

ANNUAL MEETING HANDOUT

Making Evaluation Practices Work in Real-Time

This session offered a glimpse of how some projects and organizations are integrating evaluative thinking and practices into their daily work and product development processes. The session focused on sharing different ways of facilitating learning and evaluation capacity building, with an emphasis on sharing the products of those labors.

Presenters

» **Sarah Cohn**, Evaluation and Research Manager, Science Museum of Minnesota

Annual Meeting & MuseumExpo

As the museum field's premier professional development opportunity, the Alliance's Annual Meeting & MuseumExpo showcases the best thinking from practitioners and visionaries on major issues confronting museums and the communities they serve.

This session handout is from the 2013 Annual Meeting in Baltimore.

Team-Based Inquiry

A Practical Guide for Using Evaluation to Improve Informal Education Experiences

By Scott Pattison, Sarah Cohn, and Liz Kollmann





The Nanoscale Informal Science Education Network (NISE Net) is a national community of researchers and informal science educators dedicated to fostering public awareness, engagement, and understanding of nanoscale science, engineering, and technology.



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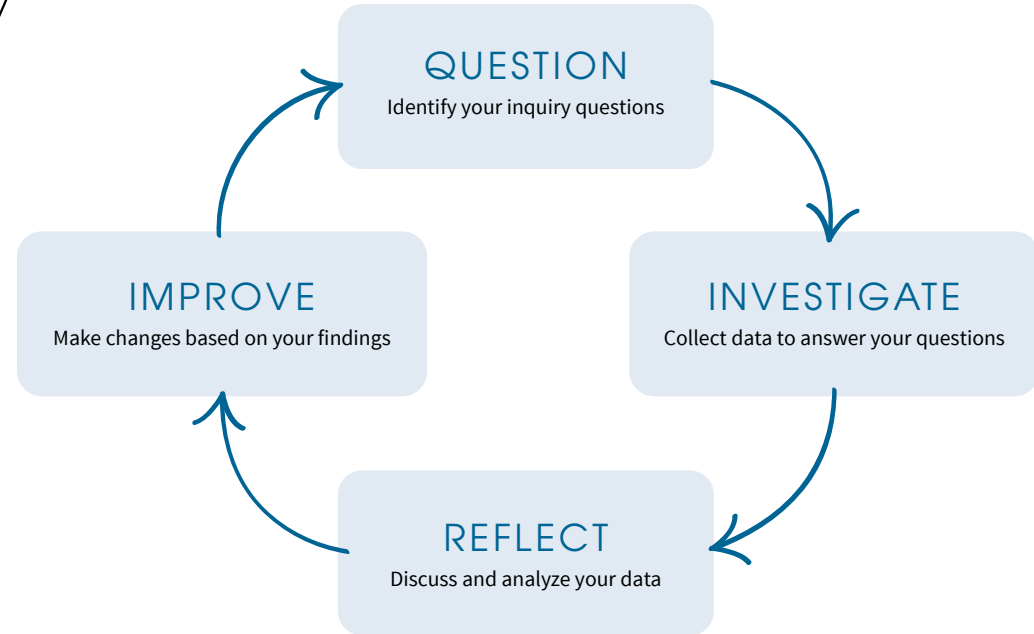
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Team-Based Inquiry at a Glance

Team-based inquiry (TBI) is a practical approach to empowering education professionals to get the data they need, when they need it, to improve their products and practices and, ultimately, more effectively engage public and professional audiences. The TBI process involves an ongoing cycle of inquiry: question, investigate, reflect, and improve.



- TBI can be used to address a range of questions related to understanding your audience, developing and improving educational experiences, training staff, and more.
- The TBI process is often most successful when it is collaborative and team-based, small scale and focused, embedded in ongoing work, and led by education professionals.
- A good TBI **question** is one that (1) you don't know the answer to, (2) focuses on useful

and actionable information, and (3) can be realistically investigated given your resources and time constraints.

- The **investigation** method, whether it is surveys, interviews, observations, or another creative approach, should be chosen to best answer your inquiry questions.
- **Reflecting** on and analyzing TBI data often involves identifying patterns and themes across information you collect from many participants.

- Making **improvements** and changes based on your findings is one of the most critical steps of the TBI process.

- TBI studies should be conducted ethically and responsibly, with close attention to the comfort, rights, and privacy of participants.

Introduction

This guide introduces team-based inquiry (TBI) as a tool for helping those without formal training in evaluation to use data collection, evaluative thinking, and data-based decision making to inform their work and more effectively achieve their educational goals. The TBI approach was developed by the Nanoscale Informal Science Education Network (NISE Net) in 2010, building on a variety of evaluation, research, and inquiry approaches, and has since been tested and refined based on the input of evaluators and education professionals from across the country.

Although we hope that TBI will be useful and relevant to a variety of individuals, this guide was particularly written for museum

Team-based inquiry is a practical approach to empowering education professionals to get the data they need, when they need it, in order to improve their products and practices and create successful educational experiences.

educators and other informal science education professionals who develop or lead experiences for the public and have little or no background in evaluation. It is not a comprehensive guide to evaluation and inquiry. Rather, it's a practically oriented introduction to TBI, primarily focused on the types of inquiry you might do to



inform the development or improvement of educational experiences, including facilitated activities, demonstrations and stage shows, labs and classroom programs, and interactive exhibits.

The process of TBI was designed to help you use data to answer questions critical to your work, especially related to developing educational experiences. For example, you might conduct an inquiry study to better understand what participants already know about a topic and then use that information to create an experience that builds on participants' prior knowledge and interests. Or you might observe participants to determine

how well an existing educational experience fosters conversations and how it might be improved to better achieve this goal. More broadly, you might also use the TBI process to improve communication within your department or develop a new training for staff members.

Working with educators across the country, we have seen TBI used successfully to inform and improve all aspects of educational work, including program and exhibit development, facilitation and teaching strategies, staff training and professional development, community outreach and audience engagement, website design, and more. TBI studies have also focused on team communication, meeting structure and format, project administration and management, and strategic planning.

Why should I use TBI?

Across both the for-profit and not-for-profit sectors, more and more organizations are recognizing that in order to achieve their goals, stay competitive, and adapt to ever-changing markets and audiences, they need to embrace professional learning and data-based decision making. The fields of informal learning and education are no different.

TBI is one approach to incorporating these practices and ways of thinking into your work. It was designed to be accessible, practical, and inexpensive and to serve as an entry point for those individuals

“Team-based Inquiry allows us to systematically test a program, collect visitor feedback, and make improvements on our own timeline. Overall, it has helped enrich and speed up our development and prototyping process.”

- Ali Jackson, Sciencenter

and organizations looking to build their capacity for evaluation, professional inquiry, and data-based decision making. Like many other approaches to professional inquiry and learning, it was also designed to help foster effective teams and organizations. Over and over we have found that a collaborative process of inquiry helps team members achieve shared understandings of their educational goals, discuss

underlying assumptions and expectations, find effective strategies for working together and achieving consensus, and develop trust and a sense of common purpose.

When should I use TBI?

Although TBI is a flexible process that can be used to inform many types of projects and address many needs, there are cases when a different approach to gathering information and informing your work might be more

appropriate. A particularly important consideration is when to use TBI and when to hire a professional evaluator.

In our experience, TBI is most useful when you want to improve your own practice or you need information quickly to make decisions about a specific project. It's important, however, that the risks or costs associated with those decisions are not extreme. For example, we don't suggest using the TBI process for employee assessment or for making major capital reinvestment decisions. On the other hand, we do recommend TBI when fostering a successful team process, building shared understandings, and developing team members' evaluative thinking and data-based decision making skills are just as important as the accuracy and credibility of the study.

Another approach to gathering information to inform your work is to hire a professional evaluator, either from within or outside your organization. Although the costs and time associated with this approach are often higher, it is worth considering when: (a) there is a need for accountability to an outside agency, (b) the risks and costs associated with questions or decisions are high, (c) you have more

TBI IS PARTICULARLY USEFUL WHEN:

- You need information quickly to inform specific projects or educational experiences,
- The risks or costs associated with the project are low, and
- Fostering a strong team and building evaluation and inquiry skills are important goals.

time and resources to invest in a comprehensive data collection process, or (d) the accuracy and generalizability of the information are more critical than shared understanding, skill building, and timeliness. In some cases, funding agencies may require you to hire an external evaluator to conduct a final assessment of how well a project has achieved its intended goals.

Both of the approaches described above, TBI and working with a professional evaluator, emphasize systematic, well-documented data collection and analysis. However, there is also a lot you can learn by simply trying out a new educational experience with a few participants. Especially for newly developed programs, a few test runs will likely reveal major issues that need to be addressed right away, such as the organization of information, malfunctioning props or materials, or terms and concepts unfamiliar to participants. Working with educators, we frequently encourage this “try it out” process as a first step before beginning an inquiry study.

These approaches are certainly not exhaustive, nor are they mutually exclusive. Ideally, the TBI process complements the strengths and weakness of both professional evaluation and trying out a new experience with a few participants.

Using the guide

This guide is organized around the four phases of the TBI approach and is designed to walk you through the process and provide you with concrete tools and strategies for each phase. The first chapter

outlines the TBI process and provides suggestions for organizing an inquiry team and beginning your project. The remaining chapters address the four phases of a TBI study: question, investigate, reflect, and improve. We conclude with a list of additional resources and further reading to help you deepen your understanding of evaluation and professional inquiry.

We designed the guide knowing that educators and museum professionals are busy people in need of practical, concrete information. Each chapter begins with a summary of main ideas

and includes call-out boxes throughout to highlight key points. To better illustrate each aspect of the TBI process, we have also gathered stories, anecdotes, and quotes from a variety of educators who have led or participated in TBI studies. Finally, each chapter ends with a real-world example of professional inquiry, intended to demonstrate how a team might conduct a TBI study from start to finish.

Throughout the guide, we introduce a variety of tools and forms that we have found helpful in our own work. All of these can be found



“I’ve done program development with both professional evaluators and with team-based inquiry. Since I’m working with volunteers, I’ve found that TBI helps us make changes and try out different things within a shorter time frame. Opening up the evaluation process also allows the volunteers to have more ownership and buy-in.”

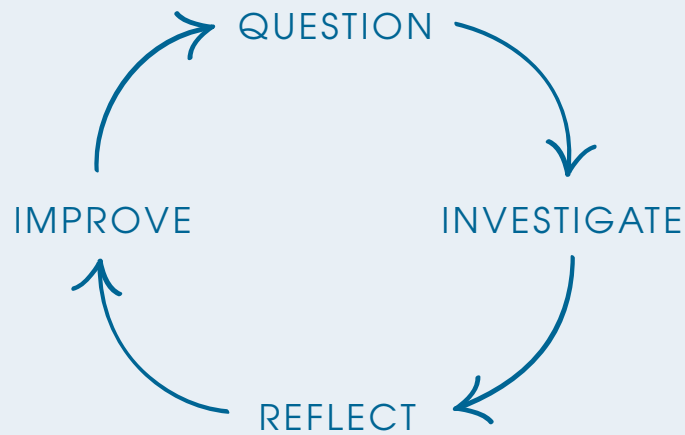
- Shari Hartshorn, Science Museum of Minnesota

in the appendix and modifiable digital versions can be accessed on the NISE Net website: <http://nisenet.org>. We have made the forms as generic as possible so that they can be used with a variety of projects and in a variety of settings and we encourage you to modify and adapt the tools and forms to suit your own needs, goals, and audiences. Above all, we encourage you to share your experiences and insights to help us improve the TBI approach.

*“It’s always important to frame
our TBI questions around things
we can actually act on.”*

- Kevin Dilley, Sciencenter





Chapter 1: Overview of the TBI Process

Delve deeper into the team-based inquiry (TBI) approach and the key steps to prepare yourself, your team, and your organization for an inquiry study. In this chapter, you'll learn that:

- TBI is systematic inquiry involving four steps: question, investigate, reflect, and improve.
- TBI is often most successful when it is collaborative and team-based, small scale and focused, embedded in ongoing work, and led by education professionals.
- Getting started on a TBI study involves assessing the level of supervisor and organizational support, understanding the need for inquiry, and assembling your team.
- The TBI summary form (Appendix A) is a useful tool for guiding the team through the inquiry process and documenting and sharing your work.
- TBI studies should be conducted ethically and responsibly, with close attention to the comfort, rights, and privacy of participants.

The TBI approach

The process of team-based inquiry (TBI) is very similar to the creative problem solving and critical thinking we often hope to encourage in the educational experiences we design for children and adults. For example, exhibits and programs at science centers often engage participants in scientific reasoning, including asking questions, making predictions, testing, exploring, observing, and making sense of the natural and physical world.¹ More generally, many museums and informal learning institutions are working to foster “21st century skills,” including critical thinking and problem solving, creativity and innovation, communication and collaboration, and scientific and numerical literacy.² At the heart of these skills is the ability to collect and synthesize information to answer meaningful questions—the same skills and reasoning strategies that TBI is designed to foster in education professionals.

Although the name is new, the fundamentals of TBI are not unique. The approach draws from a diversity of perspectives, including action research,³ practitioner inquiry,⁴ learning-focused and

participatory evaluation,⁵ and evaluation capacity building.⁶ All of these share a common focus on using data and systematic inquiry to empower professionals and create opportunities for learning and reflection. In developing the TBI approach, we have tried to synthesize and package the critical aspects and tested strategies from these different

TEAM-BASED INQUIRY IS:

- **Systematic**
- **Led by education professionals**
- **Collaborative**
- **Small scale and focused**
- **Embedded in ongoing work**

approaches in a way that is accessible for and relevant to the work of museum educators and informal science education professionals.

The TBI process was designed with a few simple but ambitious goals in mind. By regularly incorporating TBI into your work, we hope you will be able to:

1. Improve your educational products and practices,
2. Foster effective teams and organizations, *and*
3. Build your skills and capacity to conduct inquiry and evaluation.

One of the key characteristics of TBI is flexibility. The process may look very different depending on your needs and the context of your work. However, based on the research outlined above and our own experience, there are several characteristics of the TBI approach that we believe are essential to its success.

First, TBI involves a systematic process of inquiry that challenges your own preconceptions and helps you to use data more effectively. Second, to be most useful and relevant, TBI should be led by the education professionals for whom the information is most important. Third, as its name implies, TBI is collaborative and team based and should involve a group of professionals with shared goals working together during every stage of the process. Fourth, TBI studies should be small scale and focused,

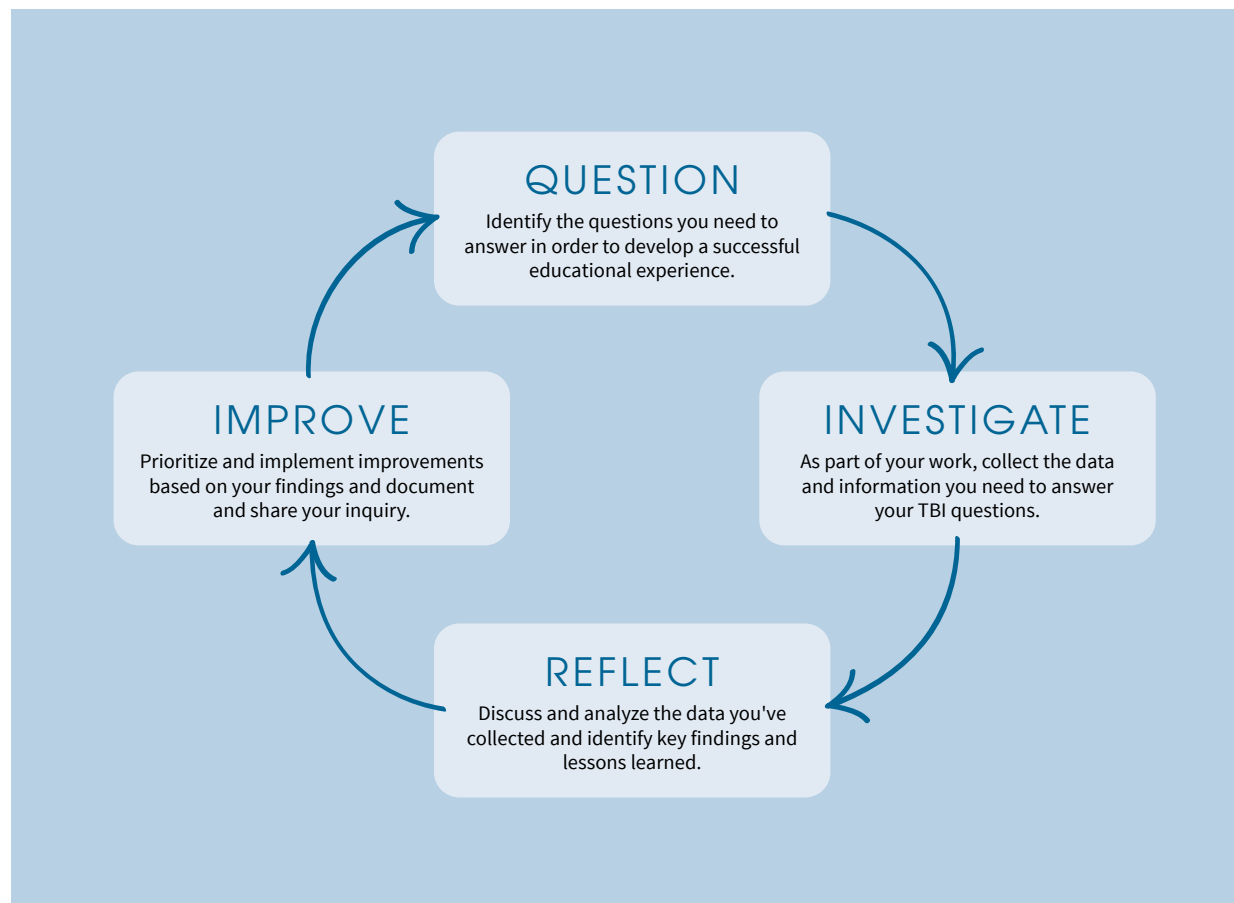


primarily designed to inform specific projects or educational experiences. Finally, TBI should be embedded in your ongoing work so that it is realistically scoped and becomes an integral part of your professional practice.

The inquiry cycle

At the heart of TBI is an easy to follow inquiry cycle. The first phase of the inquiry process, *question*, involves identifying the types of information you need to inform your work and develop your educational experience and then formulating those information needs as inquiry questions. In the next step, *investigate*, you collect data and information in a way that is best suited to answering your questions and is practical and feasible within the constraints of your study.

During the *reflect* phase, you discuss and analyze the information you have collected with your team and articulate key findings and lessons learned. Finally, and most importantly, you *improve* your educational experience, or inform your work more broadly, based on the findings from your study. This last step is also the time to document the inquiry, not only to share your findings with colleagues, but also to ensure that your team has a common



understanding of what you have collectively accomplished and learned.

As the diagram shows, this is a cyclical process. Ideally, you and your team will continue to engage in cycles of inquiry as new challenges and questions arise and as you become more comfortable incorporating TBI into your ongoing work.

Getting started

There is no magic formula for getting a TBI project started. Most importantly, you and a group of colleagues should have a clear need for information and an interest in incorporating data collection and systematic inquiry in your work. Several important things to think about as you begin are: (1) determining if your supervisor or organization will be supportive, (2) being clear about the need for inquiry, and (3) assembling a group of colleagues that share your interest in professional inquiry and will help make the process successful.

Organizational support

Support from your supervisors and organizational leaders is an important factor that can contribute to the success of your inquiry.⁷ Although it is certainly possible to carry out a TBI study without organizational support, it is much easier, and more rewarding, when you have the encouragement and buy-in of your managers and institutional leaders. These individuals can help ensure that you have



the time and resources to incorporate this approach into your work and the opportunity to regularly meet with your inquiry team.

More broadly, it can also be helpful if your organization has already developed a culture of learning that supports reflection, professional inquiry, and data-based decision making

and values innovative professionals like you who want to use inquiry to become more effective educators. However, even if you lack strong leadership support or a culture of learning at your institution, you still may be able to use the TBI process effectively. In fact, carrying out a very small study with a few like-minded colleagues and then presenting the results and, more importantly, the improved educational experience to your superiors may be an effective way to gain buy-in and support.

Identifying a need

Another important step before you begin the TBI process is to clearly understand the need that you hope to address through your study. For example, the idea of inquiry might arise from the need to create a new program, improve an existing activity, or make a decision between two potential themes for a new exhibit. The need for inquiry might also come from an external source, such as a funding agency that requires evaluation or a senior organizational leader that wants to integrate data-based decision making into the institution's culture. Although it may seem obvious, clearly articulating your need can help to keep you and your team motivated throughout the TBI process and stay focused on the information that is critical to inform your work. Understanding this need is also an important first step in identifying and prioritizing your inquiry questions, which we discuss in the next chapter.

Assembling a team

The next step in preparing for your TBI study is to assemble an inquiry team. Remember, working collaboratively with other colleagues is an essential component to inquiry and learning. Not only does a

team-based process help to develop shared understanding, foster buy-in, and promote teamwork within your organization, but having a variety of perspectives and backgrounds directly contributes to more effective inquiry and strengthens the quality of your findings. For example, the multiple perspectives of different group members can help reveal your own unspoken biases and assumptions that influence how you analyze data and interpret findings.

If you're just starting out on your first TBI project, we suggest finding a few colleagues who are supportive of the process, rather than trying to convince more skeptical individuals. In our experience, it's also important that each team member is invested in some way in the outcome of the study. This will help ensure that team members stay involved and supportive throughout the process. You might also want to consider including individuals with a variety of backgrounds on your team, as well as different roles and levels of authority within your organization. Regardless of who is on the team, don't underestimate the importance of relationship building. Trust, respect, and communication among team members are essential for successful TBI.

The ideal size of your team will certainly depend on the question, project, and context, but we have often found that working with between three and eight individuals helps to keep the process manageable and provide opportunities for all team members to participate. Of course, there may be times when it's not possible to collaborate with other colleagues. In this case, you may want to

“The TBI summary form was a really good tool and I used it a lot while we created the program. I focused on the four main titles—question, investigate, reflect, and improve. It was a roadmap: here was my question, here’s how we answered it.”

- Aaron Guerrero, Children’s Museum of Houston

conduct a small TBI study by yourself and use the results to interest others in collaborating on future projects.

Using the TBI summary form

One of the tools that can help guide you through the TBI process is the summary form (Appendix A). This form provides an easy way for teams to document their progress as they go through each phase of the TBI process and, in our experience, helps teams to keep in mind the bigger picture and the end goal of the study. Completing the summary form

as you go is a great way to keep track of your work, capture details you might forget later, and save time at the end when you want to describe and share your results. As part of the inquiry process, we recommend that you update and review the summary with your team at the end of each phase. (See Appendix B for an example of a completed TBI summary.)

Conducting inquiry responsibly

In almost every TBI study, especially those involving the development or improvement of an educational experience, you will be collecting information either directly or indirectly from people, such as museum visitors. The process of conducting inquiry or evaluation with individuals raises many issues of privacy, ethics, and responsibility. Even though your study might be quite small and informal compared to other more traditional research or evaluation projects, it is still important that you collect, handle, and store

information from participants carefully. In the *tips and tricks* section of each chapter, we highlight approaches to conducting TBI ethically and responsibly. As you read through the guide and go through the process of TBI, keep in mind the following questions:⁸

- Does your organization have guidelines or regulations about collecting data or conducting research and evaluation?
- Will potential participants have the opportunity to learn about what information they will be providing and how that information will be used so that they can make an informed choice about whether or not to be involved?
- Is all the information you plan on collecting essential to answering your inquiry questions or are there ways to decrease the burden on your study participants?
- Will you be storing and sharing results and findings from your study in a way that respects the rights and privacy of participants?

“If you develop programs, there is a small amount of evaluation you do all the time. You ask if it’s working and make changes. TBI is a way of being more thoughtful about this process. Yes, it’s an evaluation tool but it can be very flexible based on what you are doing and it can change.”

- Shari Hartshorn, Science Museum of Minnesota



“We don’t always have the budget to pay for evaluators, so training our staff to collect and analyze data for their own programs makes sense.”

- Brad Herring, Museum of Life and Science

Overview *tips and tricks*

- Working with someone with experience in evaluation or research can be extremely helpful, especially when first going through the TBI process. If there is no one with evaluation experience at your institution, consider connecting with a local university or evaluation firm.
- Keep in mind that TBI is intended to be a flexible approach that can be applied to investigate any aspect of your work and make improvements during any stage of a project.
- Professional development and learning are long-term, ongoing processes. It may take several TBI studies before you become comfortable with the process and your team and organization begin to benefit from the experience.
- In our experience, between three and eight individuals is usually a good size for a TBI group.

TBI in Action:



Prototyping a hands-on science activity

Shari Hartshorn, Science Museum of Minnesota

Creating the activities for the yearly NanoDays event is a major project involving development, testing, and revising. From the educators' point of view, we need to know if the facilitators will have everything they need to successfully lead the activity or program. In terms of the public, we need to make sure the content is working well and that visitors are interested. For the last couple of years at the Science Museum of Minnesota, we have used the team-based inquiry process to work with our volunteers to collect information about the prototype activities and help the NISE Net project team make improvements to those activities.

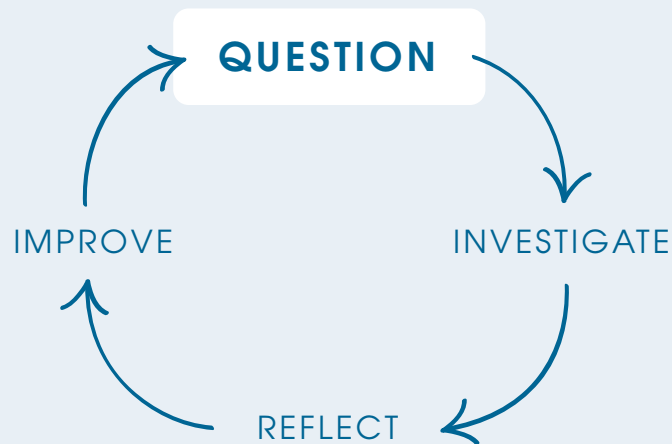
For example, one year we were testing a new activity that was intended to introduce visitors to

the idea of nanoscience by demonstrating how the nano structure of butterfly wings creates the iridescent patterns we see. In the activity, visitors hold butterfly wings under normal light to see the beautiful colors and then shine a light through the wings and watch these colors replaced by duller brown pigments. The activity also includes a picture highlighting the nanostructures of the wings and scales.

When we were testing the activity, I had asked the volunteers to use half sheets of paper to quickly note observations of visitor behavior and conversations and, on the back side, to reflect on how the interactions went and ways to improve the activity. We then had a meeting to look over all of the notes and discuss overall impressions.

Volunteers kept observing that visitors were confused about what the magnified images were—many of them didn't get at first that they were looking at butterfly scales. For the final activity, we made clearer, more prominent image labels and provided suggestions for facilitators about how to orient visitors to the images.

This process has now become a regular part of how we develop programs for the NISE Net. Although we've been doing evaluation at the Science Museum of Minnesota for many years, the TBI approach gives us a concrete way to think about what we need to know, collect and analyze data to answer our questions, and then make improvements to our programs and activities.



Chapter 2: Asking Questions

Work with your team to identify inquiry questions in order to guide and focus your study. In this chapter, you'll learn that:

- Team-based inquiry (TBI) questions are not what you ask participants but rather the broader questions that you need answered in order to move forward with your work.
- Identifying inquiry questions is critical for building shared understanding within your team, ensuring that your study has a realistic scope, and gathering useful and actionable information.
- A good TBI question is one that (a) you don't know the answer to, (b) focuses on useful and actionable information, and (c) can be realistically investigated given your resource and time constraints.
- The question worksheet (Appendix C) can help your team brainstorm and prioritize inquiry questions.



Asking TBI questions

Let's say you have recently begun developing a new educational experience, such as a hands-on activity for families. It's well researched, methodically developed, clearly aligned with your educational goals, and, you hope, thoroughly entertaining. You have already tested it with a few colleagues to help work out the major kinks and you would like to include it in your regular schedule of daily activities and demonstrations. As you imagine taking it out on the floor, however, the questions start flooding in. How will participants respond? How is it relevant to their interests and prior knowledge? How will I know the activity is achieving its goals?

Important inquiry questions arise all the time out of daily work. It's these questions that matter to you and are essential for moving forward in your work that are the foundation of any team-based inquiry (TBI) study. Using questions to focus your inquiry ensures that your study has a realistic scope and that the information you gather is useful and actionable. By providing a focused opportunity for your team to discuss educational goals, information needs, and project priorities, the process of identifying inquiry questions is also a powerful way to develop shared understandings and expectations among team members.⁹

TBI questions are not what you ask participants but rather the broader questions that you need answered in order to move forward with your work. They define the focus of the inquiry and inform decisions about data collection during the *investigate* phase.¹⁰ You might wonder what the public already knows about a particular topic, what aspects of your educational experience might be more or less engaging, or what improvements could be made so that more participants walk away understanding your intended educational messages. Although TBI questions are not the same as survey or interview questions, they do directly inform how you collect data, as described in the next chapter. For example, if your inquiry question focuses on how to make your educational experience more

A GOOD TBI QUESTION IS ONE THAT:

- (1) You don't know the answer to,
- (2) Focuses on useful and actionable information, and
- (3) Can be realistically investigated given your resource and time constraints.

engaging, you might observe participants and look for evidence of engagement and interest and ask participants at the end of the experience to indicate their favorite part of the program.

What makes a useful TBI question?

The success of your TBI study can depend a lot on asking the right types of inquiry questions. Most importantly, these must be questions that you need and want the answers to in order to inform your work. In our experience, a productive TBI question can't be easily answered with information you already have, focuses on gathering data that you can act on immediately, and can be realistically investigated given your available time and resources.¹¹

For example, although you might be very curious to know how your educational experience impacts participants' achievement in school, it's unlikely that you'll have the time or resources to investigate this question. Similarly, it's not worth designing a TBI study to determine whether participants prefer a theater show or tabletop activity format if you have already committed to developing the latter. And although it may be very relevant to ask what age of children typically comes to your institution and might participate in your educational experience, your organization may already have the answer to this question readily available based on marketing data.

Especially in the context of developing an educational experience, TBI questions often focus on participant characteristics (e.g.,

interest or prior knowledge), short-term participant outcomes that indicate whether or not you are achieving your goals, challenges to address, or current successes and strengths to build on.

Identifying TBI questions with your team

Although there are a variety of approaches to identifying inquiry questions, we've found that three broad steps work well for many groups: (1) preparing, (2) brainstorming, and (3) prioritizing.

Preparing

Before you can begin brainstorming possible questions, it's important that you clearly articulate the goals of your program or educational experience, understand the constraints of your study (e.g., available time, resources, and staff), and gather any relevant background information. Talking through these issues with your team before brainstorming questions begins the process of building shared understanding and buy-in, helps to set clear boundaries around the study, and highlights what you know and don't know about your educational experience.

Although it's easy to overlook, clearly articulating the goals for your experience is particularly important. Without a clear and shared understanding of what you want the experience to accomplish and how you want it to impact participants, it's very difficult to know what information you need to improve the experience or even how you would know if it had been improved at all. For example, you

“We used TBI to look at a summer camp program for high school students. Our big questions were: Was the program interesting? Were the lab activities easy to do? How could we improve the program and make it more engaging?”

-Rashmi Nanjundaswamy, Lawrence Hall of Science

might have educational goals related to communicating a particular big idea, increasing participants' awareness of a topic, encouraging participants to practice a skill, or fostering conversations and collaboration among participants. Each of these goals will suggest a different educational approach and different inquiry questions.¹²

Brainstorming

After your team understands the constraints of your study and has clearly articulated goals for your educational experience, you can lead the group through the process of generating possible inquiry questions. A fun and low-cost way to do this is with sticky notes:

1. Find time (at least an hour) for your team to meet. Make sure each of your team members has a pad of sticky notes.
2. Start by asking team members to individually write down responses to the prompt: "What information do we need and what questions do we want to answer to make this educational experience successful?" Each idea should be noted on a separate sticky note. Remind the group that these should be broad questions and information needs, not survey or interview questions and not ideas for data collection methods.
3. After the group has had some time to brainstorm individually, ask each team member to share.
4. As each idea is shared, begin grouping similar sticky notes into categories. Continue generating new ideas until you feel like the group has exhausted potential information needs and you have grouped all similar questions into categories.

Prioritizing

The goal of this final step is to prioritize a few inquiry questions from the many that you have brainstormed and to ensure that answering the questions you choose will provide useful and actionable information. For this step, we suggest using the question worksheet (Appendix C).

For each group of sticky notes that you created during the previous exercise, articulate one broad inquiry question that captures the essence of the ideas in that group and note these in the worksheet. Then for each broad question, think about why it's important, the general types of information needed to answer the question, the resources and time required, and how actionable the information will be. After completing these sections of the worksheet, prioritize the questions from high to low. Remember, a productive TBI question provides both useful and actionable information and can be answered given the time and resources available. Through this process, your team should be able to identify one to three high-priority questions to guide your TBI study. (See Appendix D for an example completed question worksheet.)



“We’ve done a lot of evaluation work to get participant feedback to continually improve our in-person meetings and workshops. In the past, we asked a lot more questions, but now with team-based inquiry we’ve been keeping it simple and focusing only on what we really wanted to know. So, we took out questions about things we knew were not on the table, things we weren’t going to change, or were out of our control.”

- Catherine McCarthy, Science Museum of Minnesota

Question tips and tricks

- Consider carefully whether you could answer any of your TBI questions with existing information in order to avoid unnecessarily burdening participants and your team.
- Don’t worry if you can’t answer all of your TBI questions with one study. Because inquiry is always a continuous process, you can save some questions for the future.
- Buy-in from team members is critical throughout the TBI process but especially during this phase. If possible, all team members should agree that answers to your prioritized questions will be useful, relevant, and actionable.
- During this phase, it’s common for team members to jump right to brainstorming survey or interview questions. Remind your team of the difference between an inquiry question and a survey question and emphasize the importance of determining what information needs to be collected more broadly before deciding the best way to collect that information.
- Take some time at the end of the *question* phase to update the TBI summary form (Appendix A) with your team. Describe the educational experience, if applicable, your TBI questions, why those questions are important for you to answer, and any background or context relevant to why you began the TBI process.

TBI in Action:



Gary Hodges / Sciencenter

Developing a program for preschool children

Michelle Kortenaar, Sciencenter

We were developing a series of nanoscience programs and we knew we needed at least one activity for families with preschool children. This is something we'd never done before and we had a lot of questions about how to develop a nanoscience program for a young audience and how to engage the children and maintain their interest. Already, we had been working on the idea of using the book, *Horton Hears a Who*, as the centerpiece of a story time program. So we decided to put together a small group to do some team-based inquiry around developing and improving the activity.

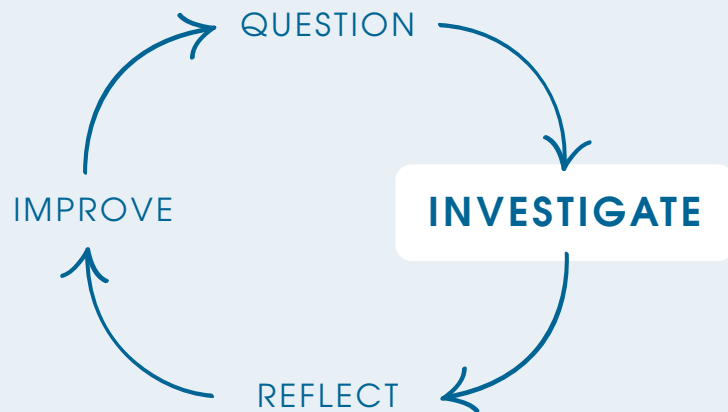
We knew that the overall goals should be to engage young children and encourage them and

their parents to think about very small things. We gathered our TBI team and spent about an hour discussing the activity goals, what we already knew about engaging young children in science, and the types of information we would need to make the program a success.

Although we had many questions about what children already knew and what ideas they might take away from the program, we felt the priority should be making sure children in this age group were interested. In the end, we settled on two broad TBI questions: (1) does the program engage young children and (2) how could it be improved in order to be more engaging. We dropped questions about whether a different book might

be better, since we knew we were going to stick with *Horton Hears a Who*.

To answer these questions, we observed children during four story times. We also interviewed parents to gather ideas about how the program could be improved. After reviewing the data, it was clear that the activity was still not maintaining children's attention. Based on feedback from parents and brainstorms with our team, we decided to shorten the story and encourage the children to participate directly by, for example, asking families to put their hands to their ears and listen carefully, just like Horton. When we took the improved activity back on the floor, it was a big success.



Chapter 3: Investigating Your TBI Questions

Choose a method for investigating your team-based inquiry (TBI) questions and dive into the process of data collection. In this chapter, you'll learn that:

- The data collection method should match the inquiry questions you are trying to answer.
- Common approaches to collecting data related to developing an educational experience include surveys, interviews, and observations. Each of these approaches has unique strengths and weaknesses.
- During data collection, make sure your participants feel comfortable at all times—they will act and respond differently if they are nervous or feel like they are being judged.
- Data can be collected from anywhere and in many different ways. Be creative when thinking about how you could answer your inquiry questions.

Choosing your investigation method

Now that you have clarified the goals of your educational experience and have identified a few team-based inquiry (TBI) questions with your team, you may already have a sense of the general type of information you'll need to collect. The key now is to select the best data collection method to answer your inquiry questions, and not the other way around. In other words, make sure to match your investigation method to your questions, rather than choosing a method and then brainstorming questions.

In this chapter, we highlight three common approaches to collecting data that are particularly useful for informing the development of educational experiences: surveys, interviews, and observations. Each has its own strengths and limitations. In reality, there are countless ways to gather useful feedback and information, and at the end of the chapter, we also suggest a variety of creative approaches you can use to answer your TBI questions.

Surveys are most useful when you want to gather participant feedback on something specific, hear from a lot of people in a short amount of time, or provide participants

SURVEYS

are useful when you need:

- **Participant perspectives and feedback**
- **Information from many participants**
- **Anonymous responses**

INTERVIEWS

are useful when you need:

- **Participant perspectives and feedback**
- **In-depth responses**
- **The opportunity to ask follow-up questions**

OBSERVATIONS

are useful when you need:

- **Information about participant talk and behavior**
- **Descriptions of participants' experiences**
- **Staff perspectives and reflections**

extra privacy when answering questions. Surveys can help you understand what participants like and don't like about the educational experience, how they are reacting to specific aspects of the experience, or the kinds of messages or ideas they are taking away.

Interviews are a natural extension of surveys. While surveys are often well-suited for close-ended questions, such as asking participants to rate how interesting they found the experience, talking directly to participants through interviews can be a more natural setting for gathering open-ended responses. Interviews give you the opportunity to dig more deeply into participants' ideas and perspectives by asking follow-up and probing questions. Using interviews, you might explore inquiry questions about how participants are connecting the educational experience to their own lives, what aspects of the experience participants are or are not understanding, or elements of participants' interests and prior experiences that could be incorporated. Several drawbacks are that

interviews are often more time consuming and don't provide the privacy of surveys.

Observations give you the opportunity to stand back and capture what’s going on in the educational experience, including how participants are behaving and interacting, what facilitation strategies staff members are using, and the particular aspects of the experience that seem to be engaging participants. This approach is particularly appropriate when you have educational goals related to skills, social learning, or engagement, all of which focus on what participants do and say.

Survey data collection

Appendix E is a basic survey that you can use as a starting place for your own TBI study. (An example completed survey is also attached in Appendix F.) This form was developed and tested to ensure that it is useful for collecting participant feedback on an educational experience and exploring whether or not participants are walking away with the intended educational messages or big ideas. The survey also asks for basic personal information to help you determine how your educational experience works for different participants groups. As with all of the forms and tools in this guide, you will want to tailor the survey to your own goals and TBI questions.

How you approach and recruit visitors can be just as important as having good survey questions. We’ve found it useful to think about survey data collection in three steps: (1) the connection, (2) the collection, and (3) the close. Each of these steps is important

“When conducting surveys for large group programs, I announce at the beginning and end of the presentation, “we have a new program we are testing out and would love feedback about what’s working and not working.” We provide the survey at the end if they want to share their thoughts.”

- Karine Thate, Museum of Science Boston

for making participants feel comfortable, valued, and respected as they share their thoughts and time with you.

Connection

When initially approaching participants, make your introductory statement short and sweet. Start by introducing yourself, what you are asking them for, and why their feedback is important. You will only have a moment, so make your request compelling

and quick. Emphasize how participants’ thoughts and opinions are important for improving the educational experience. At all times, help participants feel comfortable by making eye contact, smiling, and being inviting and supportive.

Even if you do all of this, you will still have people who decline to participate. If participants hesitate, you can highlight that you would like to hear from many individuals and that their feedback is important. If they say no again, however, let them go: “Thanks for considering. Have a great rest of your day!” It’s not fun to get refusals, but it is part of the process.

Collection

When participants say yes, make them physically comfortable. If possible, move them to a quieter space, allow them to sit down on a chair or bench, or take them out of the flow of traffic. Make sure they have everything they need, such as a clipboard and pencil. Give them any final instructions, including a reminder that their honest opinion is important, hand over the survey, and then step back.

Close

Once participants are finished with your survey, gather the clipboard and pencil from them with a smile. Ask if they have any questions, thank them, and wish them well. This is also a good time to provide a thank you gift, if you have one. Making participants feel important and respected throughout this process generates good will towards you and your institution.

With the completed survey in hand, take a moment to ensure you have noted the date, your initials, the name of the educational experience, and a unique number for the survey. During the next phase of TBI, this information will be important for remembering when, where, and why you collected the data. Store the completed surveys somewhere safe, grab a new form, take a deep breath, and begin again!

Interview data collection

Conducting interviews is similar to collecting survey data—instead of handing over the clipboard, you will ask the participant the questions. You can follow the same three steps, connect, collect, and close, as described above to recruit participants, make them comfortable, and engage them in the interview. Because interviews are often longer than surveys, it can be especially useful to offer a thank you gift as an incentive when connecting with potential participants.

Appendix G is a modified version of the participant survey that includes prompts and follow-up questions appropriate for an interview. (An example completed interview is also attached in Appendix H.) Remember, the strength of interviews is the opportunity to dig deeper into participant answers. For example,

Survey and interview tips and tricks

- Always respect the right of individuals not to participate in your study and try to avoid collecting any information that would allow you to identify participants later.
- Make your surveys and interviews as short as possible. Cut any parts that don't relate directly to your inquiry questions.
- For some types of educational experiences, you may be able to collect many surveys at once by handing them out to multiple participants.
- If you are asking visitors to spend more than two or three minutes answering questions, consider offering a small thank you gift, such as a bookmark, a stick-on tattoo, or a gift card.
- Collecting surveys when you are facilitating the educational experience is possible but challenging. Consider getting help from a volunteer or staff member.
- In our experience, 15 to 20 surveys or interviews will usually give you enough data to begin identifying meaningful themes and patterns during the *reflect* phase.
- As soon as data collection is complete, take some time to update the TBI summary form (Appendix A) with your team. Add a description of the investigation method and process, including when you collected data, what information you gathered, how many participants were involved, and any other relevant information.

if in response to a question about what the participant liked about the experience, he or she says, “the jokes,” you can ask which jokes or why the jokes were funny. However, remember to keep the conversation focused around your inquiry questions and avoid over burdening participants.

For interviews, try memorizing the prompts and questions so that you can maintain eye contact as much as possible. When taking notes, capture as much of the response as you can, asking participants to slow down or repeat themselves as needed. When you’re finished with the interview, go back and fill in any details you left out.

Observation data collection

Watching your educational experience and collecting information on participant conversations and behaviors is another powerful method for investigating inquiry questions.

The easiest way to collect observational data is by watching someone else facilitate the educational experience. As an external observer, you can capture the interactions more completely, without having to split your attention. Sometimes, however, you may need or want to use the observation form to capture your own notes and reflections as the facilitator. Collecting data using both approaches is actually a great way to capture multiple perspectives on participant interactions.

The observation form included in Appendix I (with an example completed form in Appendix J) can be used to collect observation

“For the observations of our science demonstration, I would write down visitor comments immediately after they left, before I even cleaned up. I also noted the number of kids, estimated ages, and the number of adults.”

- Aaron Guerrero, Children’s Museum of Houston

data either as an external observer or the activity facilitator. The first page of the form provides space to note the educational goals, document the start and end time of the experience, describe the participant group, and collect notes on behaviors and conversations. On the second page, you can reflect on what worked well or not so well to support the educational goals, based on your observations. The form was designed to capture observations from one group of participants. By completing several observation forms for multiple participant groups, you will have a set of data to analyze during the *reflect* phase.

Collecting observation data as an external observer

As an outside observer, you can focus more completely on visitor and facilitator talk and behaviors related to your TBI questions, without having to worry about guiding the experience for participants. Using the observation form, we recommend thinking about collecting data in three steps:

(1) prepare for the activity, (2) observe during the activity, and (3) reflect at the end of the activity.

Prepare: In preparation for data collection, talk through the purpose of the observations with your TBI team and the facilitator of the experience. Together, clearly articulate the educational goals and agree on any specific aspects of the experience you might want to focus on.

Observe: During the activity, note the time when participants arrive or the activity starts and then use the observation form to

capture what participants and the facilitator do and say during the experience. For example, write down the questions participants ask, who they talk to, comments they make, what they do during the activity, and when people join and leave. While taking notes, focus on what you see happening, rather than your interpretations of the events. For example, it is more accurate to note that “visitors laugh” rather than assume that “visitors are enjoying the experience.”

Reflect: At the end of the interaction, use the second page of the observation form to reflect on what you saw. Make sure to base these reflections on your observation data, rather than your own prior opinions about the educational experience. Ideally, debrief with the facilitator after each observation and include his or her reflections in your notes. Before beginning the next observation, complete the group characteristics section of the form.

Collecting observation data as the facilitator

Observing your audience while leading an educational experience is a natural part of your role as facilitator. You read your participants and continuously respond to their interests, questions, levels of engagement, and body language. Systematically reflecting on these experiences, by completing the observation form after each interaction with a participant group, can help you be more purposeful about these observations. As we discuss in the next chapter, looking for themes across observations can also reveal patterns that you might not have noticed otherwise.

As above, use the observation form to prepare for data collection, note observations, and reflect on the experience. As soon as you're finished with one participant group, take a few moments to complete

Observation tips and tricks

- When collecting observation data, it's a good idea to post signage around the educational experience so that individuals can decide whether or not they want to participate.
- If appropriate to your goals, try to collect observation data with a variety of audiences, such as families, adult-only groups, and school groups.
- Using the observation tool as a self-reflection form when facilitating an educational experience is a great strategy when another staff member is not available to help you observe.
- In our experience, 10 to 15 observations, each collected with a different participant group, should give you enough data to begin identifying themes and patterns during the reflect phase.
- Having a peer or supervisor observe you can be uncomfortable. Make sure everyone on the TBI team understands that the observations are about improving the educational experience rather than grading or assessing the facilitator.
- As described above for surveys, update the TBI summary form (Appendix A) with your team after you're finished collecting observation data.

the observation form while the interactions and facilitation are still fresh in your mind. Start on the first page, describing the participant group, what happened, and what was said during the interaction, and then jot down your reflections on the second page. Make notes about anything that was particular to that specific experience or group to help jog your memory when analyzing the data.

Other data collection approaches

There are many other ways to collect data beyond surveys, interviews, and observations. Different inquiry questions may require very different methods for capturing feedback. For example, you can use

CREATIVE INVESTIGATION APPROACHES:

- Card or photo sorts
- Sticky notes
- Group discussions
- Graffiti walls
- Voting
- Meeting notes
- E-mails
- Participant drawings
- Social media
- Activity artifacts
- Tablets or smartphones

information you receive as part of your everyday work. From meeting notes and e-mails to hallway conversations and one-off visitor comments on the floor, these are all data that can be used as part of your investigation. You can also find creative ways to get feedback from participants. For example, you can gain insights by looking at participant drawings or creations or you can explore what people know about a topic by posting a question and providing participants a space to share their thoughts, such as with cards or sticky notes.

What's important is to be systematic and purposeful. Align your method with your inquiry questions, develop a consistent way of recording information, collect data from a range of participants, and think carefully about the strengths and weaknesses of the investigation method. Above all, be creative when thinking about the best approach to answering your inquiry questions.



TBI in Action:



Science Museum of Minnesota

Testing educational posters

Ali Jackson, Sciencenter

We were in the final stages of determining what should be included in the NanoDays 2012 kit. In particular, we were thinking about whether we should print a series of educational posters—whether they were a valuable enough addition or if, for the same cost, we should include another hands-on activity. So we conducted a team-based inquiry study to answer the question: Are educational posters worth including in the NanoDays 2012 kit? We also had questions about the amount of content we could convey with a poster and the overall graphic design.

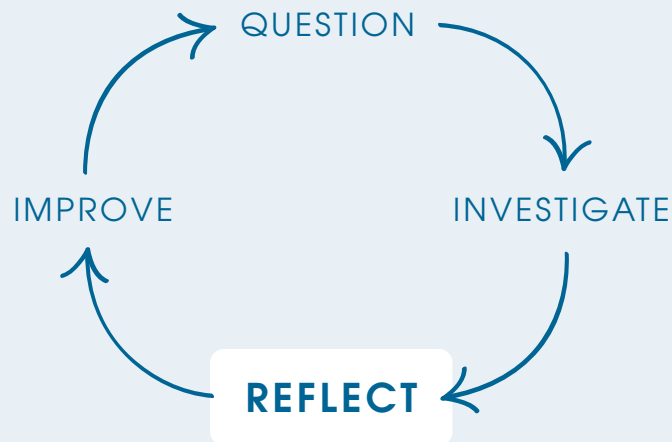
We displayed a set of draft posters at NanoDays 2011 events at three different institutions. At each institution, one of our team members interviewed 10 visitors who had been through the area of the

museum with the nanoscience activities and posters. Because we hadn't done much interviewing before, we worked with an evaluator to write a recruitment script: *"Hi, my name is _____ and I am working with the museum to get people's feedback so that we can improve the visitor experience. Would you mind answering a few questions? It should take about 5 minutes."*

If visitors agreed to participate, we asked them first if they had noticed the posters and, after pointing them out to the visitors, what they found most and least appealing about them. We kept the interview short (four questions), knowing that visitors are busy. At each institution, we also had informal conversations with educators who had facilitated the nanoscience activities to get their impressions of the posters.

After collecting the data, we met as a team and reviewed all the compiled visitor and educator comments, looking for reoccurring themes and patterns. Consistently, both visitors and educators were very positive about the posters and appreciated how they created ambiance for the activities and helped to emphasize key messages about nanoscience.

In the end, we decided it was worth it to include printed posters in the kit and used feedback from visitors and educators to improve the poster design. Overall, the study was a great experience learning how to conduct interviews and using data to make cost-benefit decisions.



Chapter 4: Reflecting on Data

Explore the process of analyzing and interpreting team-based inquiry (TBI) data collaboratively. In this chapter, you'll learn that:

- Reflecting on your data involves (1) organizing, (2) analyzing, and (3) interpreting the information you have collected.
- Data analysis will differ greatly based on the type of information you have collected. Two common types are numeric data and open-ended responses.
- Analyzing data from TBI studies often requires identifying patterns and themes across information from many participant groups.
- Collaboratively reflecting on data with your team helps to explore different interpretations, develop shared understandings, uncover assumptions, and generate buy-in.

Team-based inquiry data

Now you have a pile of team-based inquiry (TBI) data from the surveys you collected, the interviews you conducted, or the observations you made. But what does all this information mean? How does it relate to your inquiry questions? What did participants think about your educational experience? Did you achieve your goals? In order to figure this out, you'll need to (1) organize, (2) analyze, and then (3) interpret your data through the data reflection process.

Numeric data and open-ended responses

There are two main kinds of data that you will likely collect through your TBI study: open-ended responses and numeric data. To keep things simple, we are assuming that numeric data includes information from questions that have limited response categories, such as age, gender, state of residence, or zip code, and questions

with a predetermined list of responses, such as asking people to rank their interest on a scale from 1 to 5 or using a behavior checklist to understand how people are using an activity.

In contrast, open-ended responses come from questions with no predetermined set of answers, such as when you ask participants to describe in their own words what they



thought the educational program was about. Open-ended responses can also include observation notes about participant discussions or interactions. Both the survey and observation data collection tools introduced in the investigate chapter contain a mix of open-ended responses and numeric data.

Organizing TBI data

The first step in the reflection process is to get your data into a form that can be easily sorted and summarized. There are a number of ways that you can do this. If you collected open-ended responses, you can compile the feedback in an electronic document or simply make copies of your data and cut them into pieces so that you can sort them into physical files. If you have numeric data, you may want to enter them into a spreadsheet program that will easily allow you to count responses or calculate averages and percentages.

Analyzing TBI data

After organizing your data, it's time to start analyzing. Data analysis allows you to condense large sets of data into smaller chunks that give some meaning to the information you have collected. For example, you may want to calculate the percentage of participants who were male and female or determine how many participants mentioned being interested in a particular aspect of your educational experience. When analyzing the data, you can both look for broad trends across the entire dataset and explore different subsets within your data. For example, you may want to investigate if adults with older children had different perspectives on your educational experience than adults with younger children. As with organizing

your data, the analysis approach you choose will be dictated by the type of information that you collected.

With numeric data, you can look for patterns in entire sets of data as well as search for differences between groups. While you could use complex statistics, this is often not necessary. General descriptors, such as counts, percentages, and averages can provide you with all the information you need to answer your inquiry questions. Presenting data in charts or graphs can also be a clear and visual way to show numeric results.

A common approach to understanding open-ended responses is to look for trends and patterns that appear across multiple participants. Sorting the data into different themes is the essence of open-ended data analysis. For this type of data, we recommend using the reflection discussion process described below to analyze and interpret responses collaboratively with your team.

Interpreting TBI data through a data-reflection discussion

Analyzing your data is only the first step of data reflection—you also need to interpret what the information means and how it relates to your inquiry questions. As with data entry and analysis, there are many different approaches you can use. There may also be different interpretations for the same set of data.

In developing the TBI approach, we created a four-step data reflection process to help you and your team members focus on

the purpose of your TBI study, immerse yourselves in the data, and make sense of the information you collected. Through this process, your group can explore multiple possible interpretations of the data, develop shared understandings, uncover assumptions, and generate team buy-in. Although specific steps are described below, this process is meant to be flexible to fit the needs of your team, your TBI study, and your data. A cheat sheet outlining the discussion process can be found in Appendix K.

Below we describe the steps of a data reflection discussion for analyzing and interpreting open-ended responses, which we have found is the most common type of TBI data. However, the process can be used as a general guide to interpreting numerical data as well.

Step 1: Describe and clarify

Begin the data reflection discussion by reminding your team what your inquiry questions were and what you hope to achieve through the data discussion. Also, remind team members how and where the information was collected. Give the team a chance to ask questions and discuss as needed so that everyone has a common understanding of the study.

Step 2: Observe and discuss

Hand out copies of the data to the team if they don't already have them. For example, if you have data from 10 surveys in which participants indicated what they thought the educational experience was about, you might list all the responses to the

“Our team-based inquiry group looked at feedback from workshop participants in order to plan and improve future workshops. We divided the data and analyzed it in a single afternoon by sharing common themes we noticed when reading the comments.”

- Ali Jackson, Sciencenter

question in one document and provide a copy to each team member. You can also cut the responses up into individual pieces of paper for easy sorting later.

Spend time as a group reviewing and reading the data. When everyone is ready, have each team member mention one unique response that he or she feels is particularly interesting or important and why that response stood out. During this step, encourage group members to quote responses directly. If your team starts to describe themes within the data during this step, this is okay. Write down these comments so that they can be recorded for the next data reflection step and continue to ask team members to describe one piece of interesting or important data. Remind the group that the purpose of this step is to help identify responses that are most relevant to the inquiry questions, ensure that everyone is deeply familiar with the data, and uncover possible biases the team might have before moving on to interpretation.

Step 3: Immerse and notice

At this point, ask team members to suggest unique trends or patterns they notice in the data that relate to the group's inquiry questions. These patterns are the themes in the comments and responses that occur multiple times across different participants. For example, you might find that five out of 10 of your survey respondents indicated, in various ways, that the explosion was the most interesting part of your educational experience.

Continue this step until the team feels that you have uncovered all the response themes. Make sure to write down each theme as it's mentioned for later sorting.

Step 4: Categorize and explain

After exhausting all potential themes, work with your team to sort the data. Go through each theme one by one and determine, as a group, which of the responses fit within that theme, keeping in mind that some responses may fit multiple themes. If you're short on time, this step can be completed by a single team member or a smaller group of individuals and then brought back to the team for further discussion.



Finally, count and record the number of responses that correspond to each theme in order to get a sense of which themes were more common than others. At this time, it's natural to discuss how well the themes fit the data and if any should be combined or removed. Afterwards, you should also discuss possible explanations for each theme, related to your inquiry questions, and begin thinking about implications for your work. In the *improve* phase, described in the next chapter, you'll spend more time identifying improvements and changes to your educational experience based on the findings from the reflection discussion.

“I put together what I was seeing in the forms from the volunteers who were leading and collecting data on the activities and kept them with me at the time of discussion so I could pull out specific examples. As a team, we had a conference call and went through each activity and discussed what we were finding.”

- Shari Hartshorn, Science Museum of Minnesota

Reflect tips and tricks

- As always, respect the privacy of your study participants. Before beginning data analysis and reflection, remove any identifying information, such as names or e-mail addresses.
- If you have a large TBI group, you may want to create smaller sub-teams to go through this process separately.
- Step two of the data reflection process, observe and discuss, can be challenging since teams often want to jump ahead to identify themes. Remind team members of the importance of deeply understanding the data and uncovering different biases and perspectives before discussing patterns.
- If you have a large amount of data, you may want to split your data reflection into multiple discussions, each focused on a portion of the information, such as responses to one of your survey or interview questions.
- Step four, categorize and explain, is likely to take the most time, so make sure to plan accordingly.
- Try to avoid over interpreting the data or inferring meaning beyond participant responses.
- Take some time at the end of the data reflection process to update your TBI summary (Appendix A). This is a good way for you and your team to articulate and agree on the main themes that emerged from your discussion and analysis.

TBI in Action:



Improving project meetings

Catherine McCarthy, Science Museum of Minnesota

Every year as part of the NISE Net, we run meetings for our project team members and partners. In 2012, we decided to conduct an inquiry study to understand whether we were achieving our meeting goals and how we could better support meeting participants. We also hoped to gather data that would inform the development of future meetings to ensure that they were as effective and useful as possible.

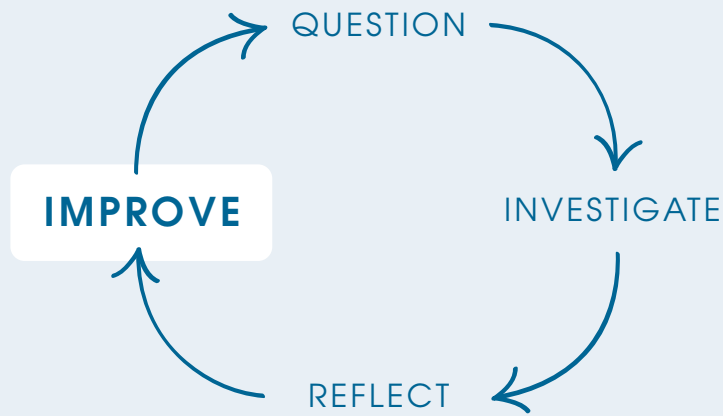
To answer these questions, we put up pieces of butcher paper at several in-person meetings and asked attendees to use sticky notes to anonymously post their feedback and ideas. We put up three prompts related to our inquiry questions: (1) what do you value most about this

meeting, (2) what's one thing you're taking from this meeting that you're bringing back to your institution, and (3) in what ways can the Network further support your nanoscience education work?

The response from participants was great. After the meeting, we transcribed the sticky notes and compiled the comments into a spreadsheet. The project team then met as a group and reviewed all the comments, identifying themes that were mentioned by many participants. In some cases, we realized that our categories were too big to be useful and that we had to separate a group of comments into smaller themes. Once we all agreed that we had captured the major themes in the data, we counted the number of comments

for each theme so that we could focus on the most common types of feedback from partners.

During our data reflection discussion, we also talked about the support we could offer to partners and how we could improve future project meetings. One of the lessons we learned from this process, which has influenced how we organize meetings since then, was that partners were interested in having more opportunities to share their own work with others. Collecting TBI data has now become a standard way we gather partner feedback and how we continually make improvements to the project.



Chapter 5: Improving Your Educational Experience

Put the data and findings from your study into action to inform your work and make improvements to your educational experiences. In this chapter, you'll learn that:

- Making improvements and changes based on your findings is one of the most critical steps of TBI. It's why you began the process in the first place!
- The changes and improvements you make will depend on the focus of your inquiry but should help directly address the need that originally motivated your study.
- An improvement discussion is a useful way to collaboratively brainstorm and prioritize changes and improvements based on your findings.
- Documenting and sharing your findings helps to foster shared understanding within your team and support buy-in for ongoing inquiry.

Putting team-based inquiry to work

At this point, you have almost made it through the entire team-based inquiry (TBI) process. You have assembled a team and worked with them to identify questions that are meaningful to your work. You have collected data to answer those questions and reflected on the data and findings. Although it may be appealing to consider the job done, don't stop now! It's time for the most important phase: putting your findings into action.

Professional inquiry is only useful if you are able to make changes and improvements to your work based on the findings. Without this, the study is just another report collecting dust on your shelf or taking up memory on your hard drive. It's also during this phase that you work with your team to synthesize and document your results. Doing so allows your team to collectively define key findings, clarify what they mean for your work, and decide how to move forward.

Surprisingly, it can sometimes be challenging to put inquiry and evaluation findings into action. Michael

Quinn Patton, a leading expert on evaluation, described a number of barriers to the use of evaluation and inquiry, including fear of being judged, skepticism about value and the potential for change, concern about time and money, and frustration from previous experiences.¹³

Luckily, throughout the TBI process you've already addressed many of these issues. During the *question* phase, you made sure that your needs were at the heart of the study and that study findings would be useful,

“Every year we test new educational activities with our guests at the Sciencenter NanoDays event. Based on their feedback and our TBI process, we then modify the educational messages and activities to improve engagement and learning.”

- Ali Jackson, Sciencenter

relevant, and actionable. During the *investigate* phase, you gathered timely information by designing and implementing a realistic and manageable study. And finally, during the *reflect* phase, you fostered shared understanding and buy-in through collaborative analysis and discussion. Throughout, you and your team were directly involved in the inquiry so that you had ownership over the process and findings and a deeper understanding of the meaning underlying the data.

This final step, *improving*, is really a continuation of the process of ensuring the inquiry directly informs your work.

Types of improvements

The types of changes and improvements you make to your educational experiences, or any other aspect of your work, will depend on the focus of your inquiry. For example, you may have been concerned about how to better communicate the main message of your educational experience to participants. In this

case, improvements might include being more explicit about the message in the educational signage, making sure activity facilitators repeat the message at the beginning and end of the experience, or simplifying or removing other content that does not support the message. In another study, you might be more focused on how to adapt an existing educational experience to engage a different audience, such as preschool children and their families. Based on your data, you might decide to include a song, add a full-body activity, or identify ways to encourage parent and caregiver participation.

Of course, TBI focused on other aspects of your work, beyond the development of educational experiences, will suggest very different types of improvements and changes. Regardless of the focus, however, it's critical that the changes help to directly address the needs and questions that originally motivated your inquiry.

Facilitating an improvement discussion

In many ways, identifying improvements and action steps is the most creative part of the TBI process. Although inquiry data can sometimes include specific ideas for improvements, such as when visitors make suggestions, often your findings highlight aspects that need to be improved without suggesting the best way to address these issues. In these cases, it's up to you and your team to draw from your combined educational expertise and experience to determine the most effective and realistic changes you can make based on what you have learned.

As part of this process, it's helpful to facilitate an improvement discussion with your team. This discussion is similar to the question brainstorm we described in Chapter 2.

1. Find at least an hour when you and your team can meet.
2. Outline the findings that the group identified during the reflect stage. It's okay if team members continue to discuss exactly what you did find at this point. This is all part of the

AN IMPROVEMENT DISCUSSION INVOLVES:

1. Outlining findings,
2. Brainstorming implications and improvements, *and*
3. Prioritizing realistic, data-based action steps

process of developing a shared understanding and ensuring that each team member has buy-in for the outcomes of the study.

3. For each finding that you outlined, brainstorm implications and possible changes. You can do this as a group, with a notetaker capturing thoughts on a whiteboard or piece of paper, or you can start out by brainstorming individually, using sticky notes.
4. Help your team identify a few actionable changes or improvements from the larger brainstorm list. Emphasize at this point that the changes should be clearly supported by the data, directly relevant to the issues you identified through your TBI study, and realistic and manageable given your available time and resources.

Documenting and sharing your work

After identifying changes and improvements, it's tempting to move on with your work and leave your unfinished summary collecting dust in a corner. However, documenting and sharing your study is a critical part of the TBI process. Taking a few moments to outline lessons learned fosters shared understanding within





your team and helps ensure that study findings translate into action. Documenting and sharing your findings also provides you with something to look back on later and a way for others to learn from your work. Finally, sharing your results can help foster buy-in for additional inquiry and evaluation.

Hopefully, you have been updating the TBI summary form after each phase of your study. Take some time now to complete the *improve* section of the form, including details about the changes you have prioritized with your team and any recommendations for future projects. (See Appendix B for an example of a completed summary.) This is also a good time to capture outstanding questions that might motivate future TBI studies. Schedule a meeting with your team to review and finalize the summary. Afterwards, find a convenient way to organize and store your paper and electronic TBI materials, including the final summary and any data you collected.

Although the TBI summary form is a useful tool for documenting and summarizing your study, don't limit yourself to the summary when thinking creatively about sharing findings with other colleagues. Other ways of sharing your work include informal presentations or announcements during staff meetings, posters displayed in hallways, key findings outlined in an e-mail, summaries shared through on-line newsletters or blogs, and presentations at conferences.

Continuing the inquiry cycle

Congratulations, you have successfully concluded your first TBI study! As we discuss at the beginning of this guide, professional inquiry and learning are ongoing, cyclical processes. Undoubtedly, additional questions arose throughout each phase of the inquiry process that can serve as the starting point for a new TBI study. And of course, questions will continue to arise as you develop new educational experiences and identify new ways to improve your work. In short, TBI is only the beginning of an ongoing process as you build your skills and capacity to conduct evaluation and professional inquiry, foster a strong culture of learning and collaboration within your department and your organization, and continue to become a more effective educator.

“It was empowering to switch to the TBI process!”

- Stephanie Long, Science Museum of Minnesota

“For NanoDays kit development, team-based inquiry has been incredibly helpful. We’ve made changes to the kit based on feedback from our NISE Net partners and data collected from visitors. Partners have suggested things we shouldn’t change, which is also valuable.”

- Kevin Dilley, Sciencenter

Improve tips and tricks

- When sharing data and findings, remember to protect the rights and privacy of study participants. Whenever possible, keep the identities of participants confidential.
- Not all of your findings will necessarily translate into improvements or changes. It’s equally important to know what is already working and should remain unchanged.
- Make sure to store your TBI summary, data, and data collection materials together in a safe and secure location. A few minutes organization now will save you time and hassle in the future.

TBI in Action:



Developing a staff training workshop

Brad Herring, Museum of Life and Science

In 2012, the NISE Net decided to conduct a series of workshops to help informal science educators facilitate discussions with visitors about the ethical and social implications of nanoscience and nanotechnology. Knowing this was going to be a new and challenging topic area for many educators, we wanted to prototype the workshop and make sure it would be useful and engaging for participants.

One of our partner organizations agreed to host the prototype workshop and to provide feedback. Beyond the education staff at the museum, we also invited managers, project advisors, and professionals from several other children's museums and science centers. After running

the workshop, we passed out a short, two-page questionnaire and asked each participant to share their feedback on how the workshop had gone, how useful it might be for other institutions, and how it could be improved. We then used these individual responses as a starting place for a group discussion with attendees.

The feedback we received had a huge impact on the final workshop content and structure. For example, participants emphasized the importance of balancing the participatory and lecture-based portions of the workshop. It was also clear from the feedback that several activities were redundant and could be streamlined. Given that we were trying to introduce a number of

interrelated ideas and skills, the feedback also helped us identify ways to more clearly orient workshop participants from the beginning.

Overall, although we had tried a number of the workshop activities and resources individually, it was valuable to use the team-based inquiry process to test the entire workshop and make improvements. At the end of the study, we wrote a brief report to document our process and findings, which turned out to be very useful for helping to plan other NISE Net workshops and professional development activities.

Further Reading

Learning about professional inquiry and evaluation is a lifelong endeavor. This guide only begins to scratch the surface of these complex and ever-changing fields. Below, we provide a list of additional readings and recommended resources to guide you as you continue to deepen your evaluation and inquiry skills and knowledge. All of these were selected to be approachable and usable by professionals without formal training in evaluation.

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W.K. Kellogg Foundation. (2004). *W.K. Kellogg Foundation evaluation handbook*. Retrieved from <http://www.wkkf.org/knowledge-center/resources/2010/w-k-kellogg-foundation-evaluation-handbook.aspx>

University of Kansas. (2013). *The community tool box*. Retrieved from <http://ctb.ku.edu/en/default.aspx>

Notes

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4. Cochran-Smith, M., & Lytle, S. (2009). *Inquiry as stance*. New York, NY: Teachers College Press.
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8. To learn more about conducting evaluation and research ethically and responsibly, see the National Institutes of Health online resources: <http://grants.nih.gov/grants/policy/hs/>. In some cases, such as on government-funded projects, you may need to have an external agency oversee your project.
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10. Preskill, H., & Torres, R. (1999). *Evaluative inquiry for learning in organizations*. Thousand Oaks, CA: Sage Publications.
11. For this definition of a good inquiry question, we are indebted to the Exploratorium and the *Guided Inquiry for Visitor Experience* project: <http://www.exploratorium.edu/partner/give/>.
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Appendices

- A. TBI summary form
- B. TBI summary form (example)
- C. Question worksheet
- D. Question worksheet (example)
- E. Participant survey
- F. Participant survey (example)
- G. Participant interview
- H. Participant interview (example)
- I. Observation form
- J. Observation form (example)
- K. Data reflection cheat sheet

Summary Title

Team-Based Inquiry Summary Form

Key contact, e-mail

Summary date

This report is a brief summary of a team-based inquiry study (TBI) and is designed to document and share lessons learned.

1. Question

What we hoped to learn and why it was important

Include the following information in this section:

- Educational experience goals, audience, topic, and description (if applicable)
- Question(s) our group wanted to answer
- Why it was important to answer those questions

2. Investigate

How we answered our questions

Include the following information in this section:

- Start and end dates of the study
- Who we collected data from
- How we collected data
- Types of data we collected
- How we analyzed the data

Attach any data collection tools or relevant documents.

3. Reflect

What we found out

Include the following information in this section:

- Summary of the data (possibly including tables or graphs)
- The most important patterns and findings that emerged

4. Improve

How we changed our practice

Include the following information in this section:

- How our group responded or plans to respond to the findings
- Recommendations for others
- Ideas for future TBI studies

Big Fish, Little Fish

Team-Based Inquiry Summary Form

Aaron Guerrero

July 26, 2012

This report is a brief summary of a team-based inquiry study (TBI) and is designed to document and share lessons learned.

1. Question

What we hoped to learn and why it was important

Big Fish, Little Fish is a program aimed at educating the public about how biomagnification occurs and affects certain ecosystems. We hope participants will learn about how chemicals such as DDT and mercury have created big environmental issues due to biomagnification and how nanoparticles may also have negative implications for certain ecosystems.

Several questions guided our team-based inquiry study:

- Do visitors understand what biomagnification is?
- Do visitors understand the difference between biomagnification and bioaccumulation?
- Do visitors understand how this is nano?
- Is the science in the program correct?
- Does the program flow well?

We wanted to answer these questions in order to improve the flow of the program, make sure we were communicating accurate information, and inform changes to the program to better communicate our main messages.

2. Investigate

How we answered our questions

We collected data and feedback from experts and visitors between July and August, 2012. We had one member of our project team, who is very familiar with programming, review the program. The program was also reviewed by a scientist from Rice University and one from the University of Houston–Downtown. Our TBI group then discussed these suggestions and comments during a phone call.

In August, we prototyped the program on the museum floor and observed eight children (ages 3–10 years old) and five adults. At the end of each interaction, we asked the children and parents the following questions: Was this activity interesting for you? What did you learn from this activity? Is there anything we should change? What is bioaccumulation? What is biomagnification? Is nano silver good or bad for us? Afterwards, we discussed the feedback as a team and identified themes.

3. Reflect

What we found out

Key things that we learned from our data collection included:

- Children, even some younger than we had expected, were drawn into the activity by the colorful fish.
- Children understood the idea of bioaccumulation and biomagnification from the demos we did but had a hard time remembering the terms.
- The program led some visitors to believe that nanosilver is just like DDT and mercury.

4. Improve

How we changed our practice

Based on our findings, we changed the intended age range to 5–12 instead of 8–12. We also decided to include a conclusion script so that facilitators can stress that the scientific studies are not 100% conclusive about whether or not nanosilver bioaccumulates/biomagnifies and that nanotechnology has many great applications. We also added pictures and definition sheets for the program to help visitors understand bioaccumulation and biomagnification.

Question Worksheet

Project Title:

Educational Goal(s)

List the goals of your educational experience.

Prioritizing Inquiry Questions

Fill in the table below for each of the broad inquiry questions that you and your team have brainstormed. Based on how useful, actionable, and feasible each question is, determine whether it is a high, medium, or low priority for your team-based inquiry study.

Inquiry question	Why is this question important to your team?	What types of information would you need to answer this question (e.g., visitor comments, program observations)?	What resources would you need to answer this question (e.g., staff, time, expertise, data collection forms)?	What changes might you be able to make if you answered this question?	Based on all of this, how high of a priority is this question? <i>H=High, M=Medium, L=Low</i>
					H M L
					H M L
					H M L
					H M L

Adapted from: Frechtling, J., & Sharp, L. (Eds.). (1997). *User-friendly handbook for mixed method evaluations*. Retrieved from <http://www.nsf.gov/pubs/1997/nsf97153/start.htm>

EXAMPLE

Question Worksheet

Project Title: Horton Senses Something Small

Educational Goal(s):

List the goals of your educational experience.

Children and parents will be engaged and interested in the program.

Children and parents will be aware that some things are too small to see.

Prioritizing Inquiry Questions

Fill in the table below for each of the broad inquiry questions that you and your team have brainstormed. Based on how useful, actionable, and feasible each question is, determine whether it is a high, medium, or low priority for your team-based inquiry study.

Inquiry question	Why is this question important to your team?	What types of information would you need to answer this question (e.g., visitor comments, program observations)?	What resources would you need to answer this question (e.g., staff, time, expertise, data collection forms)?	What changes might you be able to make if you answered this question?	Based on all of this, how high of a priority is this question? H=High, M=Medium, L=Low
Are children engaged through the whole program?	This is one of the educational goals.	Observations of children, parent or children feedback	Staff observer, observation form and way of measuring engagement	Decide if this is a promising program	H M L
Are children aware that some things are too small to see?	This is one of the educational goals.	Interviews with children	Staff interviewer, 5–10 minutes per child, an age-appropriate interview	Decide if this is a promising program	H M L
How could the program be improved to be more engaging?	We are interested in making this program more successful.	Observations of children, parent or children feedback, educator feedback	Staff observer, parent or child interview or survey, reflection time with educator	Improvements to better achieve educational goals	H M L
Would a different book be a better fit for the program?	A different book might be more engaging and better introduce the topic.	Comparison with a different story	Time to choose new book and create new program version	Probably nothing, since we have already chosen the book	H M L

Adapted from: Frechtling, J., & Sharp, L. (Eds.). (1997). *User-friendly handbook for mixed method evaluations*. Retrieved from <http://www.nsf.gov/pubs/1997/nsf97153/start.htm>

Feedback Survey

Help us improve the program you just saw!

Please take a few minutes to share your opinions below.

1. What did you like most about this activity? Why is that?

2. What are some ways this activity could be improved? Why is that?

3. In your own words, what would you say this activity is about?

4. What is your age?

5. What is your gender?

6. Who did you come with to the museum today (please check one)?

- ☐ I am here alone.
- ☐ I am with a school or tour group.
- ☐ I am here with family or another social group that includes children/youth and adults.
- ☐ I am here with family or another social group that includes adults only.

7. If you are visiting the museum with children, please indicate the number of children/youth in each of these age groups: ____ under 2 ____ 2-5 ____ 6-8 ____ 9-12 ____ 13-17

Thank you for your time and feedback!

Before you leave, please return your completed survey to a staff member.

EXAMPLE



Feedback Survey

Help us improve the program you just saw!

Please take a few minutes to share your opinions below.

1. What did you like most about this activity? Why is that?

It visually demonstrated the amount of sugar in drinks. Surprising and interactive.

2. What are some ways this activity could be improved? Why is that?

Have more details on the bad effects of a high carb intake.

3. In your own words, what would you say this activity is about?

Information to make better choices.

4. What is your age? 64

5. What is your gender? F

6. Who did you come with to the museum today (please check one)?

- ☐ I am here alone.
- ☐ I am with a school or tour group.
- ☒ I am here with family or another social group that includes children/youth and adults.
- ☐ I am here with family or another social group that includes adults only.

7. If you are visiting the museum with children, please indicate the number of children/youth in each of these age groups: under 2 1 2-5 1 6-8 9-12 13-17

Thank you for your time and feedback!

Before you leave, please return your completed survey to a staff member.

Participant Interview

Hi, my name is _____. Today we are asking for feedback to help us improve the program you just saw. Your responses will be completely anonymous. Do you have a brief moment to help us out by telling us what you think?
<if yes, proceed> <if no, end with> "No problem. Enjoy the rest of your visit."

1. What did you like most about this activity? Why is that?

<probes> Anything else? Can you tell me more about that?

2. What are some ways this activity could be improved? Why is that?

<probes> Anything else? Can you tell me more about that?

3. In your own words, what would you say this activity is about?

<probes> Anything else? Can you tell me more about that?

4. Would you mind telling me how old you are?

5. What is your gender?

6. Who are you visiting with today? <read responses>

- ☐ I am here alone.
- ☐ I am with a school or tour group.
- ☐ I am here with family or another social group that includes children/youth and adults.
- ☐ I am here with family or another social group that includes adults only.

7. <If visiting with children> Could you tell me the number of children/youth you are visiting with in each of these age groups: ____ under 2 ____ 2-5 ____ 6-8 ____ 9-12 ____ 13-17

Thank you for your time and feedback! Do you have any questions for me?

EXAMPLE



Participant Interview

Hi, my name is _____. Today we are asking for feedback to help us improve the program you just saw. Your responses will be completely anonymous. Do you have a brief moment to help us out by telling us what you think?

<if yes, proceed> <if no, end with> "No problem. Enjoy the rest of your visit."

1. What did you like most about this activity? Why is that?

Being about to watch my daughter think through the game and watch her thought process. And that she could make a bracelet to bring home. It was interactive.

<probes> Anything else? Can you tell me more about that?

It helps me learn about my daughter and how a 3 year old thinks. And she had fun making the bracelet!

2. What are some ways this activity could be improved? Why is that?

You could explain what "greedy" means more.

<probes> Anything else? Can you tell me more about that?

I think she is a little young to understand the activity.

3. In your own words, what would you say this activity is about?

Impulse control

<probes> Anything else? Can you tell me more about that?

I would say this activity is about how kids think and how they learn to control their desires and make choices.

4. Would you mind telling me how old you are? 41

5. What is your gender? M

6. Who are you visiting with today? <read responses>

- ☐ I am here alone.
- ☐ I am with a school or tour group.
- ☒ I am here with family or another social group that includes children/youth and adults.
- ☐ I am here with family or another social group that includes adults only.

7. <If visiting with children> Could you tell me the number of children/youth you are visiting with in each of these age groups: ____ under 2 1 2-5 ____ 6-8 ____ 9-12 ____ 13-17

Thank you for your time and feedback! Do you have any questions for me?

Observation Form

Educational Goal(s)

List the goals of your educational experience.

Start time: _____

End time: _____

Total time:

Group Characteristics

Indicate the type of participant group and the number of group members in each age category.

No. of adults: _____ 18–29 _____ 30–50 _____ 51+

No. of children/youth: _____ under 2 _____ 2–5 _____ 6–8 _____ 9–12 _____ 13–17

Group seems to be (circle one): School or tour group Family or friend group

Observations

What happened during the program (description of participant and facilitator talk and behaviors)?

Reflections

*From what you observed, what about the program **worked well** to support your educational goals?*

*From what you observed, what about the program **didn't work as well** to support your educational goals?*

Any other reflections (e.g., other strategies to try, interesting visitor comments, group specific issues)?

EXAMPLE

Observation Form

Educational Goal(s)

List the goals of your educational experience.

Learn about and experiment with the seismic process

Use scientific tools (seismograph) for studying earthquakes

Start time: 10:25:05

End time: 10:31:20

Total time: 6 min., 15 sec.

Group Characteristics

Indicate the type of participant group and the number of group members in each age category.

No. of adults: 18-29 2 30-50 51+

No. of children/youth: under 2 2-5 2 6-8 9-12 13-17

Group seems to be (circle one): School or tour group **Family or friend group**

Observations

What happened during the program (description of participant and facilitator talk and behaviors)?

Family (two adult and two kids) walks up to table.

All members look at seismograph on iPad.

Adult male taps table to see if recording changes, laughs and looks towards children, feels texture of the materials to attach to the device.

Adult male chooses the brick to attach.

Both adults watch the device move the brick and look toward the seismograph.

Educator turns a crank that makes the device go.

The whole family looks intently at the recording.

Adult male says, "Let's go rough on rough."

The two kids are looking at an exhibit nearby.

Adult male helps change the materials out so a rough object moves on a rough surface.

Adult female says, "More severe earthquakes."

Educator turns the crank.

Kids looking back and forth between the recording and an exhibit nearby.

All look again at the recording.

Family talks about their personal experience in an earthquake with the educator. Adult male says, "We are from California, so we have been in earthquakes. They [kids] haven't been in any big ones, right?"

Kids nod, mention some little ones they experienced, where they were, what they did.

Kid says, "We were at school and everything started to shake!"

Both adults start to talk about the earthquake in 1989.

Reflections

*From what you observed, what about the program **worked well** to support your educational goals?*

Since the whole family was involved, at least to some degree, in different components of the scientific process in testing the objects, this activity seemed to work well.

One adult chose different objects with varying characteristics to try out and seemed systematic in testing them.

The other adult made predictions about the seismographic measurement, saying that the rough textures would cause a "bigger earthquake."

So, together, the adults mainly, tried out different variables and hypothesized about outcomes.

All members did look to the iPad to see the recording and testing of their predictions. So, the program engaged the entire family.

They seemed to understand the use of the seismograph and engaged in scientific thinking.

Program appeared to support content goals and use of the tool.

*From what you observed, what about the program **didn't work as well** to support your educational goals?*

The kids lost interest at various points and started to look at a nearby exhibit.

Perhaps have other hands-on opportunities for other members of the family—especially so young kids can get involved.

Maybe instead of the educator, a visitor could turn the crank to make the device go.

Any other reflections (e.g., other strategies to try, interesting visitor comments, group specific issues)?

The whole family became very engaged talking about personal experiences with earthquakes.

Maybe include information about known earthquakes to connect to visitor experiences.

Examples of seismographic recordings of past earthquakes to show?

Data Reflection Cheat Sheet

Use the four steps outlined below to focus on the purpose of your team-based inquiry (TBI) study, immerse yourselves in the data, and make sense of the information you collected.

1. Describe and clarify:

The facilitator reminds the team of the inquiry and data discussion goals. The group asks questions as needed.

2. Observe and discuss:

The group spends time reviewing the data. Afterwards, each team member mentions one unique piece of data that he or she feels is particularly interesting or important.

3. Immerse and notice:

Each team member suggests a unique theme or pattern he or she notices in the data related to the goal of the data reflection.

4. Categorize and explain:

After exhausting potential themes, the team sorts the data by theme, counting the number of data points in each category and discussing possible explanations.