A guide for expanding inquiry-based science education into the community

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When we moved from Pasadena, California, to Seattle, Washington, in 1992, we brought with us a passion and commitment for supporting K-12 science education. We recognized then, as we do now, that for our society to continue to advance, we need a scientifically competent workforce and a scientifically literate citizenry. We understood the importance of the scientific community’s involvement and support of the educational pipeline both to encourage future scientists and engineers as well as provide our society with the capacity to make informed decisions about the world in which we live. As we worked to establish the new Molecular Biotechnology Department at the University of Washington, we established a new vision for the biological sciences in the Puget Sound region and contributed to a new vision for science education.

In 1995, we worked with Seattle Public Schools to submit and receive a grant from the National Science Foundation to support science education reform at the elementary school level. The core of this program was the adoption of new inquiry-based science curriculum for each grade, Kindergarten through five. The adoption was robust as it included three sets of instructional materials for each grade level, which were based on current research on how children learn science. As part of the strategic plan for adoption, teachers from every elementary school in the district participated in a professional development program.

In 1998, we were awarded a second grant from the National Science Foundation to support a parallel program at the middle-school level in five regional school districts (Bellevue, Highline, Shoreline, Seattle, and Northshore). While teachers and students were becoming engaged in these science education reform efforts, it became clear to us that students’ families needed a vehicle for understanding how these new teaching practices would benefit students in learning scientific concepts. The new inquiry-based science materials, which had been professionally developed by national experts, provided students with opportunities to explore science through a variety of hands-on investigations. The use of textbooks as the primary source of knowledge acquisition had become outdated.

To help families and the community-at-large better understand inquiry-based science education programs in the schools, we embarked on an inquiry-based Family Science project. We piloted Family Science events at those schools undergoing science reform efforts, with support from the Rathman Foundation and the Seaver Institute in 1995. In due course, we applied and received funding from the National Science Foundation in 1996 to create a regional Family Science project with the goals of engaging and empowering families to learn science together and to build community support for inquiry-based science education.
In 2000, we left the University of Washington to found the Institute for Systems Biology, a nonprofit research institution. We brought with us the mission and passion for pioneering new scientific methods along with an increased commitment to support K-12 science education reform. With a core staff of science educators, we created the Center for Inquiry Science, a group responsible for the Institute's K-12 science education program. A central component of their programming has been the Family Science project.

The Family Science project, hosted by the Institute for Systems Biology, brought together schools, parents, and community organizations to support science education reform in Seattle Public Schools. Each elementary school's Family Science program consisted of many different types of activities carried out over several years. The participating schools served economically, ethnically, and linguistically diverse populations and targeted schools with more than 80 percent minority students and where over 65 percent of students received free or reduced lunches. Similar demographics were targeted at secondary schools where Family Science programs expanded in later years.

We believe the Family Science project has been a remarkable success—reaching over 24,000 family members at Family Science events from over 60 schools in the Puget Sound area. The program's accomplishments were made possible with the involvement of families, schools, informal science education venues, community centers, and universities. We want to thank everyone involved in the development and creation of the Family Science project.

The Celebrating Science guide has been written to celebrate the Family Science project by sharing its successes and strategies. The guide offers readers a strategic, purposeful, and reflective approach to communicating and building support for inquiry-based science education programs; to encourage family engagement in such programs; and ultimately to celebrate student involvement and achievement in science.

We encourage others to use the Celebrating Science guide as a resource for supporting science education reform within their own community and to celebrate with us the progress of student achievement in science.

Sincerely,

Leroy Hood, M.D., Ph.D.
President
Institute for Systems Biology

Valerie Logan, M.A.
Community Partnerships
Institute for Systems Biology
Acknowledgments

The Family Science staff recognizes the contributions of the community partners who have participated in Family Science programming. We would like to acknowledge and thank all of the teachers, parents, after-school care providers, and administrators who have contributed from different school districts in the Puget Sound Region: Bellevue, Highline, Northshore, Seattle, and Shoreline.

We acknowledge the businesses and organizations supporting us throughout the years:

- 21st Century Learning, Community Learning Centers
- Friends of Old Hay
- National Oceanic and Atmospheric Administration (NOAA)
- Woodland Park Zoo
- Pacific Science Center
- School's Out Washington
- Seattle Aquarium
- Seattle Audubon
- Seattle Parks and Recreation Department
- Starbucks Coffee Company
- The GENETICS Project at the University of Washington
- The Home Depot
- The National Wildlife Federation
- Washington State Leadership and Assistance for Science Education Reform (LASER)
- Washington State Parent Teacher Association

We would like to give a special thanks to the supportive environment at the Institute for Systems Biology (ISB) and for the leadership from Lee Hood and Valerie Logan as well as all volunteers from ISB who came to facilitate many family events at schools and large community venues. Their help was invaluable to the success of this program.

Special thanks also go to Andrea (Andi) Anderson, from SoundView Evaluation & Research, who kept us on track through her thorough evaluations and reports. Her genuine commitment to the growth of the Family Science program is recognized and greatly appreciated.

Thank you also to many family members and friends who provided valuable input during the writing and editing of this guide. Your comments were appreciated and contributed greatly to this work.

We want to give special thanks to Amy Hale, whose contribution to the Family Science program throughout the years has been incorporated in the Celebrating Science guide. Her roles in the Family Science program were numerous, starting as an invested mother; later becoming a science resource teacher, facilitator, and organizer of events; and, ultimately, program manager. Her leadership brought together, in many cases for the first time, large community events involving many local organizations—including the creation of Zoo Day, an event that reached thousands of students and families in the Seattle area.
Celebrating Science provides a framework for establishing a Family Science program based on our experiences in carrying out events the past 10 years. These events took many forms as we considered the context and culture of the groups involved without losing sight of the program goals. Using our lessons learned, we hope you can develop your own Family Science program to:

- Strategically build awareness of new science education programs.
- Encourage participants to engage in meaningful interactions to build understanding of inquiry-based science education.
- Celebrate children’s involvement and achievements in science.

Celebrating Science was written with teachers, school administrators, family members, out-of-school-time educators, and community-based organizations in mind. Although some sections might seem more relevant for a particular group than others, we still encourage those involved in creating a Family Science program to read the guide in its entirety and acknowledge contributions from each of these groups.

Celebrating Science was intended as a guide to help users successfully develop a customized Family Science program for their community. It may also provide additional strategies for events currently happening at your school. As your Family Science program grows and key participants evolve, the Celebrating Science guide can serve as a tool for documenting your program history. We suggest using a 3-ring binder to house the Celebrating Science text and to continually update the binder with notes and resources using the Event Planning and Documentation Tool.

To synthesize lessons learned, we divided the Celebrating Science guide into four main sections:

1. Learning in the 21st Century
2. Establishing Family Science Programs
3. Sustaining Family Science Programs
4. Creating Inquiry-based Activities

As you read through the guide, look for the icon for successful strategies from our Family Science program. The Forms section of this guide contains sample evaluation forms and documentation tools for participants, facilitators, and Family Science Planning Groups. For electronic versions of these forms or any other section of the guide, visit our website at:
http://projects.systemsbiology.net/celebratingscience

We hope Celebrating Science provides you with ideas and resources for integrating a Family Science program with your group’s unique community needs and interests.
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Why Involve Families in a Science Education Program?

Research strongly indicates that families’ active participation in their children’s schooling improves student achievement.\textsuperscript{1} Thus, family involvement in children’s learning is a crucial component of any systemic and sustainable change in education. This rationale is based on the benefits of parent participation in a child’s education, the conviction that informed parents are more likely to become advocates for high-quality science education, and the critical role involved parents can play in advancing science education reform as their children move from elementary school into secondary school.

Education reform is a complex, involved, and lengthy process. Research and experience in science education reform has shown there are at least five key elements in a successful science education program:\textsuperscript{2}

1. Adopting and implementing inquiry-based science curriculum and materials.
2. Including professional development for teachers that provides both rich content knowledge and inquiry-based teaching and learning strategies.
3. Supplying materials and apparatus to classrooms through a centralized materials support system.
4. Implementing assessment methods consistent with the goals of an inquiry-based science program.
5. Building strategies for administrative support and community participation to sustain commitment to science education reform.

A Family Science program that is strategic, purposeful, and reflective can be a catalyst to supporting science education reform.

Specifically, the Family Science project at the Institute for Systems Biology was created with the mission to empower families to learn science together and to build community support for inquiry-based science education. The Family Science project was designed to support the fifth key element of reform: community participation. The project goals were to:

- Engage communities that are traditionally underrepresented in science careers.
- Build networks of support and leadership for quality science education and literacy within Seattle schools and local communities.
- Engage families in student learning.
- Reduce barriers for students and families to fully participate in quality formal and informal science education.

These efforts reflect the nation’s vision for developing citizens ready for the challenges of the 21st century.


\textsuperscript{2} These five elements of reform come from the Washington State Leadership and Assistance for Science Education Reform (LASER), which are modeled after the national LASER program developed by the National Science Resources Council.
What is Contemporary Science Education?

Almost 50 years ago, the Soviet Union shocked Americans by launching Sputnik, the first Earth orbit satellite. That event called for increased attention to our nation’s Kindergarten through 12th grade science education. The “best and brightest” students were encouraged to take science electives and consider careers in science or engineering. For these select students, new science textbooks and lab equipment were supplied to science departments. This group of students benefited from an increased emphasis on science education.

But women, minorities, and average students were not exposed to this rigorous science curriculum, nor given the opportunity to explore science concepts as they related to the world they lived in. As a result, this type of science education actually widened the achievement gap among these groups. Even with the emphasis on increasing our prowess in science and technology, new science courses were not thought of as core subjects.

Today, contemporary science education supports educating all students, with a particular emphasis on closing the achievement gap. Curriculum and teaching approaches have changed and these changes are supported by educational research and student achievement data. By attending to the learning of all students, not only is our education system filling the pipelines to science and engineering colleges and our national workforce, but it supports the development of a literate citizenry with an ability to think critically and continually learn. Simply put, contemporary science education is preparing citizens and the workforce for the future.

To address these issues, scientists, educators, and educational researchers convened over the past two decades to study how people learn science. More specifically, the term standards has been provided for documents that outline a sequence of what students should know and be able to do. These documents summarize research on what children are developmentally ready to learn and in what order concepts need to be introduced and taught. To accompany the “what” and “when” of teaching science concepts, there have been several studies on effective “best practices” for teaching science. We now know that passive reading or listening to lectures is not enough to form a lasting understanding of scientific principles or develop scientific skills. Rather, learning must be student-centered. This entails actively constructing new knowledge by connecting old ideas and beliefs to new information gained through personal investigations and discovery provided through classroom experiences.

This contemporary way of teaching and learning has been described as inquiry-based science and is the central component of this guide. Research demonstrates that by infusing science programs with inquiry, significant improvements in scientific achievement occurs for all students, including those from underserved populations, and contributes to students’ overall success in school. Hence, understanding inquiry-based science in the context of classroom learning is fundamental for developing a Family Science program.

“Well-tested research-based programs are designed to prepare children for the scientifically and mathematically complex societies of the 21st century. Such programs are based upon sound, current scientific knowledge about how the brain functions, how humans think and learn, and how this knowledge relates to understandings about our world.”

–Lawrence F. Lowery, The Biological Basis of Thinking and Learning

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Defining Inquiry-based Science

Inquiry is a search, an active process of understanding not simply the transfer of information or knowledge. Teachers, science educators, and curriculum developers have designed models for incorporating the process of inquiry into classroom practice. Inquiry-based science can be described in terms of what students do in the classroom, what teachers do to support the inquiry process, and how instructional materials support teaching and learning.

What Students Do

In the inquiry-based science classroom, students are not passive; rather, students engage with science content in a manner that parallels the process used by scientists. Students explore and discover science through a process of inquiry by:

- **Focusing** on the content at hand through observations and questions
- **Exploring** these ideas with hands-on experiences
- **Reflecting** on what they have observed or measured to make meaning from their experiences
- **Applying** and extending their findings to new questions or problems.

What Teachers Do

Teachers support student inquiry-based activities by facilitating students’ scientific understanding through:

- Assessing student prior knowledge
- Asking guiding questions, without providing answers
- Arranging the classroom to promote collaboration and communication skills
- Providing focused opportunities for open-ended investigations
- Modeling analysis techniques
- Fostering reflection and critical thinking skills
- Providing real-world connections and integration with other subjects.

How New Science Curriculum Supports Teaching and Learning

Newly developed science curriculum supports the standards and best teaching practices for inquiry-based science learning. These materials highlight how students can build deep conceptual understanding of science concepts starting from their own curiosity, observations, and questions. By capitalizing on students’ natural inquiry abilities, many topics can be approached in the early grades and built upon in later years.

This way of learning makes possible deeper understanding and better retention of science concepts. In addition, the new science curriculum simultaneously builds both students’ content knowledge and process skills, paralleling the experiences of working scientists. Moreover, and perhaps far more importantly, the new science curriculum promotes students’ development of problem-solving, communication, and collaboration skills applicable to everyday life situations.

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What an Inquiry-based Classroom Looks Like

When observing a traditional versus inquiry-based science classroom the subtle shift in teaching and learning may not seem immediately apparent. Students in both classrooms are found reading, making observations, asking questions, conducting experiments, and making interpretations. Both include direct instruction from the teacher. A major difference, however, is that in an inquiry-based classroom teachers use instructional materials and teaching strategies that harness students’ innate curiosity for knowing “how we came to know” things rather than confirming “what we know.”

These next two examples illustrate the differences between “what we know” and “how do we know.” These classroom vignettes demonstrate how inquiry-based learning experiences extend beyond the learning of facts and hands-on activities. It shows how, through teacher-to-student and student-to-student discourse, deeper, more fundamental learning occurs using inquiry-based instruction.

Example of a traditional science lesson:

As the 7th-grade students filed to their desks, placed in rows in the classroom, Mr. Jones asked the students to get out their textbooks, paper and calculators. As homework the previous night, the students were given pages 81-84 to read in their textbooks, which defined the term density. Mr. Jones began the class by reviewing this reading, “Today, we will study one property of all matter – density. Who can give me a definition of density?” Sam raised his hand and replied, “Density is the mass divided by the volume.” Mr. Jones continued by writing the mathematical equation of density on the board and explaining the common units of density measurement: grams per cubic centimeter or grams per milliliter.

Next, Mr. Jones provided students with sample calculations and posed the task: “Calculate the density in grams per milliliter of aluminum if a 50cc block has a mass of 135g.” Students copied the information from the board and performed the calculation. After confirming the correct answer, 2.7g/cc, Mr. Jones proceeded to introduce the lab activity for studying density.

Mr. Jones passed out a laboratory handout that included the definition of density, a lab question, list of materials, and specific procedural steps. The students were asked to move to lab stations and complete the lab activity over the next two class periods. At each lab station, students were supplied with several uniform chunks of metal, wood, plastic, cork, and a sheet of foil. Students were asked to determine the mass and volume of each sample using a gram scale, ruler, and graduated cylinder of water as demonstrated by Mr. Jones. An additional page of sample calculation problems was to be completed as homework. The calculations and a written conclusion for the lab activity were to be turned in at the end of the lab period the next day.

The following day, Mr. Jones monitored the behavior of students in their lab groups. He clarified questions about the procedure and handling of equipment as needed. At the end of the lab, students exchanged their papers and Mr. Jones provided the answer key on the overhead. The corrected papers were collected and entered into the grade book.

Mr. Jones reminded the students that a quiz on this material would occur in two days and would include calculations for density and a practical exam on using a gram scale.
In a classroom where students are looking for a "correct" answer, the instruction follows more traditional methods, such as giving students scientific facts and definitions in lecture format and repeating laboratory procedures that lead to a specific, known result. Scientific concepts are often presented quickly and in only one setting.

In the previous example, Mr. Jones directed the class through all the steps to confirm what already was known. Research shows that many students have difficulties applying and extending the concepts learned from these types of experiences to new situations. Research also indicates that students approached in this manner quickly become disinterested and have difficulty seeing the relevance for how this information will be useful in their own lives, beyond remembering the facts for a test. Traditional methods may be hands-on but not necessarily minds-on.

Example of an inquiry-based science lesson:

Ms. Rodriguez greeted her students and invited them to sit in their cooperative groups at the lab stations in the classroom. "Before we begin our investigation today, I would like you to watch a brief demonstration," she said. Next, she asked the students to predict what would happen when she placed an ice cube in two separate glasses of clear liquid. Meredith guessed that the ice cube would float in the "water," since that is what happened at home. Siry agreed with Meredith, recalling that icebergs float. Most students nodded in agreement. Ms. Rodriguez then placed the first ice cube in the first beaker and it floated, but in the second beaker a second ice cube sank to the bottom. The students were visibly shocked. Jose asked, "What's your trick?" "Good question. Are there more questions you would like to ask about this system?" Ms. Rodriguez replied. Ms. Rodriguez and her students discussed the students' original assumption that the liquids in the beakers were water. Ms. Rodriguez asked, "Based on what you just experienced, how might you alter your assumptions?" Ms. Rodriguez and her students discussed the properties of the two liquids—both clear and non-viscous. Students then asked their teacher to place the first ice cube in the second beaker of liquid to see if the same result would occur. The first ice cube sank just as the second cube had. This prompted other students to ask further questions and examine the liquids and ice cubes more closely. Through their observations, the students inferred the cubes appeared to be normal ice cubes, but the first beaker contained water and the second beaker contained rubbing alcohol, as noted by the smell.

Ms. Rodriguez questioned the students about what they knew about floating and sinking from their own experiences and made a list of their responses on the board. Next, she prompted the students to extend the idea of floating and sinking with the variety of materials found at their lab stations: plastic dishpans, water, metal containers, nuts and bolts, blocks of wood, bar of soap, Styrofoam, rubber bands, aluminum foil, shells, plastic lids, cork, a gram scale, and a graduated cylinder (measuring cup.) After their initial explorations, the class generated a list of floaters and sinkers. Ms. Rodriguez asked, "Which property of these materials might contribute to whether something floats or sinks?" Many thoughts were shared, including how much something "weighs," since several students had weighed the objects to make predictions about floating and sinking. At the end of the period, Ms. Rodriguez asked the students to create a concept map (bubble-arrow diagram) to explain their current ideas about floaters and sinkers as homework.

continued on page 13
As shown in the inquiry-based science lesson, students are motivated to learn when given the opportunity to pose their own questions and examine how the natural world functions. Teachers in inquiry-based classrooms empower students by providing a variety of opportunities and methods for students to observe, question, and investigate the world around them. As students build meaning from these experiences, additional opportunities to extend and apply the new information helps to solidify the knowledge and skills gained.

Studies show that learning science in this manner reflects how children naturally learn through experimentation, which facilitates connections between new information and former experiences or ideas. As a result, students retain more information and have a deeper understanding of science concepts.

"Scientific investigations usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected evidence."

–Atlas of Scientific Literacy, 7 pg. 15

Example of an inquiry-based science lesson continued from page 12

The next day, Ms. Rodriguez had the students complete a lab where they compared blocks of wood, metal, plastic, and cork placed in various liquids (water, oil, and alcohol) for floating and sinking. Ms. Rodriguez instructed the students about measuring the volume of an irregular ball of aluminum using the graduated cylinder and displacement of water and reviewed the use of a gram scale. After forming a common lab question, the students used the gram scale to measure the number of grams of each item and used a ruler or a graduated cylinder for determining the volume of each item. All this information was compiled with the original floater and sinker list and discussed as a class. Along the way, the students asked about the weight of objects and their ability to float. Ms. Rodriguez went from group to group to discuss this question. Students were able to state their results from the many different objects by developing the statement, "For every one unit of volume (cubic centimeters or milliliters), this object has a mass of X grams. This compares to water, which for every one milliliter always has a mass of 1 gram." Following this analysis of their experimental results, Ms. Rodriguez led a whole class discussion on weight versus mass. She was able to introduce the term "density" to be used for the concept of how much mass an object has for every one unit of volume and used this term to analyze the class data on floaters and sinkers.

Next, Ms. Rodriguez applied the concept of density to principles of engineering and the arts. The students designed ways to solve the challenge of how to make "floaters sink" by using sponges and lemons with and without their skins. Students then applied their findings to the next challenge—how to make an object float and sink at will—principles used in submarine design. Also, returning to Siry's original prediction, the class proved how icebergs float and what makes them dangerous to ships by measuring how much of a large chunk of ice is actually submerged under the surface of the water (i.e., about 9/10ths).

Ending the unit, Ms. Rodriguez demonstrated how to marble paper using the different densities of ink and water (i.e., the ink floats on the water in swirling patterns that can be transferred to paper). Students were fascinated with applying science principles in artistic ways. Students created their own marbled paper and constructed a final concept map of their understanding of density on the paper for their science notebooks.

The combination of all these lessons guided students through different activities that helped them develop an understanding of density and apply and extend the concept to new situations.
Educational research demonstrates that inquiry-based teaching and learning and parental involvement in education impact student achievement. Establishing a Family Science program can serve as a place for communicating reform efforts in science education within a broader community context. The process encompasses three major areas that contribute to a program's sustainability:

- **Building partnership infrastructure founded on common goals.**
- **Creating a program that fits the school and community cultures.**
- **Growing a comprehensive program through ongoing evaluation processes.**

### Building Partnerships

Three main components within the larger community contribute to a child's education and development: schools, out-of-school programs, and families. Each has unique perspectives, strengths, and responsibilities. These three groups constitute the **Triangle of Support** (see below) for children's development and are the primary stakeholders in a student’s education.

In the school setting, support for student academic development involves individual teachers, building and district administrators, and the school board. Opportunities for student learning in the out-of-school setting include programming found within the schools, community centers, after-school care, and a wide variety of community organizations—such as scout troops, neighborhood churches, Boys & Girls Clubs, YMCA, YWCA, 4-H, and many others. The family component is extensive and includes parents, grandparents, and other adults invested in a child’s learning (i.e., clergy, caregivers, and more). The community at large encompasses all of these environments and includes governmental agencies, the business community, informal educational settings (i.e., museums), and higher education institutions.

### Triangle of Support

![Triangle of Support Diagram](image-url)
In planning a Family Science program, it is important to be aware of and nurture relationships with people that cross boundaries between these categories: family, out-of-school programs, schools, and the community at large. These relationships are essential in developing program alignment among Triangle of Support (see p. 14) members and providing important insight on how to maximize each learning environment. This leverages and extends student learning opportunities.

Successful Strategies:
Family Science events could be housed at an after-school program, community center, or museum in partnership with a school.

Harnessing the strengths of these key players into a strategic partnership is basic to the development of complementary learning programming.⁸

To maximize efforts in building a partnership infrastructure, seek common connections with other invested adults to create a Family Science Planning Group. Be sure to develop alliances with stakeholders within the Triangle of Support who demonstrate any one of the following characteristics:

- Commitment to science education and student achievement
- Expertise and experience in inquiry-based science
- Awareness of science education reform efforts
- Commitment to increasing family involvement in children’s education.

As with all strategic planning, a common foundation is critical for success. Families, facilitators, and community organizations participating in Family Science events over the past 10 years identified four key strategies for successful partnerships:

- Create partnerships with groups that have similar goals, commitments, and vision
- Establish a common mission up front
- Determine specific audiences for each event
- Make learning outcomes intentional and targeted.

As the Family Science Planning Group comes together, it is important that all involved find common purposes with partners and have clear communication about the purpose of a Family Science program, each partner’s role, and potential contributions.

“We The Family Science program at the Institute for Systems Biology was a great ally in doing the work I was trying to do. My work with the community leadership program led me to want to work with families of underserved populations. It was nice that there was a group outside the museum that was interested in doing some of the same things. I felt like I had a broader base to work from.”

—Museum Educator

Creating a Comprehensive Program

After building a partnership infrastructure, the Family Science Planning Group is now ready to create a program driven by inquiry-based science education. The model below captures three key factors in building a Family Science program within the context of science education reform. Creating a comprehensive program requires that stakeholders be aware of:

- Where the school and/or district’s reform efforts are toward adopting, implementing, and integrating inquiry-based science curricula and teaching strategies.
- How aware, receptive, and engaged the community is toward science education.
- How to select events compatible with the level of community participation and science education reform.

Family Science Program Model: Stages of science education reform and phases of community participation as aligned with compatible events.

<table>
<thead>
<tr>
<th>STAGES OF SCIENCE EDUCATION REFORM</th>
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<tbody>
<tr>
<td>Adoption refers to the first stages of planning when school/teachers/district are deciding on which curriculum to adopt; teachers are becoming trained on the new materials through professional development and piloting the materials in their classrooms; and new ways of assessing student learning are being explored.</td>
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| Implementation is the second stage when schools start piloting newly adopted science curricula; professional development has evolved to develop lead teachers in inquiry-based science teaching; and new testing methods are being piloted. |

| Integration refers to the final stages when curriculum has been implemented in all classrooms and grade levels at the school; professional development is targeted to the needs of all teachers; and inquiry-based science assessment testing methods are being used system-wide. |

<table>
<thead>
<tr>
<th>PHASES OF COMMUNITY PARTICIPATION</th>
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<tbody>
<tr>
<td>In the awareness phase, the community becomes alert to changes in the science program and there becomes a need for information about what reform entails. As community participation grows, stakeholders become interested and receptive to science program changes. The result is community engagement and commitment to inquiry-based science education.</td>
</tr>
</tbody>
</table>
The Family Science Program Model introduced on the previous page integrates three key factors in creating a Family Science program: stages of school science reform, phases of community participation, and compatible events. We will describe how these factors come into play when establishing a Family Science program.

As noted earlier, the five key elements of a successful science education program include:

- Adoption of inquiry-based curriculum
- Materials support system for supplying materials and apparatus to classrooms
- Professional development for teachers in inquiry-based science
- Inquiry-based assessment methods
- Administrative support and community participation.

These five key elements are collectively referred to in the Family Science Program Model as School Science Reform Efforts and are shown as progressing from adoption to integration. When planning a Family Science program, one should recognize that within a given school district, schools and even classrooms may be at different stages of the continuum.

For this reason, we recommend the Family Science Planning Group identify which stage of science education reform corresponds with their school and district reform efforts. Then appropriate goals can be established for a Family Science program.

Community Participation refers to stakeholders’ progression from awareness of, receptiveness to, and engagement in inquiry-based science education. The interplay between the levels of community participation and school science reform efforts directly impacts what events are most appropriate for creating a comprehensive Family Science program. In general, Family Science events can introduce families and the community to inquiry-based science learning. The desired outcomes for Family Science events are to:

- Inform and build awareness of inquiry-based science and reform efforts
- Showcase students’ work based on inquiry-based science learning
- Explore science concepts using inquiry-based processes.

In the Forms section of this guide, we have created a tool to assess the stage of science reform at your school and the phase of community participation in reform efforts.
A comprehensive Family Science program will inform, showcase, and explore the impact inquiry-based science education has on students’ understanding and overall achievement in school. The following pages elaborate on each of the events mentioned in the Family Science Program Model (see p. 16). Below is a description of these events.

**Informational Events** can be scheduled at any stage of the science reform efforts, but are crucial in the initial stages of reform and as new families join the school. The first events should inform stakeholders about science education reform and curriculum adoption processes. Informational sessions can demonstrate inquiry-based science teaching and learning, and highlight the benefits for student achievement. New curricula and kit materials can be on display.

**Showcase Events** highlight students’ work and scientific thinking. Inquiry learning processes are more evident as science reform efforts move toward implementation stage. As teachers and students become more familiar with inquiry-based processes, they are better prepared to share these approaches with families and the community. The depth of student learning demonstrated at these events can be powerful. Not only can parents participate in inquiry-based activities, but their own children have learned enough to teach their parents the concepts. Events that showcase student learning can be empowering for students, teachers, and families and solidify their support for science education reform.

**Exploratory Events** are appropriate for any level of community participation. This type of event allows families, students, and community members to experience an inquiry-based approach first-hand by deeply exploring a science concept together. The research principles underlying the new curricula apply to adult learning as well. Once participants experience inquiry-based science personally and understand the depth of learning possible, they are more likely to support reform efforts.

---

"...did you notice how busy and involved the kids were during (Family Science Night)? I saw kids of all ages at all stations, finding something in each activity that met their needs for learning or entertainment. They were excited, inquisitive, and actively pursuing scientific thought and process. It’s something we haven’t had enough of at our school. The eagerness with which the kids embraced the scientific activities should be incentive for us all to continue to find them similar offerings. I think it was terrific validation for the time and effort invested by the teachers, and I hope they feel the same way." —A parent writing to the Principal
Family Science Program
Case Studies

These examples show how three schools came to choose Family Science events compatible with their program goals. In each case, there was a match between the school’s stage in the science reform effort, the phase of community participation, and the types of events chosen. The cases are based on the Family Science program’s experience in facilitating these events. The names of the schools and participants have been changed.

Informational Event

Century Elementary served a highly diverse community. In designing an Informational Event, Mr. Petro, principal of Century Elementary, considered cultural differences, previous school experiences, and differing parental expectations of the educators. He wanted to effectively communicate the contrasts between inquiry-based and traditional science classrooms and create a welcoming environment for all families. Mr. Petro, a lead science teacher, and parent volunteers were on hand to facilitate the event. As a team, they used interactive materials to engage families early on, prompting dialogue through the use of interpreters. Since many families were already familiar with their translator, a sense of community was fostered between the school and home environments. Families overflowed the lunchroom area, with well over 120 participants. The tone of the event was highly positive. As parents left the meeting, they made several comments about their enthusiasm for future Family Science events.

By holding an Informational Event, Mr. Petro and his team were able to address concerns and questions regarding the school’s new science curriculum. Many parents did not know what the adoption entailed, how students would benefit, and how the curriculum differed from previous adoptions. By recognizing and addressing the needs and challenges facing his community up-front, Mr. Petro’s Informational Event was successful. Many questions were asked in the highly interactive session, which resulted in parents’ buy-in and support for inquiry-based science reform and future events.

Successful strategies used in this case included:

- Writing invitations in eight major languages spoken in the community.
- Paying for translators (most often instructional assistants and community members) to call families with personal invitations.
- Talking up the event to students two weeks before the meeting.
- Combining the event with a book fair and offering free books to each child attending.
- Asking community business partners to provide refreshments and a low-cost pizza dinner.

“Hands-on activities are a much more effective means of explaining the science program to parents than the traditional curriculum night or meeting. The activities have a nice transfer to home use.”
—Elementary School Principal
Showcase Event

Although new to the inquiry-based curriculum, teachers and students at Stillwater Middle School were challenged to develop projects for the upcoming district science fair. To reflect the new inquiry-based materials and better address the needs of older students, the district shifted the focus of the science fair from "projects and displays" to individual student generated "investigations." Students presented their research findings in a science conference format. However, the inquiry-based curriculum was so new that teachers found students needed additional scaffolding, classroom-guided experiences, and one-on-one mentoring to present their own investigations at the conference.

Stillwater science teachers asked the Family Science team for assistance in recruiting, organizing, and training volunteers who could help students with their projects at an after-school science club. These volunteers worked with the after-school program to garner supplies and assist students with their experiments. The Family Science team also contacted scientists in the area to serve as mentors to the students. The scientists were able to model the inquiry process for students and provide help with content knowledge questions.

It took weeks of preparation, but the results were worth it. The Stillwater Middle School students received significantly higher judging scores than in past years as well as recognition through specific science conference awards. The students and their "inquiry team" (science club volunteers, after-school program personnel, and scientist mentors) received important recognition and publicity in the newspaper acknowledging their efforts in improving student achievement.

Together, the teachers and volunteers successfully devised strategies to:

- Train volunteers to assist students in using the inquiry process to conduct an investigation, both in the classroom and at Science Clubs.
- Recruit science content "experts" (graduate/undergraduate students, science, and engineering professionals) to work with individual students in Science Club or by email.
- Encourage minority college students to participate as volunteers or content experts.
- Provide access to scientific equipment and everyday materials needed to conduct investigations.
Exploratory Event

Ms. Larson and Mr. Lee, third grade teachers at Redwood Elementary, had teamed together for two years to implement the new science curriculum. As a result of their professional development, they were comfortable with the materials. The driving force behind their enthusiasm for the new curriculum was seeing the students’ improved thinking and problem-solving skills, even in subject areas outside of science. Recognizing their proficiency with the inquiry-based materials and their comfort with science content, the Principal, Mrs. Nikolov, asked them to provide an “inquiry-immersion experience” for the parents as the focal point for Math-Science Night later in the year.

The event was highly successful, with 40 parents constructing straw towers and testing their ideas about structural design. Many parents complimented Ms. Larson and Mr. Lee for helping them better understand the concepts of tension and load, as well as demonstrating the strengths of inquiry-based learning. Mrs. Nikolov shared results of this Family Science event with her colleagues at a district meeting.

Ms. Nikolov offered the following suggestions for other principals hoping to implement a Family Science program at their schools:

- Ask an experienced inquiry teacher to guest speak/facilitate at a school just beginning their reform process.
- Consider combining events with another school or community center to share experienced facilitators.
- Provide a stipend for enthusiastic teachers to create and lead a Family Science event at the school.
Growing a Comprehensive Family Science Program

The growth of a comprehensive Family Science program relies on the Family Science Planning Group’s responsiveness to community needs through ongoing evaluation efforts. To avoid Family Science events simply becoming a “check-off” event, the Family Science Planning Group needs to purposefully balance the phase of community participation with the stage of science reform. (See the Family Science Program Model on page 16.)

From the beginning, the Family Science Planning Group should establish key evaluation targets matching the vision and outcomes selected for the Family Science program. During implementation, the Family Science Planning Group can take the opportunity to evaluate individual events. Such information can help them determine which strategies might be considered for the next event(s).

At year’s end, the Family Science Planning Group can determine whether the program met its goals through reports compiled from all surveys, interviews, and notes collected throughout the year. This information can be used to make decisions about:

- Next steps for Family Science events and program development
- Identifying additional stakeholders and potential partners
- Strategies for sustaining financial support.

The table below provides a suggested timeline and venues for gathering data to evaluate Family Science programs.

<table>
<thead>
<tr>
<th>TIME</th>
<th>DESCRIPTION OF EVALUATION</th>
<th>DATA COLLECTION METHODS</th>
<th>CONSIDER ASKING…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial…</td>
<td>Identify starting level of reform efforts and community participation. Identify program’s goals with partners and select compatible events.</td>
<td>Meetings, informal discussions with stakeholders [needs assessment]</td>
<td>What is the purpose of the evaluation?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>What audience are you targeting?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>What kind of information do you want to gather?</td>
</tr>
<tr>
<td>During…</td>
<td>Collect information on whether outcomes were met for individual events. Assess level of community’s participation.</td>
<td>Surveys conducted by event facilitators; informal interviews; pictures; notes [formative evaluation]</td>
<td>What methods will be used to gather the information?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>How do you plan to disseminate findings?</td>
</tr>
<tr>
<td>Final…</td>
<td>Reflect on the program and its compatibility with science reform efforts and the level of community participation.</td>
<td>Reports from surveys conducted throughout the year [summative evaluation]</td>
<td></td>
</tr>
</tbody>
</table>

“The reader can find sample evaluation forms in the Forms section of this guide and on the website: http://projects.systemsbiology.net/celebratingscience

“Family Science brought to the events two things: A desire to take a look at how we impacted the audience and that there was also a desired result we were aiming for.”

—Museum Educator
How do you sustain a Family Science program? Working with like-minded people, collaborating to meet mutual needs, and maintaining newly formed relationships are key to a program’s sustainability. This section presents strategies for supporting those wanting to develop inquiry-based science learning experiences for parents, families, and community groups. These strategies are offered not as a checklist, but rather as ideas to consider in crafting Family Science programs in other settings.

**Strategies for Planning, Implementing, and Evaluating Family Science Events**

Earlier in this guide, it was recommended that you form a Family Science Planning Group with members from the Triangle of Support (see p. 14) who are committed to science education and student achievement, involved in inquiry science, aware of science reform efforts, and committed to increasing family involvement.

Steps for sustaining a Family Science program within your organization fall into four main categories:

- Planning Family Science events
- Implementing Family Science events
- Evaluating Family Science events
- Follow-up projects.

"All the staff went to the professional development offered through the NSF Local Systemic grant, and since then the staff has been more interested and involved in science."

—Elementary School Principal

"Thank you for your enthusiastic contribution to our Science Night. 'Experience Science' gave our students, parents, and school staff a very special opportunity to engage in so many different aspects of science. We are very grateful for all that you shared. Thank you from each of us at our school!!!"

—Teacher
Steps in Planning Family Science Events

1. Develop a Common Mission

A project’s mission, vision, and goal statements provide the organizing language that helps you decide what to do and how and when to do it. Here are a few tactics to support your overall strategy.

- Work with people, groups, or organizations whose goals align with yours.
- Determine specific audience for events.
- Make learning outcomes for events intentional and targeted.
- Bring all stakeholders to planning discussions.
- Provide the Family Science program framework but be flexible and responsive to all participants’ needs.
- Gather a diverse group of people who can provide multiple perspectives.
- Build working relationships through open communication.

2. Recruit a Leader

Forming a Family Science Planning Group lessens the likelihood of leaving leadership to chance. One strategy learned through our own Family Science events was to recruit a point person, a lead teacher, or committed volunteer to call meetings, plan agendas, assign tasks for events, and orchestrate event/program timelines. The leader will then delegate to others such tasks as:

- Advertising the event.
- Communicating with other organizations that can contribute through donations or volunteering time.
- Recruiting and training volunteers for facilitating activities.
- Selecting activities that highlight inquiry-based learning.
- Planning and organizing the event layout.
- Organizing set-up and take-down crews.
- Collecting data from event evaluations and reporting to the group.

3. Advertise the Events

Advertise early and frequently. Place monthly articles in school newsletters. This will help spread information and get families further involved in science beyond the school classroom. A September article can give background information on the program. Other months could reflect theme topics. For example, February is Dental Health month and the activity could be about teeth.

Consider translating flyers into the native languages of families in your school and organization. Flyers can be posted at local community gathering places such as community centers, churches, and local coffee houses.

4. Document the Events

Document your school’s Family Science events and planning decisions. These records will help build the structure for an ongoing Family Science program and provide continuity for new volunteers. If you use the Event Planning and Documentation Tool (see Forms section) the guide will gradually become individualized for your school and provide a rich history of Family Science events and outcomes.

We encourage taking photographs at events since photos are wonderful communication tools. Try to capture a variety of activities and people. Exhibit the photos with name tags after an event to share with the community. Include them in your school newsletter, send them to your volunteers and contributors, or use them at next year’s Informational Event. Place a few photos in your Celebrating Science binder as a tool to explain events to future event planners. Remember to use a photo waiver form for permission to use photographs in public relations materials.
Steps in Implementing Family Science Events

5. Choose an Event

As suggested in the Family Science Program Model (see p.16), three types of events are particularly effective in developing a Family Science program. An overview of these events is below.

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Venues</th>
<th>Facilitator(s) of Event/Activities</th>
<th>Expected Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Informational Events</strong></td>
<td><strong>School-based:</strong></td>
<td>Principal</td>
<td>Inform families and community about school and district science reform efforts</td>
</tr>
<tr>
<td></td>
<td>PTA meeting</td>
<td>Family Science Planning Group</td>
<td>Inform families and community about benefits of learning science through inquiry</td>
</tr>
<tr>
<td></td>
<td>Open house booth</td>
<td>Teachers</td>
<td>(i.e., increased overall student achievement)</td>
</tr>
<tr>
<td></td>
<td>Curriculum night</td>
<td>District science specialist</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Newsletter articles</td>
<td>Out-of-school time provider</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community-based:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Science clubs (at schools or</td>
<td>Volunteers trained in inquiry-based teaching and learning (i.e., parents, teachers, scientists,</td>
<td>Experience first-hand inquiry-based science activities</td>
</tr>
<tr>
<td></td>
<td>out-of-school program)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community centers</td>
<td></td>
<td>Encourage families to extend inquiry learning at home.</td>
</tr>
<tr>
<td></td>
<td><strong>School-based:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PTA meeting</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Open house booth</td>
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<tr>
<td></td>
<td>Curriculum night</td>
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<td></td>
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<tr>
<td></td>
<td>Newsletter articles</td>
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<tr>
<td></td>
<td>Community-based:</td>
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</tr>
<tr>
<td></td>
<td>Science clubs (at schools or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>out-of-school program)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community centers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Showcase Events:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Science Celebrations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>School-based:</strong></td>
<td>Students</td>
<td>Share students’ classroom work based on inquiry science</td>
</tr>
<tr>
<td></td>
<td>Science fair</td>
<td>Teachers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Science club</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community-based:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community centers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Out-of-school program</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Science club</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Science Conferences</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>School-based:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>School classrooms</td>
<td>Teachers</td>
<td>Model inquiry-based teaching and learning</td>
</tr>
<tr>
<td></td>
<td>Science club</td>
<td>Students</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community-based:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community centers</td>
<td>Scientists</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Out-of-school program</td>
<td>Out-of-school time provider</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Science club</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Exploratory Events</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>School-based:</strong></td>
<td>Volunteers trained in inquiry-based teaching and learning (i.e., parents, teachers, scientists,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Math and science night</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community-based:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Out-of-school program</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Recruit and Train Facilitators

Facilitators must model high-quality inquiry teaching. They should be comfortable in using inquiry strategies and letting the learner “find out” the answer. Since Family Science events do not enjoy the continuity of instruction found in the classroom, facilitators must be skillful at launching participants—especially adults who may have limited or negative science experiences—into a question that can be answered within a short time frame and with the materials present.

Choose a facilitator who can highlight key scientific concepts through modeling of the inquiry-based process and can encourage participants to explore scientific principles with materials on hand. One way to facilitate the inquiry-based experience for large groups is to create a set of guiding questions in advance. In the Creating Inquiry-based Activities section of this guide, several strategies for facilitating activities using an inquiry approach are described.

7. Select Activities

Select open-ended science activities that highlight inquiry-based learning strategies (see FERA Learning Cycle Model, p. 29.) Some other useful strategies for involving diverse audiences are to:

- Keep event start-up and focus activities short, with a minimum of explanations and instructions, before the hands-on experience.
- Use one-page, pictorial diagrams (even cartoons) outlining activities whenever possible.
- Use translators to engage non-English speaking families in the activities.
- Use "challenge" activities to keep participants involved and trying new ideas.

8. Gather Supplies

Once you have accumulated materials for an event, you may wish to sort them by activity and store them in plastic tubs. Make sure you indicate where these supplies are stored in the Event Planning and Documentation Tool. (See Forms section.) Consider soliciting donations from local businesses to stock supplies (e.g., straws from restaurants, wood stirring sticks from coffee shops, washers from hardware stores).

9. Plan the Layout

Planners and facilitators will need to consider the total number of participants expected for the event and an optimal group size for each activity. Things to consider include:

- Can the written directions be read from all places where participants might be situated?
- Where will paper towels, extra materials, tape, etc., be stowed for easy access?
- Will participants be standing or sitting?
- Are materials to remain at the event or can some be taken home for further exploration?
- Are there any special needs for electricity or water at this activity station?

Materials can be shared equally among participants when each station is limited to no more than four or five people. If there is only one facilitator, limit the number of stations to ten.
Steps in Evaluating Family Science Events

10. Conduct Program Evaluation

The successful growth of any program depends on the time committed to evaluate and re-evaluate the target audience's needs. This table outlines the types of evaluations that are helpful in growing a comprehensive Family Science program. See the Forms section (p. 37) for examples of each suggested evaluation.

<table>
<thead>
<tr>
<th>PROGRAM EVALUATION</th>
<th>INITIAL EVALUATION</th>
<th>DURING EVENT EVALUATION</th>
<th>FINAL EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify purpose of evaluation</td>
<td>Clarify program goals, processes, and outcomes</td>
<td>Assess specific event outcomes</td>
<td>Assess Family Science program goals</td>
</tr>
<tr>
<td>Identify audience</td>
<td>Partners and other Triangle of Support members</td>
<td>Participants, event and activity facilitators, volunteers, and Family Science Planning Group</td>
<td>Family Science Planning Group</td>
</tr>
<tr>
<td>Identify venues for data collection</td>
<td>Meetings</td>
<td>During Family Science events</td>
<td>Meetings</td>
</tr>
<tr>
<td>Determine data collection methods</td>
<td>Informal interviews, Written survey</td>
<td>Surveys and informal interviews</td>
<td>Collection of surveys</td>
</tr>
<tr>
<td>Logistics</td>
<td>[Assess program needs]</td>
<td>[Debrief after Family Science events]</td>
<td>[Define next steps for Family Science program]</td>
</tr>
<tr>
<td></td>
<td>Each year before planning Family Science events, assess the program's needs.</td>
<td>With questionnaires in hand, the Family Science Planning Group should take some time to discuss what went well and what could be improved for the next event. Use questionnaire in Forms section</td>
<td>After all events have taken place, the Family Science Planning Group will have a better picture of the phase of community participation and the current stage of science reform efforts and be ready to consider new ways of growing the Family Science program. Use questionnaire in Forms section</td>
</tr>
</tbody>
</table>
Follow-up Projects

To further expand the learning from a Family Science event, consider these follow-up activities.

Create Check-out Kits

When budget and time permit, a worthwhile project is to create check-out kits for families. Teachers and out-of-school programs could have access to these materials as well. The kits can contain materials and directions necessary to do an inquiry-based activity. All activities should include simple materials appropriate and safe for home use. Funds to supply kits could be raised by a Parent Teacher Association or submitting a grant application to local foundations or businesses. A kit collection requires space, refurbishment, and check-out and check-in methods. A dedicated volunteer is needed to perform these tasks. Housing each kit in a plastic tub is convenient. They can be bar-coded like library books. For ease of transport, it is best if the kit can fit in a child's backpack. Kit collections could be housed at the school library, out-of-school program space, or the local community learning centers.

Develop Take-home Activity Packets

At Family Science events, encourage families to continue inquiry-based science at home by providing take-home activity sheets and perhaps the materials to do the activity. These supplies could be laid out at a table, assembly-line style, or prepackaged in a baggie.

Offer Science Classes for Families

Throughout the year, offer inquiry-based science classes for families who are interested in learning about specific science concepts in more depth. These could be offered to a limited number of individuals, perhaps four to six families, held over multiple sessions (e.g., each Monday evening in November.) A team of instructors, including a content expert (e.g., scientist, university professor) and a facilitator trained in inquiry-based teaching (e.g., science teacher, parent) could deliver the workshops as a team.
The goal for Family Science events is to give families an opportunity to gain first-hand experience with some basic science concepts in a hands-on, inquiry-based format. The activities selected should be used to introduce families to the investigative science programming at their child’s school and how this contrasts to more traditional, scripted science lessons. This section can help facilitators adapt science activities to model inquiry-based learning using a teaching strategy called a learning cycle. This teaching strategy is a valuable tool for training and preparing facilitators for Family Science events. Activities following this approach can be found on educational websites; in science activity books; and in instructional materials used at schools, out-of-school programs, or organizations.

### Framing Activities Using a Learning Cycle

Various learning cycles, or instructional models, form the core of inquiry-based science education programs in schools today. These learning cycles can contain four or more steps and are based on the most recent educational research on how people learn. All these models follow a similar progression, encouraging a student to move from curiosity to understanding.

The model shown here was developed by the National Science Resources Center (NSRC) and used in their Science and Technology for Children (STC) instructional materials. It is known as the FERA Learning Cycle, and consists of four phases: 1. Focus; 2. Explore; 3. Reflect; and 4. Apply. (See diagram above.) This instructional approach is not a locked-step method but rather a cyclical process. It is a teaching strategy used to facilitate student-centered learning. Teaching methods and curriculum using a learning cycle approach have been shown to be effective in increasing scientific understanding.

The foundation of the inquiry process is the innate curiosity of children heard in their questions: “Why are plants green, Daddy?” or “Mom, how are rainbows made?” The acts of questioning and the process of discovery are highlighted within each step of the FERA learning cycle. By following this approach, Family Science activities can lead participants from confirming “what they know” to understanding “how they come to know” science concepts.
Facilitator’s Guide

In the following pages, a brief description of each phase of the FERA learning cycle is provided together with successful strategies used at each step during Family Science events. These are summarized in a table at the end of this section. We highly recommend reviewing the table since it quickly provides an overview of the FERA learning cycle strategies for supporting inquiry-based learning. In the Forms section, this same handout is formatted for taking notes.

Phase 1: Focus

Facilitators at Family Science events can engage participants through questions focused on everyday observations and in making connections to experiences they already possess. Facilitators must encourage participants to find a "mental anchor" to connect prior knowledge and experiences to new information. Otherwise, new information is disconnected and fleeting—leaving retention, retrieval, and application to novel situations improbable. Starting an activity with a question session is one way to make this connection. Such questions are often started in the following manner:

- What did you observe when…?
- Have you seen…?
- Did you ever notice…?
- I wonder…?

Successful Strategies:

To provide a more concrete focus, an “activity baggie” can include materials used in the upcoming investigation. Allowing time for the participants to focus and ask questions, try mini-experiments, or complete a short assigned task can be a powerful focusing technique. In some cases, participants may not be familiar with the materials and this can provide an initial, common experience. Participants already familiar with the materials can test their own assumptions by answering the following question: What does this remind you of?

Phase 2: Explore

Hands-on experiences are an essential component in the inquiry process, as learners gain insights through personal experimentation and discovery. In this step, Family Science participants decide which question(s) to test; make a prediction; come up with a process for testing their ideas; and record their observations. Facilitators should encourage participants to record their observations using descriptive language and include detailed diagrams or charts.

Questions to help with making a prediction and setting up an experiment:

- What do you guess/predict will happen when...?
- Do you have any past experiences that led you to make your guess/prediction?
- How do you think you can find the answer to your question with the materials at hand?

Questions to help during experimentation:

- What did you notice happening when...?
- Can you describe...?
- What happens if...?
- Does it matter if I try...?
- Can you describe/find a way to...?
- How many ways could you...?

Successful Strategies:

During Family Science activities, participants have the opportunity to directly explore science questions using materials on hand. Some participants may want reassurance on the “right” answers or wish for you to tell them the answers. Others may be hesitant starters. Facilitators can guide participants in their own discovery process by using questioning strategies throughout the activity and refraining from directly explaining observed events.

As in classroom practice, family members could be assigned roles to ensure active participation in the experience (e.g., “materials manager” to collect supplies and monitor procedures, “record-keeper” to record predictions and write observations, and a “reporter” to describe the group’s activity and share their discoveries.)
Phase 3: Reflect

Reflection is the key component that makes an activity inquiry-based, not just a hands-on experience, and is where learners make meaning from their explorations. Sharing ideas with others is a useful strategy for reflection. Participants can be encouraged to share their discoveries, main ideas, challenges, new questions, and problem-solving strategies for the activity using these kinds of questions:

- What surprises did you find...?
- What was happening when...?
- What do you think about...?
- Why do you think that...?
- How is ________ the same? How is it different?
- Does the information/data you collected support any particular ideas you have?
- What did you see/notice that gave you that idea?
- What might be another explanation for...?
- What ideas link all of our experiments?

Phase 4: Apply

During this stage, participants are asked to extend and apply their findings to new situations. This requires participants to think critically about what they have learned in the activity. Facilitators can guide them to: consider what new questions or ideas have arisen as a result of conducting their experiment; explore related concepts; and apply their ideas to real-world settings. Applying and extending discoveries and observations to new situations builds critical thinking skills and problem-solving abilities. Questions that may help this discussion include:

- Where does this happen in the real world?
- Can you think of ways to use these ideas everyday?
- How might this experiment be different if...?
- What would happen if...?
- Could you design another test to try...?
- What ideas do you want to try next?

Successful Strategies:

At Family Science events, it is important to structure activities to include time to reflect on the results of the experiment – to review initial ideas, offer explanations for observations supported by evidence from data, and communicate findings to others.

Given the potential size of Family Science events (50+ participants), whole group discussions may be more practical and inclusive of all participants, especially second-language learners. Facilitators can catalyze oral discussion by asking probing questions, which lead participants to key findings based on the experiments and tie together the main conceptual story for that activity.

Successful Strategies:

In addition to applying the science content learned, participants could share their ideas and impressions about how science education is changing in the classroom and implications for student learning.
Summary of FERA Learning Cycle

This table summarizes the FERA learning cycle. It contains a list of strategies that support inquiry-based learning.

<table>
<thead>
<tr>
<th>Phases</th>
<th>Purpose</th>
<th>Strategies</th>
<th>Questions/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Focus</td>
<td>Find out what participants know or think they know</td>
<td>Narrowing the concepts through observations and questioning</td>
<td>What did you observe when...?</td>
</tr>
<tr>
<td></td>
<td>Challenge what they know or think they know</td>
<td></td>
<td>Have you seen...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Did you ever notice...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>I wonder...?</td>
</tr>
<tr>
<td>2: Explore</td>
<td>Provide common set of experiences</td>
<td>Avoid &quot;why&quot; questions and refocus the participants on asking &quot;how,&quot; &quot;what,&quot; &quot;when,&quot; &quot;where&quot; type of questions</td>
<td>Questions to help with making a prediction and setting up an experiment:</td>
</tr>
<tr>
<td></td>
<td>Decide on a testable question</td>
<td>Limit supplies to help focus questions and procedures</td>
<td>What do you guess/predict will happen when...?</td>
</tr>
<tr>
<td></td>
<td>Make predictions</td>
<td></td>
<td>Do you have any past experiences that led you to make your guess/prediction?</td>
</tr>
<tr>
<td></td>
<td>Come up with a process for testing idea</td>
<td></td>
<td>How do you think you can find the answer to your question with the materials at hand?</td>
</tr>
<tr>
<td></td>
<td>Conduct experiment</td>
<td></td>
<td>Questions to help during experimentation:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>What did you notice happening when...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Can you describe...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>What happens if...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Does it matter if I try...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Can you describe/find a way to...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>How many ways could you...?</td>
</tr>
<tr>
<td>3: Reflect</td>
<td>Make sense of observations and information collected</td>
<td>Require participants to support thinking with evidence collected from their investigation</td>
<td>What surprises did you find...?</td>
</tr>
<tr>
<td></td>
<td>Share and explain new ideas as a way to deepen understanding</td>
<td>Provide definitions and explanations using participants' experiences and data as basis for discussion</td>
<td>What was happening when...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>What do you think about...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Why do you think that...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>How is _________ the same? How is it different?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Does the information/data you collected support any particular ideas you have?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>What did you see/notice that gave you that idea?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>What might be another explanation for...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>What ideas link all of our experiments?</td>
</tr>
<tr>
<td>4: Apply</td>
<td>Apply recently developed understanding to new situations</td>
<td>Provide a challenge activity to apply concepts in a new setting</td>
<td>How might this experiment be different if...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>What would happen if...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Could you design another test to try...?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>What ideas do you want to try next?</td>
</tr>
</tbody>
</table>
For a printable copy of this guide and other resources, visit http://projects.systemsbiology.net/celebratingscience.

The resources listed in this section have been divided into five categories:

- Science Education Reform
- Inquiry-based Science
- Parental Engagement
- Activity Books
- Organizations Supporting Inquiry-based Science

To read a review for many of the books cited, visit NSTA Recommends® website at: http://www2.nsta.org/recommends

### Science Education Reform


### Inquiry-based Science


### Parental Engagement


Activity Books

General

K–4

K–8

K–12

5–8

5–12
Organizations Supporting Inquiry-based Science

Center for Inquiry Science at the Institute for Systems Biology
http://systemsbiology.org/Center_for_Inquiry_Science
The Center for Inquiry Science is a team of science educators uniquely hosted at a nonprofit research institution, the Institute for Systems Biology. While drawing from and contributing to educational research, the Center for Inquiry Science’s efforts support K-12 inquiry-based science education within the Puget Sound region and often, if requested, across Washington State. The services offered by the Center for Inquiry Science include development, facilitation, and coordination of professional development and consultation for teachers and administrators.

Exploratorium: The museum of science, art and human perception
http://www.exploratorium.edu/explore/index.html
The Exploratorium is a museum of science, art, and human perception located in San Francisco, CA. Online since 1993, the Exploratorium was one of the first science museums to build a site on the World Wide Web. Included in their award-winning site are more than 18,000 web pages and many sound and video files exploring hundreds of different topics. Many of the resources on their website are examples of very simple uses of information technology, but thoughtfully implemented. For example, the site contains instructions for over 500 simple experiments, all of which may be viewed on any type of web browser, with even the slowest connection, and easily printed out.

Leadership and Assistance for Science Education Reform (LASER)
http://www.nsrconline.org/school_district_resources/laser.html
In 1998, the National Science Resources Center (NSRC) launched a nationwide initiative Leadership and Assistance for Science Education Reform (LASER) as a part of its outreach program. Building on the NSRC's national leadership development program, the LASER Center's goal is to improve science education for about 1 million students in 300 school districts nationwide. To accomplish this goal, the NSRC formed partnerships with eight regional sites, publishers of National Science Foundation (NSF)-supported middle and elementary school instructional materials, and several major corporations and private foundations. The NSRC and LASER partners offer school districts a comprehensive menu of programs, products, and services for initiating and implementing inquiry-centered K-8 science education programs. LASER partners provide regional programs that build community support for science education, develop school district leadership and strategic planning capabilities, identify and support a cadre of teacher leaders, provide quality instructional materials, and broker resources and technical assistance.

National Science Teachers Association
http://nsta.org
The National Science Teachers Association (NSTA), is the largest organization in the world committed to promoting excellence and innovation in science teaching and learning. The Association serves as an advocate for science educators by keeping its members and the general public informed about national issues and trends in science education. NSTA disseminates results from nationwide surveys and reports and offers testimony to Congress on science education-related legislation and other issues. The Association develops position statements on issues such as teacher preparation, laboratory science, use of animals in the classroom, laboratory safety, and elementary and middle-level science. Each year, the Association’s legislative network reaches nearly a half million educators.
Organizations Supporting Inquiry-based Science continued

Parent Teacher Association  
http://www.pta.org/  
This organization has a breadth of resources and serves as an advocacy group for students. Let your local PTA know about your Family Science program and how it benefits students through family and community participation.

School’s Out Washington  
http://schoolsoutwashington.org  
School's Out Washington supports after-school providers in offering quality programming for children's success. Their training and curricula build on the strengths of the organization's program and provide the tools needed to make life-long learners of the children served. This organization takes an infusion approach to introducing literacy, science, and math into after-school. Their curricula help programs create quality environments to explore academic concepts in the context of play in after-school time. Their trainings on the Cool! Curricula help the materials come alive and ensure that the time invested makes the greatest impact on student learning.

Other Resources to Consider in Your Community

Here are some organizations in the Seattle area that are adopting inquiry into their programming. Look for similar resources in your community and let them know about inquiry-based science education and its great benefits for student learning.

- Audubon Washington
- Burke Museum of Natural History and Culture
- Museum of Flight
- Museum of History and Industry
- Pacific Science Center
- Seattle Aquarium
- Washington Mathematics Engineering Science Achievement (MESA)
- Woodland Park Zoo
An Introduction to Forms

This section contains all the forms mentioned throughout the *Celebrating Science* guide. The table below contains a brief description of these forms and where they are referenced in the *Celebrating Science* guide.

<table>
<thead>
<tr>
<th>Forms</th>
<th>Description</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Evaluation</td>
<td>This type of evaluation is done right after a Family Science Planning Group has been established. The main purpose is to identify the stage of science education reform and the phase of community participation at your school.</td>
<td>See section on Establishing Family Science Programs p.16-17</td>
</tr>
<tr>
<td>During Event Evaluation</td>
<td>When establishing a Family Science program, three types of events were suggested to support school science education reform and community participation. To evaluate the success of these events, three sets of participant questionnaires were created to reflect the distinct outcomes from each event: Informational, Showcase, and Exploratory. Two other event questionnaires were created for facilitators/volunteers and the Family Science Planning Group to evaluate the planning and implementation of events. Other questions may be added to these questionnaires that deal with the participants’ attitudes and their perceptions of the event, facilitators, and organizers. But remember to keep evaluations short, simple, and when possible anonymous.</td>
<td>See section on Establishing Family Science Programs p. 18-21</td>
</tr>
<tr>
<td>Family Science Planning Group Questionnaire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Program Evaluation</td>
<td>After summarizing all surveys performed throughout the year, members of the Family Science Planning Group should come together to reflect on the program’s past, present, and future goals. This questionnaire provides a few questions to get the group started thinking about the next steps.</td>
<td>See section on Establishing Family Science Programs p. 22</td>
</tr>
<tr>
<td>Event Planning and Documentation Tool</td>
<td>Use this tool to document the event details, such as the venue chosen, the outcomes hoped for, the activities chosen, storage location, list of supplies, layout, and facilitator’s notes.</td>
<td>See section on Sustaining Family Science Programs p. 24-27</td>
</tr>
<tr>
<td>Contact Information Sheet</td>
<td>This is a simple form included as a reminder to collect contact information from members of the Family Science Planning Group, volunteers, facilitators, and other contributors to the event.</td>
<td></td>
</tr>
<tr>
<td>Facilitator’s Handout</td>
<td>One of the intentions of the <em>Celebrating Science</em> guide is to assist the Family Science Planning Group in adapting materials to model inquiry-based learning for families. This handout summarizes the FERA learning cycle. With this handout, facilitators can quickly turn a science activity into an inquiry-based learning experience by following each phase. To document the facilitator’s own questions, a Notes column is provided.</td>
<td>See section on Creating Activities Using Inquiry p. 29</td>
</tr>
</tbody>
</table>
### Instructions

Answer each question to the best of your knowledge. Don't worry if you don't know something. The purpose of this initial evaluation is to create a common ground for establishing a Family Science program through discussions on science education reform and the community’s participation in these efforts. (See Family Science Program Model p. 16.)

### Science Education Reform Efforts in School

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is the school in your community at the adoption stage?</td>
<td>❑</td>
<td>❑</td>
</tr>
<tr>
<td>Adoption phase refers to the first stages of planning when school/teachers/districts are deciding what curriculum to adopt. Professional development introduces teachers to new materials and teaching strategies for inquiry-based science. New ways of assessing students are explored.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Is the school in your community at the implementation stage?</td>
<td>❑</td>
<td>❑</td>
</tr>
<tr>
<td>At the implementation stage, schools start piloting newly adopted science curricula in part of the school system. Professional development has evolved to develop lead teachers in inquiry-based science. New assessment methods reflective of new teaching methods are put in place.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Is the school in your community at the integration stage?</td>
<td>❑</td>
<td>❑</td>
</tr>
<tr>
<td>At the integration stage, the curriculum has been implemented at all grade levels at the school. Professional development is targeted to the developmental needs of all teachers. New testing methods are used system wide.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Community Participation in Science Education

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Is the community aware of science reform efforts?</td>
<td>❑</td>
<td>❑</td>
</tr>
<tr>
<td>The awareness phase refers to the community's alertness to changes in the science education program and there is a need to provide information.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Is the community receptive to inquiry-based science education?</td>
<td>❑</td>
<td>❑</td>
</tr>
<tr>
<td>The receptive phase refers to community's support for and openness to inquiry-based science education.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Is the community engaged and committed to inquiry-based science education?</td>
<td>❑</td>
<td>❑</td>
</tr>
<tr>
<td>The engaged phase refers to the community's commitment to and full participation in science education reform.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Instructions**

Please fill out the questionnaire below and add any other comments you might have about the event. Thank you for your time.

**Questions**

<table>
<thead>
<tr>
<th>Questions</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The presentation clarified how inquiry-based science and traditional science teaching and learning differ.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. After the presentation on science education reform, I have a better understanding of what inquiry-based science is.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I think the school and district are moving in the right direction by using inquiry to teach science.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I support the school and district in the science reform efforts.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. What brought you to this event?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Has the event been useful to you? Why or why not?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Provide any suggestions for improvement or other comments.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Instructions

Please fill out the questionnaire below and add any other comments you might have about the event.

Thank you for your time.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I enjoyed seeing students explain what they have learned in the classroom.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. After this event, I understand how inquiry-based science education differs from traditional science education.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. After this event, I feel confident that the school and district are moving in the right direction by using inquiry to teach science.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. What brought you to this event?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Has the event been useful to you? Why or why not?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Provide any suggestions for improvement or other comments.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Evaluation Forms

## Questions

1. This event gave me the opportunity to explore science concepts in a different way.
2. I enjoyed working along with my child in solving the given problems.
3. The activities helped me experience and understand the inquiry process.
4. After this event, I have a better appreciation of the teaching strategies for inquiry learning.
5. What brought you to this event?
6. Has the event been useful to you? Why or why not?
7. Provide any suggestions for improvement or other comments.

## Instructions

Please fill out the questionnaire below and add any other comments you might have about the event. Thank you for your time.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. This event gave me the opportunity to explore science concepts in a different way.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. I enjoyed working along with my child in solving the given problems.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. The activities helped me experience and understand the inquiry process.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. After this event, I have a better appreciation of the teaching strategies for inquiry learning.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. What brought you to this event?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Has the event been useful to you? Why or why not?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Provide any suggestions for improvement or other comments.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Instructions**

Please fill out the questionnaire below and add any other comments you might have about the event. Thank you for your time.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Did you feel adequately prepared for your role this evening? If not, please let us know how we could have better prepared you.</td>
<td>❑</td>
<td>❑</td>
</tr>
<tr>
<td>2. Did you feel your time was well spent facilitating this activity station? If not, please let us know why and suggest some possible changes.</td>
<td>❑</td>
<td>❑</td>
</tr>
</tbody>
</table>
**Instructions**

Please fill out the questionnaire below and add any other comments you might have about the event. Thank you for your time.

**Family Science Planning Group Questions for Debriefing after Event**

1. How well did the event attain its outcomes?

2. What were the benefits?

3. What changes would you make?

4. What were the parents’ reactions?

5. What were the students’ reactions?
Final Program Evaluation - Family Science Planning Group Questionnaire

Instructions

At the end of the school year, members of the Family Science Planning Group should come together to reflect on the program’s past, present, and future goals. Below are a few questions to get the group started.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. As the Family Science program has grown, the community's participation/involvement at events has increased.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. As the Family Science program has grown, the community's understanding of inquiry-based science has increased.</td>
<td></td>
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</tr>
<tr>
<td>3. The partnership infrastructure includes members from the entire Triangle of Support.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. The Family Science program, through its different events, clarified for participants how inquiry science and traditional science teaching and learning differ.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. The phase of community participation matches the science education reform stage.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Define Next Steps

1. Please take some time as a group or as an individual to think about the lessons learned from doing this type of event and list some next steps to make any necessary changes. Consider, at a minimum:

   - Selecting different types of for events in the coming year.
   - Identifying additional stakeholders for Family Science Planning Group.
   - Identifying potential funding partners and other resources.
Event Planning and Documentation Tool

Part 1 of 2

Event Title: ________________________________

Date: ____________________ Location: ____________________ Number of people: ____________________

Organizer(s): ________________________________

Logistics

Create contact information sheet for:

☐ Family Science Planning Group

☐ Volunteers, contributors, and/or funding partners

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Venue(s)</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Event Planning and Documentation Tool

### Part 2 of 2

**Date__________________**

<table>
<thead>
<tr>
<th>Name of Activity</th>
<th>Storage Location</th>
<th>List of Supplies</th>
<th>*Layout</th>
<th>Facilitator(s)</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

*Layout:* Draw a layout map of the event space that includes where electricity and water access are located and how tables need to be organized.

_________# of tables__________access to water__________access to electricity

### Evaluations Completed:

- [ ] Initial overall school and community evaluation
- [ ] During event evaluation
- [ ] Final program evaluation

### Follow-up projects completed:

<table>
<thead>
<tr>
<th>Title(s) of activities used:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish check-out kits</td>
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<tr>
<td>Develop take-home activity packets</td>
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<tr>
<td>Offer science classes for families</td>
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Date__________________

Contact Information Sheet

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<th>Family Science Planning Group</th>
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## Contact Information Sheet

<table>
<thead>
<tr>
<th>Volunteers, Contributors, and/or Funding Partners</th>
<th>Year ___________</th>
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<tbody>
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Instructions

Use this as a way to organize and prepare specific activities for Family Science events using the learning cycle.

<table>
<thead>
<tr>
<th>Phases</th>
<th>Purpose</th>
<th>Strategies</th>
<th>Questions/Notes</th>
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</thead>
</table>
| 1: Focus | Find out what participants know or think they know  
Challenge what they know or think they know | Narrowing the concepts through observations and questioning | (For questions, see p. 32, FERA learning cycle summary table.) |
| 2: Explore | Provide common set of experiences  
Decide on a testable question  
Make predictions  
Come up with a process for testing idea  
Conduct experiment | Avoid “why” questions and refocus the participants on asking “how,” “what,” “when,” “where” type of questions  
Limit supplies to help focus questions and procedures | |
| 3: Reflect | Make sense of observations and information collected  
Share and explain new ideas as a way to deepen understanding | Require participants to support thinking with evidence collected from their investigation  
Provide definitions and explanations using participants’ experiences and data as basis for discussion | |
| 4: Apply | Apply recently developed understanding to new situations | Provide a challenge activity to apply concepts in a new setting | |

Date__________________