

Inquiry in Kindergarten

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When the shades are pulled up in my kindergarten classroom, sunlight beams in through the windows. Early in the school year I give mirrors to the children so they can explore the light that shines in. They enthusiastically manipulate their mirrors, experimenting and discussing their captured sunlight, spontaneously sharing and copying each other's discoveries. At "debriefing" sessions, they build their science vocabulary by talking about the path of light. They are delighted to use terms like "reflection," "projection," and "screen" as I paraphrase their statements and model the new words for them. Soon the language of light is part of their everyday talk.

For my kindergartners, this exploration serves as a way to begin investigating interesting light and color phenomena. It also begins the process of asking and answering their own questions, which is at the heart of the inquiry experience.

Since being part of the Exploratorium's Teacher Learning Group over the past four years, I've used the study of light and color not only to build an understanding of science content for my students, but also so they can practice using materials and learn the process skills of inquiry (observing, questioning, interpreting, etc.). As the children mature in their ability to communicate, they also build their vocabulary and knowledge of light and color and learn how to design their own investigations.

Tools of Inquiry

Once the children are comfortable using their mirrors, I give them new tools to use, such as prisms. Prisms allow the children to explore what happens when light is bent. It's a magical event when we learn how to make rainbows!



Working with the Round Light Source

As they investigate, both in the classroom and out, each student learns how to observe and record information about light and color in their personal science notebooks. Children start to compare observations found outside the classroom with the investigations they do in class. They begin to see many ways to do research, and their observations become part of the repertoire of resources that we draw upon for further science explorations.

In our classroom, inquiry is also facilitated by a useful tool called the "Round Light Source" (RLS), a powerful lamp covered with a cylindrical box. The box has four rectangular windows where light beams shine through. Masks with narrow light slits or colored gels: red, green and blue, can be attached to the windows, enabling the children to experiment with either white or colored light. For instance, they can use mirrors to project colors onto a screen, or mix the lights to make new colors. I use the RLS as a learning station in my classroom, just the same as a sandbox and blocks.

These activities allow my students to use their skills in manipulating sophisticated materials and in sharing new ways of communicating and investigating. Three or four children typically sit together to investigate. As they learn to mix colored light, there are happy shouts: "Look! I made yellow!" "Hey, that turned green!" "Where'd the red go?" followed by looking at each other's work and finding out how this magic was accomplished.

Inquiry path

As the children explore light and color with these tools, I guide them to follow a structure that helps organize their investigation. Built into the structure is the expectation that each child is accountable for his or her own question, materials, recording, and work time. I have divided the structure of the work into these five parts:

1. Form a question
2. Make a plan
3. Do the investigation
4. Record and report
5. Reflect, revisit, and plan again

Each child states his or her interest in the form of a question. I carefully model questions and write them down for all to see (Fig. 1).

Fig. 1

A selection of the Kindergartners' inquiry ideas and plans:

Xandria asked: "If I mix yellow and orange and pink, can I make gray?"

Veronica and Jacy asked: "Will blue and green light make yellow?"

Austin, Geron and Jerrick asked: "Can we make yellow? Can we put it on a screen? Can we put yellow on the table?"

All the students above planned to use the round light source, color gels, mirrors and screens.

Kevin asked: "What colors are in the rainbow? I plan to use the RLS with white light and a prism."

LaVelle asked: "Can I put the rainbow from the CD to the screen? I plan to use the light from the window [sunlight], a CD and a screen."

This question, and the materials used to investigate it, become the plan for the activity that follows. Children work individually or in small groups. I work with them by observing, questioning, supporting their efforts, and redirecting their investigations. I actively reflect their activities back to them in my own words, which helps when they report their work to others later on. I also help them manage their time. When the investigations are finished, each member of the class reports to the others. As the children tell what they observed, I write the observations on a chart. Sometimes the children write and draw their own reports.

In the beginning, the children have a hard time articulating their discoveries, so I help them "find" the right words to explain what they discovered. This is a crucial step, since it sets a tone that allows each child to "own" the experience while communicating it accurately. Each person profits by comparing the experience being reported with his or her own. Since this is a group activity, I'm careful to validate each child's individual contribution - an easy task with 4- and 5-year-old children!

As their experiences build throughout the year, the children in my kindergarten class constantly report and reflect on color and light interactions all over the school, as well as at home. It's exciting to see evidence that the children understand the concepts of light and color. When a student makes a rainbow by maneuvering some "found" object in the path of a light beam, the satisfied look on that child's face tells you that a concept has been understood because he or she has actually predicted what was going to happen. Often, the children who have the hardest time engaging in regular classroom work will shine in inquiry.

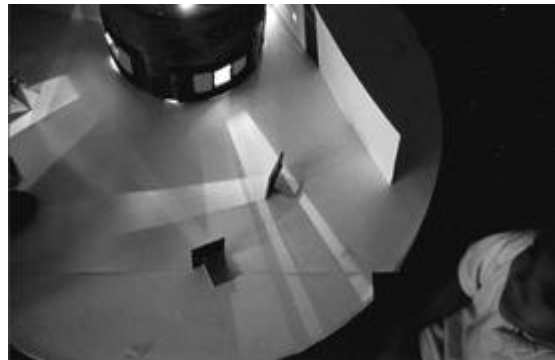
We are now ready to revisit and plan further investigations. I ask students if they want to repeat their experiments or if they would rather try something else. Children approach revisiting in different ways: some try what another person did; others repeat or vary their first plan in some way. Thus the cycle of inquiry, plan, work, record, and reflect is repeated.

Concepts

As my kindergartners learn how to question, plan, and communicate, they also learn about the concepts of light and color. At the same time, their experiences are supported by many other classroom activities. For example, the children are taught to use watercolor paints and to predict what new colors they can make by mixing them. In one of our more cooperative projects, we mix food coloring and water in a clear pan on top of the overhead projector. As the colored pigments combine, they are projected on the wall and ceiling, making larger-than-life color mixtures that the children can observe.

Whenever possible, I use a still or video camera to record investigations. I've had the best results with a digital camera, which has allowed me a variety of ways to print out images. One powerful way of sharing is to print out the children's work on overhead transparencies. In this mode, the entire class can share investigations together. Seeing pictures of themselves is highly motivating and helps the children stay focused as they describe what they did or what will happen next. It's also easy to write and rewrite statements right on the transparency, thus modeling the writing process. Children can even have their own copies on paper. It's very powerful for children to have their work "published," as well as publicly acknowledged.

As a teacher I have learned much from my interaction with the Institute for Inquiry Learning Group and from my own four-year exploration into children's inquiry learning. The different phenomena of light and color are fundamentally interesting and connect children to the real world using sophisticated tools, language, and ideas. I have seen how language develops during the inquiry process. As children share what they see, they find words to express and refine their thinking. As my students have taught me over and over again, kindergartners can indeed do inquiry.



Two views of the Round Light Source set up on a table with screens and mirrors.

Joanna Villavicencio is currently on leave from her position as a kindergarten teacher in the San Francisco Unified School District.