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...?

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.)

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 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.
### 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><strong>1: Focus</strong></td>
<td>Find out what participants know or think they know. Challenge what they know or think they know.</td>
<td>Narrowing the concepts through observations and questioning.</td>
<td>What did you observe when...? Have you seen...? Did you ever notice...? I wonder...?</td>
</tr>
<tr>
<td><strong>2: Explore</strong></td>
<td>Provide common set of experiences. Decide on a testable question. Make predictions. Come up with a process for testing idea. Conduct experiment.</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. Limit supplies to help focus questions and procedures.</td>
<td>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...?</td>
</tr>
<tr>
<td><strong>3: Reflect</strong></td>
<td>Make sense of observations and information collected. Share and explain new ideas as a way to deepen understanding.</td>
<td>Require participants to support thinking with evidence collected from their investigation. Provide definitions and explanations using participants' experiences and data as basis for discussion.</td>
<td>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?</td>
</tr>
<tr>
<td><strong>4: Apply</strong></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...? What would happen if...? Could you design another test to try...? What ideas do you want to try next?</td>
</tr>
</tbody>
</table>