend. ***DEMO:*** Trying to show visitors that something that was gold [typically] wouldn't be able to prove anything about the chemical composition of the pickle juice, but could be used in an unconventional way as a test instrument. ***SEMINAR:*** Trying to explain in general terms that NT is something that's out there and a lot of people are looking at and it has potential to do good things, but also some potential pitfalls and problems as far as being able to provide new properties to existing technologies. Being able to change a person's cloths just by touching the clothes, changing the color of zinc oxide, added value, changing waterproof properties, potential to cure diseases like cancer. Discussing potential advantages and problems.
Bucky balls Watched demo – burning substances [my 8 year old loved it too] They had calendars there with electromicscorpys. **Buckyballs** – how didn't nano particles come together – their shape. I don't know if you know this but their structure [based on triscillinas] that Buckminsterfuller invented is the basic structure of cells. **Demo** – showing how different elements [with video] how they behave in different ways than normal. There were some phases things. Blowing up stuff.
Magnetic cars – showed size of nano Made some little ball We went to them all Some room talking about (college students) with displays I think they all were trying to tell us that nanotechnology is not something that is out of reach for the normal person, that it can be used in everyday life, even though it's on the molecular level and you can't even see it. That it's for the average joe – not the scifi, magical stuff that it was once maybe believed to be – that there are really practical uses.
Light bulb demo my daughter was involved with that. Balloons – creating a long chain using the balloons Made these little balls using white paper. I can't remember exactly what they were The light one – showing that you can use nanotechnology for lighting and that our use of electricity can be more efficient using nanotechnology. Balloons – when all of the different nanotubes connected to one another – it showed greater strength. That the bonding of the nanotubes was really strong. Not sure with the nano balls.

Response
The table where they had the different experiments Both sessions of the presentations We experienced pretty much everything that the DCM had to offer that day. Table experiments – different color fragments; magnet – to show the attraction of light with nanoparticles inside a test tube. Just to try to give an intro to general layperson – what are its applications, what can we see this technology used for in future.
Two things, demos, down at the place where bunch of people sit and listen to the demos – can't remember specifically what they were. We also went around to the different booths by various universities. Couple other booths – shaking jars to see what was inside them. Demos - The features of nanotechnology and the direction scientists can take with medicine and technology due to the size of nanotechnology. Booths – weren't all that great. I have high school students and we were looking more for stuff for HS students – and it was over their head and frankly over my head. Next year they should tone it down a bit and make it more accessible.
The water droplet activity. My kids weren't so into the nanodemos – they were about really small things They were just to give them a definition of nanotechnology on a physical basis or a physical representation of nanotechnology – to help them realize what it is, and how it is everyday.
You had to cut a strip of paper to what you thought a nanometer was. Then the people at the table told you that the people who cut nothing or cut something that was too small to see were correct. The magnet that I told you about earlier. Cut strip of paper – that it's extremely small – and the technology involves things that you don't know about or realize. Magnet – I'm not really sure. Maybe that the vibrations were nanotechnology.
There was a table demonstration that was talking about nanotechnology – that was probably it. The demo was trying to raise awareness about nanotechnology and it was trying tell visitors about the benefits of nanotechnology – the antimicrobial socks were an example of this.

Response
They had something with a protozoan – a guy doing the demo – the same thing can operate or function different at different levels – water in a tea cup. Kind of like that movie Bugs – the bead of water – can pick up a bead of water – if it's small enough it will hold itself together – tension between water and cup Another thing that you had to write out – but it was way over my daughters' heads so we didn't pay much attention to that. Something with hydro car, but I'm not sure if that was nano or not. I can't presume what you were trying to demonstrate, but I'll tell you what I think we got out of it. We got out of it that there are things on a tiny scale, microscopic, that are functioning the same and different at a much larger scale. That things we can't see can still function and perform tasks And it wasn't just the physics of it – that things still act similar on a much smaller level, but technology too – manipulating things at the microscopic level to perform differently or to make things. That this things on this scale are affecting us and relate to use – I tried to explain it to my daughter using Horton Hears a Who, that he could hear something and everyone thought it was nothing, but once they figured it out there was a whole world down there – it's similar to what McWane was saying – that just because you can't see it – it's still relevant and there is something there and it affects our life. And really for my daughter – she wants to be a scientist when she grows up – so it was exposure of another realm of science that she could do now and later – and we continue to talk about it at home. Measuring on different scales using the metric system was a little over my daughters level – so we didn't pay attention to that one as much.
Pants demo – and he showed us how you can't see it – but you can feel the resistance on this tiny – I don't remember what it was – and he used water. The blood experiment with the cancer. I don't remember anymore than that – it's been awhile. That you can – about how – even though you can't see it, it's really there and you can use that technology on a smaller level than we can realize.

Table SB5. Responses to the interview item, *Have you spoken to anyone about nanotechnology or your experience at* [XX Museum] *since you attended NanoDay(s):*

Response
□ **Family?** X **Co-workers?** □ **Friends?** X **Other:** Clients I told them that it was a fun day, but I didn't go beyond that.
X **Family?** X **Co-workers?** □ **Friends?** X **Other:** My students. I teach science for 5th through 8th grade. I spoke extensively with the kids in the 8th grade. My 8th graders are going into highschool and I was impressed that this was something they could do with a two-year degree. I can't honestly remember what else I said, however, since I was given the calendar I took that apart and put that out for the kids to look at and we discussed it and I had to admit to them that I'm not very well-versed in this and I would have to do more study. **Family –** same thing. We've had cancer in our families and the idea that you could deliver treatment directly to a tumor rather than use radiation. **Co-workers –** basically, I told them that we had a great day – my daughter took me for my birthday – I showed them the pictures from the calendar. They said "that's nice," but I did tell the other 8th grade teacher that students could get into this with a two-year degree.
X **Family?** □ **Co-workers?** X **Friends?** □ **Other:** __Some teachers **Family** – We shared about the clothing and stuff to share with them this is already here. We just don't realize – how amazed we were that it is already so prevalent in our everyday life and we just don't know it. **Friends** – same as above. "You won't believe this!" **Teachers** – I told them this [the activities at the museum and NT as a topic] is something that middle school student might like and should know more about.
X **Family?** □ **Co-workers?** X **Friends?** □ **Other:** **Family –** we talked about the buckyballs and that they were made to take medicine to different parts of the body and that they allowed them to pinpoint a specific place. We brought everyone a buckyball and so we talked about how they were structurally that way and they can make sheets of them. **Friends** -- a lot of the same stuff.
X **Family?** X **Co-workers?** X **Friends?** □ **Other:** Mostly about the NT in all instances, not so much about the Discovery Center. I talked about how I thought they [DSC] did a great job to discuss any topic, but had the potential to take things to the next level (on all topics) -- an intellectual level. Nothing like UWM – University Wisconsin Madison -- does. **Regarding NT** – To all people I spoke more about the properties of the components and what they could potentially do; how could be used, mechanics of it; what I had learned. To a select few I mentioned that it was great we learned about it, but partially an advertizing process – "You will be able to buy this someday!"
X **Family?** □ **Co-workers?** X **Friends?** X **Other:**Took the Cub Scouts that day and I spoke to a friend who is in PR in the Science Center. I told her that the science center didn't use to do these things [special event days] and I think it really helps to being people in. We've gone to a DNA day since then. The demo theater is great. I primarily said that there is a great demonstration on this fairly new technology and that someone at Wash U is a person doing it and that there are all these great applications that will improve many industries.
X **Family?** □ **Co-workers?** X **Friends?** □ **Other:** I talked to my godson about it – I asked him what he knew about it, and I showed him the magnetic car so he could get an idea of the size of it. I also talked to my buddies about it, we watch the Discovery Channel and such so we are often talking about this type of things. I told them that nano is for the average joe – not something that is super star treky that we will never use. I let them know about some of the more useful applications of nanotechnology.

Response
□ **Family?** □ **Co-workers?** X **Friends?** □ **Other:** We live in Indiana and ran into our daughter's pastor – and talked about the activities and how he had also been to NanoDays at SLSC. We talked about the activities that we had each been to and what activities his kids liked and which ones our daughters liked. It was neat that someone we knew that lived a ways away had been to the SLSC and experienced similar things.
□ **Family?** □ **Co-workers?** □ **Friends?** □ **Other:** Not specifically in regard to nanotechnology. My son is in Boy Scouts – and he has a lot of requirements he needs to complete for the Weeblos and I have talked to his leaders about how the DCM might fit into that. We love the DCM, although SciTech is closer to us – but we try to frequent both of them.
□ **Family?** X **Co-workers?** Other teachers □ **Friends?** X **Other:** Students That it was good, but the biggest problem was that it didn't seem geared towards high school students. The other teacher I was with agreed with me and thought it was a little over our students heads.
□ **Family?** □ **Co-workers?** ?? **Friends?** □ **Other:** No, I don't think so. I might have mentioned it to my husband.
X **Family?** □ **Co-workers?** □ **Friends?** □ **Other:** My mom – I told her about the activities – I described them to her. And I showed her the paper balls that we folded and put together.
X **Family?** □ **Co-workers?** □ **Friends?** □ **Other:** Not specifically about nano, more about the impact the museum has and how well they do things. Although I have talked about nano with my kids – asking them what nano is – they reply with "really really small"
X **Family?** □ **Co-workers?** □ **Friends?** □ **Other:** Really just my kids – bringing it up and making sure they remember about it and some of the stuff we learned. But other than that – I don't get out much.
X **Family?** □ **Co-workers?** □ **Friends?** □ **Other:** _____ **Husband and mother-in-law:** We just told them about the pants – and how he [presumable her son] got to experiment with the grape juice (the blood) with the cancer – we talked about the human body and how you can use nanotechnology with the body and the future advancements that are possible.

Table SB6. Responses to the interview item, *Do you think your experience at* [XX Museum] *has made you more confident about talking to others about nanotechnology?*

Response
I suppose. Right afterwards I did – when I would remember it better. I think it did – I'm always talking to people when I'm working on them and I probably did talk about it a lot. I was able to relay my what I learned to other people.
As long as I'm talking to other people on my same level, yes. One of the problems I had is that there were two people -- a young women and a young man --talking about their projects. My daughter with a degree in Physical Therapy understood more than I did. A lot of it was over my head. But, that's a hazard when you have people passionate about heir work – but they were very patient and did a great job.
Yes. Before I thought it was questionable – something off in the future; scientific. But now I can say, "This is today." This is what we're looking at.
Yes – I didn't even know it existed before we went to SLSC.
More informed. Good job of explaining potential, what their working on, and did a good job with a wide audience.
Definitely. Because honestly before I saw some of the demonstrations and exhibits the only thing I know before was the chemotherapeutic mechanisms and now I think about how NT changes how we think about substances and I didn't know about the extent of that until I wnthter.
I guess – even before I went, my friend who's into that kind of stuff – he was telling me about it, but it was me bringing info back to him – so it made me more confident to talk to him. I knew about how useful it is for everyday lives and I could let him know about that.
I know a little bit more about it – I had only heard the word before I went to SLSC. Now I know there are practical applications of nanotechnology.
Yes it has – it's definitely given me a little more of a background – some articles I have read in the past about nanotechnology, but I never knew of all of the applications that were out there. It's still in the realm of science fiction – remember the movies where they shrunk a man and put him inside a body – I think that's how a lot of people still think about nanotechnology. So to realize it goes beyond scifi. – and that there are applications and it does exist and it's a continuing technology – that's what DCM did for me.
Yes, gave me a little bit of an idea of how nanotechnology is used and the break throughs scientists can make with nanoparticles.
No
No. I'm not a very science minded person to begin with though.
I suppose so, it gave me a general sense of what the applications are and that there are benefits of nanotechnology.
Yes – since I didn't know what it was before, I have knowledge of it so can talk about it. The McWane Science Center is very good about relaying things so I can understand them and talk to my kids about it.
Yes, becoming more aware – I had no idea before – before I thought nano was just microchips in computers – I didn't realize you could use it in clothing.

Table SB7. Responses to the interview item, *Do you think your experience with the nanotechnology activities at* [XX Museum] *has affected your awareness of nanotechnology?*

Response
A little bit. Prompt: *Did you learn something you didn't already know?* Yes – most of it. I think my knowledge before was only vaguely about computers and a thought that it was about it, but not actually knowing anything.
Absolutely. Well, first of all, I really didn't know anything about it. So, any information that was given to me was new. I kind of compared it to the experience I had with fractals in math. Again, information that came about since I graduated from college. New information. Even though I didn't get 100% of what they were saying – that wasn't their fault – I could go home and look up information on the internet. I thought it was excellent.
Absolutely. It's made me aware that this isn't just some scientific musing, made up, it's something that's real and it's here today and will be here in the future and has great potential for a positive impact in our life.
See #5 above.
Yes – probably, yes. Yes -- learned some things didn't know.
Yes. I was thinking of it more in terms of chemistry and now I know it affects more. Physical and biological. I think in biology, I thin some of the molecules behavior differently in DNA and all that.
I guess so – really it just brought it back to the forefront of my brain – I heard about it 10 years ago – that it was little machines that they could put in your blood stream and maybe fix health problems. Attending the museum let me know about applications that you never heard about – originally it was the "miracle technology" and then it fizzled out. Now they want you to know that it has actual uses – maybe not as grand as they once thought, but that it has uses that you can actually use.
Really the awareness of the practical applications. I never really thought about things on that small of a level either.
Yes – Everything I said before – but it gave me more of a general knowledge – scientific knowledge about nanotechnology. I think it's good to expose the kids to different ideas and concepts. And maybe in the future they will remember this experience and then they can build on that knowledge.
Yes, similar to what I have said earlier – that it made me more aware of the uses or potential uses of nanotechnology and how it can affect medicine and electronic technology.
Uhhh….sure. I read about in a few blurbs before I went to ScienceWorks and the exhibits there just helped increase my awareness.
I don't know that I have ever heard of it before going – so it increased my awareness of it.
Yes, I wasn't really aware of nanotechnology before I visited.
Yes – I wasn't really aware of it before – there was more stuff than I remember, but something with CDs – how they look perfectly smooth to our eyes, but at the microscopic level it's real bumpy and you can store more date – that kind of awareness of understanding things are different at the smaller scale.
Really just making me aware of things – before I thought nanotechnology had to do with really just computers – but you can use it in different areas and the possibilities are – there are more possibilities to use the technology than you realize.

Table SB8. Responses to the interview item, *Have you noticed anything on TV, radio, or in the news in the past few weeks/months that relates to nanotechnology?*

Response
The only thing was them going up to fix the Hubble telescope.
No. But I haven't home for the past few weeks.
Yes. In particular, we noticed that in the news here locally that statewide summer youth programs are promoting or focusing on companies that have NT were some of the ones they wanted students involved with. [summer jobs and internships – statewide summer youth employment program – major stimulus funding.] More green jobs and cutting edge technology – NT one of them.
I don't think so.
No.
Yes. Wash U paper has done things on it. IT was just how chemo therapy is being dielifered
Yeah, I read something not too long ago – occasionally it pops up – but I can't really remember what it was. Sorry.
I saw a PBS documentary that talked about nanotechnology. I didn't pay much attention to it, but now I know what it was about.
Not really – I haven't seen anything that I can recall.
Not that I can think of.
No.
No.
I have not noticed anything.
No, but I don't have TV or listen to radio – I only get Newsweek – so I wouldn't get much.
I haven't lately.

Table SB9. Responses to the interview item, *Was there any lasting impression of your nanotechnology experience at* [XX Museum] *on your life?*

Response
I don't know. Just that I think it gave my son a better awareness and he may be able to pick up on it because of his interest. I don't know about my life.
Well, maybe it's just my philosophy, but anytime you learn something new -- whether you understand it at that time or it's new terminology – you've put ideas in my brain and now I can pursue it. I feel an obligation to my students to try and make myself more aware and I think increasing vocabulary is one of the ways you get people to engage with new ideas. Consider contacting people earlier. You'd get more information from them -- or do a double contact. Stuff you don't keep at the forefront you forget.
I find myself looking more and more for products that may be coming out that have been developed through NT that would improve the effectiveness or efficiency of products and processes in my life.
See #1 above. We really liked your museum.
I think it was very interesting and when we talk about NT in general, it's a technology that's in it's infancy, but I think carbon technology and NT could lead us into our next technology age. That is the next leap for mankind – to utilize this technology and take us into the next age (iron, bronze, …) I hope that those of you at the DSC keep up the good work and doing what you're doing.
Anytime I learn something new I get kind of excited. Seriously. It's neat to see that this industry that I thought was related to one thing has multiple, wide range of applications to various other aspects of life. I mean they put it in paint and for super-conducting and all sorts of things. And that's kind of exciting.
I think they are just trying to market it differently – 10 or 15 years ago it was this mysterious stuff that you didn't really know what it did; now they are trying to market it differently. Maybe taking it from that thing that might not be the miracle thing that they thought it was going to be, but it is the miracle thing that they think it will be – but in a much more applicable way. They don't want you to be afraid of it, but want you to realize that it has applications for your everyday use.
The thing that really stuck out the most – the lighting demonstration – that we can be more efficient and think of things in a much more micro-level.
The only thing that really comes to mind was the one segment where they talked about the stained glass – and how gold nanoparticles were used for stained glass windows. I drive by a church everyday so I guess that helps bring it to my mind very often. And how it's been used for a really long time, even if they didn't know what's what they were doing. That was probably the lasting impression for me – the application in stained glass.
Just sort of the impacts that it will probably have down the line in terms of technology and medicine.
I can't say there was – well…there is, there always is, in the big picture, everything effects everyday, but not in a way I can really say "because I experienced the exhibits at ScienceWorks I did this…" Sorry I'm not more helpful.
I guess I just became aware of it. But other than that – no.
The socks – it's sad, but that's what really stuck out in my mind. I guess they really have to make it accessible to the peoples and this was a good application for me.
Yeah – I wish I remembered more, and it's on my list of things to check up on so I will remember more, but I haven't had time to do that. I know it had a lasting impression on me – obviously if I wanted to remember more. Really just being aware of its existence – even if you don't know about it or don't think you need to know about it – it's important to know that this type of science is out there and is applicable and relevant to your life. Something interesting to follow – made me aware of it. I'm not a scientist of anything so I won't act on it or probably won't use it, but I think it's important to be aware of what's going on in the scientific world. It's kind of like you know - you follow politics, but you never run for office.

Response
The pants – it's been awhile now since we did all of that – and the things that we can remember was the pants and the blood with the cancer. And we were there for awhile and did a lot, but those are what I remember. The pants really stick out just because they didn't get wet when water was thrown on them.

Appendix B Year 4 solicitation e-mail

From: ScienceWorks Hands-On Museum [visitorstudies@omsi.edu]
Subject: Recent visit to ScienceWorks Hands-On Museum

ScienceWorks Hands-On Museum wants to hear your thoughts so that we can make our programs as interesting and appealing as possible. Please provide feedback about your experience through the link below, and enter to win one of ten **$25 gift cards to Amazon.com.** We estimate that one in every thirty respondents will receive a gift card.

Your participation is voluntary and anonymous. We hope that you will respond to this e-mail soon. E-mail questions or comments to visitorstudies@omsi.edu.

Please provide your feedback.

Brett Kiser
Project Evaluator
Oregon Museum of Science and Industry
visitorstudies@omsi.edu

You received this e-mail because you provided your e-mail address to ScienceWorks Hands-On Museum during a recent visit within the past few months. This e-mail was sent by the Oregon Museum of Science and Industry (OMSI) on behalf of ScienceWorks Hands-On Museum.

Appendix C Year 4 online survey instrument

Thank you for participating in our online survey. To make our museum programs more interesting, we want to learn about your thoughts on content areas.

This survey will take between 2 to 7 minutes, depending on the depth of your responses. Once you complete the survey, **you can enter to win one of ten $25 gift certificates to Amazon.com.*** We estimate that one in every 30 respondents will win a gift certificate.

Your participation in this survey is completely voluntary and you can stop at any time. Your responses are confidential and will be combined with other participants' responses for reporting purposes.

If you have any questions or comments about this survey, please direct them to visitorstudies@omsi.edu.

*Click here for official rules and regulations.

Next>>

To help us understand the demographics of our respondents, please answer the following questions.

When did you last visit the Saint Louis Science Center?

- ○ Within the last month
- ○ Within the last six months
- ○ Within the last year
- ○ More than one year ago
- ○ Never visited

Are you currently a member of the Saint Louis Science Center?

- ○ No
- ○ Yes

What is your gender?

- ○ Male
- ○ Female

What is your age?

[ ]

What is the highest level of education that you have completed?

- ○ Some high school
- ○ High school degree
- ○ Some college
- ○ College degree
- ○ Some graduate work
- ○ Graduate degree
- ○ Other (please specify) [ ]

What is your ethnicity?

- ○ Hispanic or Latino
- ○ Not Hispanic or Latino

What is your race? (Check all that apply.)

- ☐ American Indian or Alaskan Native
- ☐ Asian
- ☐ Black or African American
- ☐ White
- ☐ Pacific Islander or Native Hawaiian
- ☐ Other (please specify)

Do you have a temporary or permanent disability?

- ○ No
- ○ Yes

<<Prev Next>>

How much have you heard about nanotechnology?

	Heard nothing at all 1	<---- 2	----- 3	----- 4	----- 5	----- 6	----- 7	----- 8	----> 9	Heard a lot 10	Not sure
	○	○	○	○	○	○	○	○	○	○	○

<<Prev Next>>

If respondent checked '1' – he/she skipped most of survey – went directly to "Have you heard about or experienced any of the NanoDays activities"

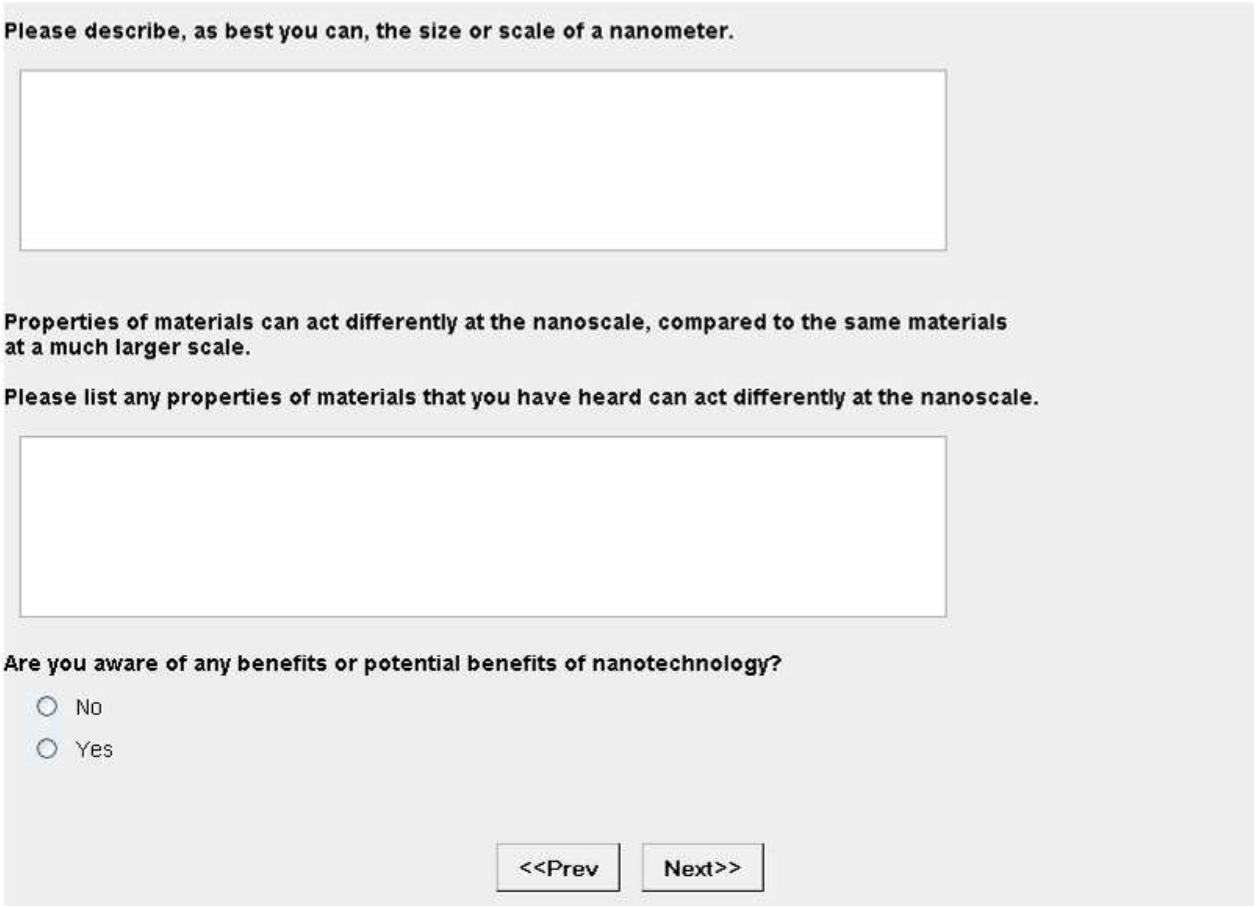
In the textbox below, write any thoughts, ideas, emotions, questions, or definitions that you associate with the term "nanotechnology."

In which of the following do you clearly remember reading, seeing, or hearing about nanotechnology? Please check one answer for each row.

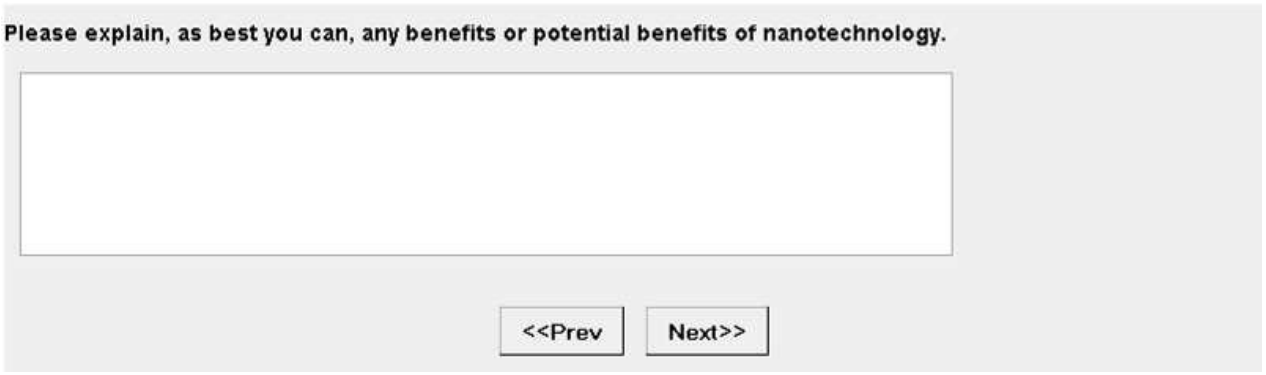
	No	Yes	Not sure
Movies	○	○	○
Consumer product labels	○	○	○
Internet	○	○	○
Television	○	○	○
Word of mouth: family, friends, coworkers	○	○	○
Print: newspaper, magazines, journals, books	○	○	○
Museums, Science Centers	○	○	○
Radio	○	○	○

Other (please specify)

<<Prev Next>>



If respondent checked "no" – they skipped the next question



Are you aware of any risks or potential risks of nanotechnology?

- ○ No
- ○ Yes

<<Prev Next>>

If respondent checked "no" – they skipped the next question

Please explain, as best you can, any risks or potential risks of nanotechnology.

<<Prev Next>>

Have you heard of nanotechnology being used in the following applications? Please check one answer for each row.

	No	Yes	Don't know
Clothing; fabric	○	○	○
Cosmetics; skin lotion	○	○	○
Solar technology	○	○	○
Computing technologies	○	○	○
Sports equipment	○	○	○
Air and water purifiers	○	○	○
Medical diagnostics and treatment	○	○	○
Washing machines	○	○	○
Paints; coatings	○	○	○
Insulation	○	○	○

Other (please specify)

<<Prev Next>>

The Saint Louis Science Center sponsored NanoDays on Friday, April 3rd and Saturday, April 4th, 2009. NanoDays consisted of multiple activities, programs, exhibits, and/or forums about nanotechnology.

Have you heard about or experienced any of the activities that were offered at the Saint Louis Science Center during NanoDays?

- ○ Neither heard about nor experienced
- ○ Heard about the nanotechnology-related activities
- ○ Experienced the nanotechnology-related activities

<<Prev Next>>

If respondent checked that they had experienced nano-activities, then they completed these items.

Please tell us what nanotechnology-related activity(ies) you experienced at the Saint Louis Science Center.

Did the experience influence your awareness of nanotechnology?

	Did not influence awareness 1	<---- 2	----- 3	----- 4	----- 5	----- 6	----- 7	----- 8	----> 9	Highly influenced awareness 10	Not sure
	◉	○	○	○	○	○	○	○	○	○	○

Please describe how the experience influenced your awareness of nanotechnology.

<<Prev Next>>

Please describe any new topics or subjects that you would like to see included in the museum's exhibits and programming.

<<Prev Next>>

If respondent checked that they had experienced nano-activities, then they completed these items.

While your answers to the previous questions are greatly appreciated, we are also interested in more detailed information about your experience.

To do this, we will be conducting follow-up interviews over the phone. If you complete a phone interview, you can enter to win a $50 gift certificate to Amazon.com.

Would you be interested in a follow-up interview that would be conducted over the phone?

- ○ No
- ○ Yes

<<Prev Next>>

Your name and phone number will only be used for the purpose of calling you for a follow-up interview and will be destroyed after the interviews and the drawing, and will not be linked to any of your responses.

Please provide us with your name, phone number, and the best time to call you.

Name:
Phone Number:
Best time to Call:

<<Prev Next>>

Thank you for your responses to this survey. We would like to thank you by entering your name and e-mail address into a drawing for **one of ten $25 gift certificates to Amazon.com.***

Your e-mail address will only be used for the purpose of sending you a gift certificate, should you win. Should you win, your name will be made public on our published winners' list, although in no case will your name be associated with your responses to this survey. Otherwise, your name and e-mail address will be destroyed after the drawing and will not be linked to any of your responses.

You are also welcome to submit your responses without giving your name and e-mail. Just click SUBMIT below.

*Click here for official rules and regulations.

To be entered to win one of ten $25 gift certificates, please type your name and e-mail address that you gave to the museum when you visited most recently.

Name:

E-mail:

Please re-enter your e-mail address. Typos are common, so we need to double check.

E-mail:

<<Prev SUBMIT

Appendix D Year 4 demographics

	Control (n=118)	Treatment (n=105)
18-24 years old	4%	6%
25-34 years old	28%	19%
35-44 years old	42%	52%
45-54 years old	13%	16%
55+ years old	12%	8%
Mean Age	40 ± 11	40 ± 10
Members	24%	23%
Females	77%	75%
Males	23%	25%
Some high school	2%	1%
High school degree	8%	6%
Some college	25%	17%
College degree	39%	30%
Some graduate work	5 %	12%
Graduate degree	21%	33%
Hispanic or Latino	3%	3%
American Indian or Alaskan Native	1%	2%
Asian	3%	1%
Black or African American	5%	6%
White	90%	91%
Pacific Islander or Native Hawaiian	1%	1%
Permanent or temporary disability	1%	5%

Table 6. Year 4 respondents' last visit to museum and NanoDays.

	Control (n=118)	Treatment (n=105)
Within last month	77%	82%
Within last 6 months	21%	14%
Within last year	1%	3%
More than a year ago	1%	1%
Never	0%	1%
Neither heard about nor experienced NanoDays	87% [a]	28% [a]
Heard about NanoDays	12% [a]	25% [a]
Experienced NanoDays	0% [a]	48% [a]

[a] X^2 (2, N=223) = 95.460, $p < 0.001$.

Appendix E Nanotechnology associations: Verbatim responses

Category	Example response
Left blank or wrote don't know	
Tiny, very small, or microscopic	*Extremely small particles* *Things on an extremely small scale. Smaller than a microscale*
Application or implications for future potential	*Controlled manner with lots of applications* *It has promise for different areas that can benefit our world*
Medical benefits or applications	*Micro technology useful for medical treatments and surgeries* *I know in the medical field scientists are using this technology for cure diseases*
New technology or smaller computers	*Whenever I hear of nanotechnology, I think of computers and speed of processing information* *New technology*
Positive emotional responses (e.g., interesting, exciting)	*I believe that nanotechnology is a wonderful and exciting science* *Sounds really cool*
Science fiction	*I think of Star Trek* *Most of my experience with nanotech is from science fiction, where the nano is either a weapon or the fountain of youth*
Tiny robots or machines	*Extremely small robots* *Dealing with microscopic machines*
Mentioned the museum or experience they had there	*We attended Nano Day on 4/4/09 and learned about nano measurements in a way that made sense to my 6 year old!* *Until that day at the science center i knew nothing of about nanotechnology*
Molecules or atoms were mentioned, or on a cellular level	*Nanotech, is the study of the control of matter on an atomic and molecular scale* *That which is brought down to the smallest (molecular) level*
Mentioned billionth of or the difference in the laws of physics	*Isn't it a billionth part of…* *Stuff that's so small that the usual laws of physics don't always apply.*
iPod nano or cellular phones	*Small electronic devices, such as iPods, cell phones* *I don't know if this is the same but I have an iPod Nano*
New science, should use caution	*My big question is long-term safety* *There also appear to be just as many problems created by or associated with its use, and there is no responsible oversight or regulation of its use.*

Category	Example response
Negative emotional response (e.g., fear, worry or confusion)	*I believe that we may be messing with mother nature here. especially if we are using products that contain nanoparticals on human skin. I also fear for the delicate web of interconnected life when we introduce these types of things. the potential for danger or misuse outweighs any perceived benefits* *There is also a risk factor with nanotechnology, they can be used by terrorists or other people to infect and essentially wipe out people just by programing the nanites in a persons body to cause harm instead of good..*
Other responses that wouldn't fit into the above categories	

Appendix F Benefits of nanotechnology: Verbatim responses

Category	Example response
Medical Benefits	*Delivery of medications* *Better drug-delivery systems, specific to cancer cells*
Benefits to machines, computers, or the use of robots	*It helps with the miniaturization of technological devices like computers and cell phones* *Computers and other technologies can be made significantly smaller*
Broad benefits for a specific industry	*Making things lighter and smaller. Out of the box way of thing about manufacturing* *I have read of potential benefits in mechanical and electrical engineering*
Environmental benefits	*Energy efficiency* *I believe there were environmental benefits*
Other specific examples of benefits that don't fit into the above categories	*It can be used to repel stains* *They also use it in socks to kill microbes so your feet don't stink*
Other responses that wouldn't fit into the above categories	

Appendix G Risks of nanotechnology: Verbatim responses

Category	Example response
Environmental risks	*Potential environmental hazard* *None of the life of this planet evolved to co-exist with nanotechnology*
Loss of control or unintended consequences	*We could lose control of the spread of nano-engineered devices* *There is some serious concern regarding the unintended consequences of nano particle development*
It's a new science and there hasn't been enough testing yet	*As with any new science, the technology must be monitored to ensure safety* *Not enough testing information out there on possible side effects*
Privacy breach or security issues	*Powerful technology can cause a great security problems (privacy)* *General big brother activities and a general reduction of human liberties*
Nanotechnology is harmful to humans	*Apparently, two studies have shown a link to mesothelioma, which is a deadly form of cancer normally linked to asbestos* *I read an article that suggested avoiding sunscreens with nanoparticles because they could theoretically be absorbed through the skin.*
Nanotechnology being used for intentional harm or the use of toxins	*I also know there are implications with weapons of mass destruction* *Public knowledge is a concern because people lacking a sense of social responsibility could use this knowledge to create untraceable weapons very quickly.*
Other responses that wouldn't fit into the above categories	

Appendix H Influence of NanoDays: Verbatim responses

Category	Example response
Increased my awareness of nanotechnology/wasn't aware of nanotechnology before	*I had no knowledge of nanometers with the exception of nanobytes until my visit at the McWane Center* *I knew nothing before.* *Made aware that it existed* *I wasn't too aware of what was involved in Nanotechnology before participating in the science center's event*
Increased my knowledge of nanotechnology	*As a middle-school science teacher, it provided me with information that didn't exist when I went to college* *Having an opportunity to hear information presented by experts in the field (and also having an opportunity to interact with those professionals) gave me the opportunity to learn new information in a way that made sense to me.*
Increased my understanding of the applications	*I didn't realize that nanotechnology was such a widespread field and had so many applications in a variety of areas (electronics, medicine, etc)* *I was fascinated by all the advances in medicine that have happened. His lecture really opened our eyes to all the up and coming things in this field*
Other responses that wouldn't fit into the above categories	

Appendix I Nanoscale: Verbatim responses

Category	Example response
Descriptive responses	*Really really small* *It is so small you can't see it with the human eye*
Correct measurement: One-billionth of a meter	*One billionth of a meter* *It is 10^-9 of a meter*
Incorrect measurement	*1 thousandth of a meter* *1/100 or 1/1000 of a millimeter*
Comparison to molecular or cell level	*A nano is smaller than an electron* *As small as an atom or molecule*
Microscopic	*Undistinguishable without aid of a microscope or other device* *Not visible with the human eye, visible with a microscope*
Smaller than a specific object (e.g., hair, pencil tip)	*If I would have to guess I would say the size of a lead pencil tip* *Something that is smaller than a follicle of hair*
Other responses that wouldn't fit into the above categories	*Measure of the ability of a very small object to do work*

Appendix J Material properties: Verbatim responses

Category	Example response
Not sure or don't know	*I haven't heard of any* *No clue*
A specific property was listed	*I believe temperature and pressure can act differently* *Fabrics have special properties (i.e. stain, water repellant)*
An object or material was mentioned without a specific property	*Water and oxygen* *Computers* *Sound or light*
Other responses that wouldn't fit into the above categories	