

Kinder Science Fair



*A kindergarten class's
year-long lessons on science-process
skills culminate in science fair
presentations that synthesize learning.*

By Angélica Torres and Debbye Vitti

A science fair might be the last thing you think of when planning a kindergarten science curriculum, but we found it the perfect avenue for teaching our students science-process skills. Working through a National Science Foundation Graduate Fellows K–12 partnership, we—a kindergarten teacher and a science graduate student—paired up to produce our school's first ever Kinder-Science Fair, which reflected both our students' ages and our approach to the event. Here we share our steps in teaching science-process skills and assembling student projects in a kindergarten classroom throughout the year. Our studies culminated in the year-end science fair, an event that involved parents and gave students a chance to demonstrate their developing communication skills.

What Is a Scientist?

Our first task was to determine the preconceptions students had about scientists. We asked students to draw what they think a scientist looks like, what a scientist does, what it looks like where they work, and what tools they use. We circulated among students and recorded their verbal descriptions. We discovered that most students had little or no prior knowledge of what scientists do or how scientific processes are carried out.

As a result of our preassessment, we focused our attention on developing students' understanding of basic science-process skills such as observation, communication, and investigation. Our best tool in organizing these lessons was the book *What Is a Scientist?* (Lehn 1998). Every time we introduced a science-process skill, we focused on one page of this book and designed the lessons accordingly. For example, to begin in September, we read to the class the page that says, "A scientist uses their five senses." Then, over the course of the month, students engaged in various activities exploring the senses, one sense per week. The activities included a taste test in which students predicted and recorded which tastes they preferred, a five-senses walk around the school garden, and exploration with "goop" (a cornstarch and water mixture).

In October, we read the page about how scientists make comparisons by measuring. To follow up, students spent a few weeks involved in "The Pumpkin Project," making predictions and then measuring, finding the mass of, and counting the seeds of pumpkins.

Our Own Investigation

Not long after that, students' questions were sparked when they observed crab apples under a tree on the playground.

What happens to crab apples? Do they disappear? Are some mushier than others? Why do some have holes while others do not? We saw these questions as an opportunity to introduce the students to the concept of an experiment, so we collected some of the apples and brought them into the classroom to talk about during circle time. We asked, What happens to the apples in nature? If no one picks them up or eats them, what happens to the apples? How do you know? Do you know for sure? How would you find out? The discussion was open-ended; we wanted students to get comfortable with the idea that they can find answers to their own questions/problems. After much discussion, we summarized our thinking into a synthesizing question: "What happens to an apple that falls from a tree? Let's try and find out." We agreed as a class to keep apples in jars under various conditions and watch what happens for the next few months. Students recorded their observations in a "data collection" log where they made drawings of the crab apples.

Student Scientists

Soon students began approaching us with their own ideas for investigations, along with thoughts on how to carry them out independently. We facilitated their process by breaking it down: *What is your question? What is your prediction? Why do you think that? How will you find out? Can you make a list of the materials you need? Can you show me in a drawing?*

Not all students were ready to conduct their own investigations. Those who did worked independently, with some teacher guidance, during quiet time, recess, and afternoon center time. For example, one student wanted to investigate if seeds would grow if he placed them on top of the dirt. After talking to him during recess and a few minutes during quiet time, we helped him set up an investigation area in the garden. On subsequent days, he recorded his observations and shared them with the class.

All year long our science lessons focused on everyday objects from the classroom and the playground as well as teacher-supplied materials. We discovered that the closer an object was to a student's everyday experiences, the more questions they asked. And, the more questions they asked, the more chances we had to develop their science-process skills through observation and inquiry.

By spring the classroom had begun to feel like a scientific community, where everyone was free to wonder out loud and find answers to their questions. By asking guiding questions, scaffolding, and "kid-watching," we had created "kinderscientists"—confident, independent, self-motivated thinkers and problem solvers who use process skills in science as well as other areas of the curriculum. When we were reading a book, students got comfortable making predictions before turning the page. They would explain why they thought something was going to happen (based on the pages we had already read). During recess when doing the monkey bars, we made predictions about how far they would get and they would make mental measurements of what rung they had made it to last time ("Look how far I

made it [showing it with our hands]! Maybe next time I'll get a little bit farther, up to here!") One student, on her own, decided to draw steps and a diagram of how to do a cartwheel. Other students started making predictions about how many seeds were in their apple recess snack.

A Fair to Remember

Throughout the year, we archived many digital photos of the students working and engaged in discussions, along with work samples, science observation logs, actual objects, lab sheets, videos, and audio recordings of students' responses. We used these materials to assess student levels of understanding of process skills and concept development, to discuss student improvement and growth, and to create and modify the curriculum. And, we decided to use them as the basis for a science-fair project that would culminate our year of science explorations. The goal of our fair was for students to deepen their understanding of the science-process skills they had acquired during the year and to practice their communication skills.

In May, we began to prepare for the science fair by making a chart with the class of what they learned about being a scientist. We gathered the class together and made a list of what a scientist does and how we had done those things in class. We asked the class if they would like to teach their parents how to be scientists. Of course, they were excited about that opportunity.

The next day, students chose an activity from the list to present. Students worked in two-person teams based on interest. Figure 1 lists the topics and presentations students would show at the science fair. We asked parents to send in tri-fold science fair poster boards, and we dedicated class time every afternoon for one month to help students organize their information. First, we helped each pair of students by asking, "What are you teaching? What materials do you need? How will you organize these materials on the poster? What will happen first, second, third, etc." We acted as facilitators, leaving it up to students to decide what they wanted to present.

Students created posters describing their chosen process skill and planned a fair presentation about it. For the posters, students used materials we had saved during the year (including photographs of class activities and previous student work, such as labeled drawings and observation logs), tools (i.e., colored pencils, hand lenses, rulers, etc.), and data sheets. They also decided what presentation tools they wanted to use at the fair, including pointers, chart stands, books, and specimens. Going through the process of assembling the boards helped reinforce the previously taught science-process skills while promoting academic growth in other areas such as writing (e.g., descriptions on their poster boards), sequencing, labeling, art/design, presentation/speaking skills, and critical thinking.

Once the boards were ready, students rehearsed for the science fair by planning and practicing how to present their ideas and teach the parents. A week in advance of the fair, we sent home a letter to parents that clearly stated our objective: Students will practice communication as a science-process skill through words, demonstrations, and pictures. The let-

Figure 1.**Presentations and the science-process skills they demonstrate.**(Some skills borrowed from *What Is a Scientist?* [Lehn 1998])

Science -Process Skills	Science Fair Station	Description of Presentation	Suggested Materials
A scientist learns from her senses	Sorting objects by properties	Uses poster with objects and descriptive words to compare properties (e.g., "This glove is stretchy like a hair tie and also light, like a feather. It is not heavy like this rock.")	Properties poster with 3-D objects and property words, various objects to sort
	Taste test	Asks participants to taste four safe objects and make predictions, (e.g., "Which one do you think will taste sour?" "Which chocolate has sugar in it?")	Pretzels, unsweetened chocolate, sour mix, sweetened chocolate, paper plates divided into four sections, chart for recording taste preferences
A scientist makes predictions	Color mixing	Asks participants to make predictions about color mixing and then mixes the colors (e.g., "Can you predict what color blue and yellow make?")	Nontoxic paints, toothpicks, food coloring, water bottles, paper
A scientist uses tools	Digital microscope	Shows details of objects using a digital microscope	Digital microscope, pill bugs, tadpole, worm, seeds, tweezers, computer
A scientist draws what she sees and notices details	Observational drawings	Encourages participants to draw things as they see them, following a poster she made with instructions on how to observe	Beaver specimens (claws, scat, chewed wood, skull), colored pencils, drawing paper, students' observation logs
A scientist must count exactly	Counting drops on a coin	Asks participants to predict and then verify how many drops of water will fit on a coin's surface	Medicine droppers, coins, colored water, data sheets
A scientist conducts investigations	Pill bugs	Discusses what they have learned about pill bugs during their investigation	Pill bug habitat, pill bugs, bug magnifiers, hand lenses, books
	Frogs	Discusses the life cycle of frogs	Aquarium with tadpoles, plastic life cycle models, frog skeletons, trade books

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A scientist sorts and classifies	Animal homes	Explains why animals live where they do	Sorting mats, pictures of animal homes, plastic animal models
	Seashells	Uses observation to classify shells in different ways	Sorting mats, shells, index cards to write categories
A scientist designs experiments to test predictions	Will the seeds still grow if they are planted on top of the soil?	Explains how he wanted to find out what seeds need to be planted under soil to grow	Pictures of experimental conditions in the playground and process, seeds, classroom plant that inspired his question, drawings, journal
	Where do pill bugs live?	Explains how he labeled pill bugs, made a map, and then tried to find them days later to see where they would travel	Color-coded map of playground, pill bugs, nontoxic nail polish to demonstrate labeling technique, labeled drawings, journal
A scientist makes comparisons by measuring	Pumpkin project	Compares pumpkins using math and science	Pumpkins, 100's chart (to count seeds), balance scale, tape measures, digiblocks, unifix cubes, lab report
A scientist communicates with words, pictures, and demonstrations	All About Books, How-to Books, and Poems	Display of students books and poems	Topics include life cycles, plants, frogs, birds, how to use a microscope, and outer space
A scientist works in teams with other scientists	Lake Wintergreen Field Trip	Display of pictures	Working in teams, kinderscientists do a nature walk/scavenger hunt
A scientist is a person who asks questions and tries different ways to answer them	Asking questions about objects	Models asking questions about everyday objects	Chart stand to record people's questions, everyday objects such as shells, apples, pinecones, etc.
A scientist keeps trying over and over	Bird's nest	Demonstrates trying again and asks participants to help build a bird nest with tweezers, as the class tried but was not successful	Tweezers, sticks, leaves, feathers, string, glue Use purchased, sterilized 
A scientist has fun	Science during recess and art	Display	Pictures of daily interactions with plants, animals, sand, water, etc. Pictures of observing and painting sunflowers outside

Figure 2.

Kinder-Science Fair schedule.

6:00–6:25: Teachers, students, and families gather in the science lab for welcome.

6:10–6:25: Overview of Practicing Science-Process Skills at Home (distribute booklet); View PowerPoint presentation *What Is a Scientist?*, a book created by the class.

6:25–6:30: Kinderscientists go to their stations
Parents and siblings are given a brief overview of how rotations will work, as well as tips on fostering communication skills with the kinderscientists.

6:30–7:10: Science Fair Stations in hallways
Families begin at their child's station and proceed through the other stations.

7:10–7:15: Teachers' students and families gather in the science lab.

7:15–7:30: Closure of the evening
Distribute "Science Surprises" to the kinderscientists (science medals, certificates, bug catchers, passes to local natural history museum, copy of the class-created book, *What Is a Scientist?*).

ter also included suggestions for parents to encourage nervous students and encourage science process skill-learning at home. We held the science fair in the evening so families could attend and participate. A detailed schedule of the evening's events is presented in Figure 2.

Finally, we created supplementary materials specifically for the event. We created a PowerPoint presentation that recapped our science learning throughout the year. The presentation featured photographs of students engaged in each science-process skill with captions and student quotes—in a sense, it was our class's version of the book which had guided us throughout the year, *What Is a Scientist?* (Lehn 1998).

We also created a booklet for parents, "Practicing Science Process Skills at Home" (See NSTA Connection). In this book, we listed and defined science-process skills and gave examples of how to teach science inquiry at home. For example, when gardening, we suggested asking children questions such as, "How many of the seeds that we plant will sprout? How many days until they sprout? Which will grow faster? How will we find out?"

At the Fair

When fair day arrived, we arranged students' projects on tables in three hallways, according to science-process skills. Additional bulletin boards displayed "All About" books created by the students on science topics. Plenty of space between tables made it easier for students and parents to hear each other. After the viewing of our class book and explanations of how to "do science" at home, the hallways filled with excitement and wonder. Families went from table to table,

participating in students' lessons. At first, students were nervous, however, as the evening progressed they became more confident in answering questions, explaining activities, demonstrating skills, and sharing what they learned to each set of parents. Parents followed the suggestions in the parent letter we had sent home by asking questions, paraphrasing, and providing time for students to respond.

Reflections and Growth

After the science fair, we took time to reflect on students' progress. We again asked students to draw and describe what scientists look like and do. We found a dramatic difference compared to the initial assessment. Students saw themselves as scientists, explained many tools scientists use, defined their workplace as being in a lab or outside, and provided a detailed description of what scientists do and why.

Through the Kinder-Science Fair, we learned that even very young students can learn science-process skills, take ownership of their learning, and engage in inquiry-based learning that fosters higher levels of thinking. Science fairs do not have to be new or foreign to students. With a solid foundation in inquiry processes, science fairs can be a reflection of students' sense of wonder from everyday experiences and a valuable tool that help them synthesize their understandings. ■

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Resources

Lehn, B. 1998. *What is a scientist?* Minneapolis, MN: Millbrook Press.

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academy Press.

NSTA Connection

Download the booklet for parents, "Practicing Science Process Skills at Home," at www.nsta.org/SC0712.



Connecting to the Standards

This article relates to the following *National Science Education Standards* (NRC 1996):

Content Standards Grades K-4

Standard A: Science as Inquiry

- Abilities to do scientific inquiry
- Understanding about scientific inquiry

Practicing Science Process Skills at Home

A Handbook for Parents By
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Handbook Objectives

After reading this handbook, you will be able to:

1. Name the major science process skills
2. Understand how we use science process skills not only in the “lab” but in everyday life
3. Better understand how to practice science process skills with your children
4. List activities you can use to teach the science process skills

SCIENCE PROCESS SKILLS

Science process occurs naturally, spontaneously in our minds. By logically breaking down the steps in our thinking, we can use *science process* to find out how to answer our questions about how the world works. *Science process* is not just useful in science, but in any situation that requires critical thinking. Science process skills include observing qualities, measuring quantities, sorting/classifying, inferring, predicting, experimenting, and communicating.

Take a few moments to check off the strongest and weakest science process skills you feel you and your child possess on the table on the following pages.

Science Process Skill	Description	Me		My child	
		Strong	Weak	Strong	Weak
Observing qualities	Using the five senses. Using words to describe what is seen, felt, heard, smelled, and (if appropriate) tasted. Notice details. Break things into parts. Name and describe the parts. Draw what you see and label parts of the drawing.				
Measuring quantities	Using numbers to describe an object, for example by counting parts, measuring different parts with a ruler, weighing with a scale or balance, and comparing objects using quantities (Eg. 2 apples weigh the same as 1 mango).				
Sorting and classifying	Make up categories and group things by breaking them down. (Eg. These are all buttons. Now I will put in a group buttons that are red. Now in that group I will separate buttons that are red with 2 holes and buttons that are red with 3 holes, etc.)				
Inference	What are your assumptions? I assume this is an insect because it has six legs, and when I've seen insects before they have six legs. What have you seen before that reminds you of this? Why do you think that's going to happen?				

Predicting	<p>What's going to happen? If I do this, this will happen... How will we find out what will happen? What are we going to do to find out what happens?</p>				
Experimenting	<p>I wonder what will happen if we do this? I predict that this will happen. What do I have to do to find out if I'm right or wrong? What materials will I need? What steps will I take (procedure)? What needs to happen for my prediction to be right? How will I know if I'm wrong? How will I measure it? Was my prediction right? If so, why? If not, why not?</p>				
Communicating	<p>Sharing ideas through talking and listening, drawing and labeling pictures, drawing and labeling graphs and acting things out.</p>				

We will often have questions after observing something. ***Observing qualities*** is the first step in science process. What details do I see? Can I smell it, touch it, hear it, or taste it? Can I break it into parts? What is happening? “I noticed Ms. Vitti has a large, rough object in her hand. It looks like it has sharp edges and I believe it’s a rock. I wonder, what will happen if she throws it?”

Math is another way to communicate in science. By ***measuring quantities***, when I say it rained 2 inches last night, we get the same picture in our minds. “The object in Ms.Vitti’s hand probably weighs more than an apple, but weighs less than a bowling ball” (How much do you estimate it weighs in pounds?)

Finding patterns is one way we organize our thinking. When we ***sort and classify***, we separate and put things together to understand how they relate to each other. “That looks like a rock. I know that shape and size are hard and have sharp edges. I could classify it with other rocks, other heavy objects, sharp objects...” (Knowing that it is a fake sponge-rock, would you re-classify it?)

When we are surprised, it is because we had an idea that things were going to happen differently. This is called ***inference***. You may have been surprised to

find out the object in Ms.Vitti's hand was actually a sponge that looked like a rock. Why were you surprised? Would you be surprised if we did it again?

The way we think in science is shaped by our everyday experiences.

What do we think is going to happen? **Predicting** or hypothesizing is a way of testing how well we understand something. Before doing something, we can say or write a prediction to see if we're right. Before Ms. Vitti threw her object, what did you think was going to happen? Why?

How can we know if our prediction is right? **Experimenting** is how we find out. What do we need to do to find out the answer to our question? How will we know if we were right? How do we know if we were wrong? Can you explain things in a different way? Make a plan and do it! Did the object in Ms.Vitti's hand behave like a rock when she threw it? Was your prediction right?

When we are **communicating**, we find ways to share the steps we took in our process. We learn from listening and answering questions. We find creative ways to explain our thinking. At this science fair, you will have a chance to look at drawings, read writing,

and communicate to learn more about science process skills.

EXAMPLES OF HOW TO PRACTICE SCIENCE PROCESS SKILLS

Observing qualities:

- During cooking, use senses to observe changes. Smell and taste ingredients.
- Watch birds, squirrels, and pillbugs. Notice what things are the same, what things are different.
- Start collections of flowers, leaves, and seashells. Make drawings. Label parts.
- “Do all leaves have veins?” “Do all leaves change color?”
- “What happens to the paint when you add more water?”
- “Does the toy boat float better when we add more bubble bath to the water?”

Measuring quantities:

- Measure during cooking.
- Follow recipes.
- When driving places, estimate distances and check with the odometer.
- Count at the grocery store. “We need 3 apricots, help me count, 1, 2, 3...”
- “How many chips are in your bag of potato chips?” Measure how long it takes to do things.

- “How long does it take you to get ready for school in the morning?”
- “How long did it take us to drive to school? How far was it?”
- Weigh things. “How much do you weigh with your backpack on? With your backpack off? How much do you think your backpack weighs?”
- Practice fractions. “We have one pie. How many people want to eat pie? How many pieces do we need? Help me cut and count”.
- “How many pizzas do we need for this many people? How many slices in each pizza?”
- Use money. “This costs \$1.00. How many quarters is that?” “I gave the cashier \$1.00. How much should I get back?”

Sorting/Classifying:

- Play “what doesn’t belong here” and take turns. Explain what qualities you look for in classifying. Use quantities too. “Each of these leaves has 3 lines”.
- Sort laundry together.
- Sort silverware together.
- Organize and put away groceries.

- Dump out a junk drawer and organize it.
Organize toys and label containers.
- When grocery shopping ask what aisle would you find eggs in? Apples? Cheese? Etc.

Predicting:

- “What will happen when I put this in the microwave?”
- “What will happen when we add salt to boiling water? What will happen when we add salt to ice?”
Find ways to use measurement to make predictions.
“How many seeds will be in this watermelon?”
- “How big do you think our avocado seed will be?”
“How many miles to grandmother’s house? How long will it take? Which one is farther, your friend’s house, or grandma’s house? How can we find out?” “How many robins will we see on our walk?”
- “How many of the seeds that we plant in our garden will sprout? How many days until they sprout? Which will grow faster?”
- “How many rungs on the monkey bar can you do without needing help or falling?” “Did you make it half-way?”
- “Before I turn the page of this book, what do you think is going to happen? Why do you think that?” (and then, “What happened? Was your prediction right? Why or why not?”)
- Before the commercial is over, “What do you think is going to happen next in the TV show? Why do you think that?”

Inference:

- “Who do you think is the tallest person in our family? Why do you think that? How can we find out?”
- “What do you think is going to happen? *Why* do you think that? How can we find out?”
- “What things remind you of this object? *Why*?”
- “How much time is left until we get there? *Why* do you think that?”
- “Have you seen this before? Have you seen something like it before?”
- “Where did this come from?”

Experimenting:

- I wonder what will happen if we plant this bulb upside down in our garden. Will it still grow? I predict that _____. Make a plan to find out and track results. Discuss the results.
- I wonder what birdseed the birds like best. I predict they will like the sunflower seeds more than the mixed seed. Make a plan to find out and track results. Discuss the results.
- I wonder if I can ride my bike faster if I crouch down on my bike. I predict I'll ride faster crouched down than riding with my back straight and head up. Make a plan to find out and track results. Discuss the results.
- I wonder if the water balloon will break easier if it has more water in it. I predict that it will. Make a plan to find out and track results. Discuss the results.
- I wonder if I can make a taller sandcastle if the sand is wet. I predict that _____. Make a plan to find out and track results. Discuss the results.

Communicating:

- If your child is trying to explain something to you, but you don't understand, you can ask them to show you what they mean.
- Model communication by writing, speaking, and demonstrating yourself
- Help your child communicate to resolve a conflict with a peer or sibling.
- Write a letter to share information to a family member.
- Make a graph of candy collected from holiday celebrations
- Make maps
- Play 20 questions
- Draw or paint pictures of things observed (ie. painting the rainbow after the sunshower)
- Talk through the steps of a process such as dribbling the soccer ball or tying shoes
- Keep a vacation journal or scrapbook
- Think-Aloud...this models your thought process

OTHER ACTIVITIES THAT ENGAGE KIDS IN SCIENCE

Miss Torres and Ms.Vitti remember some of the experiences when they were little that really opened their eyes up to science. The two most important elements: (‘unstructured’) time to play and explore, and sharing the activity with someone we loved and looked up to (parent, sibling, cousin, teacher, etc.).

- Trips to museums
- Trips to the beach and other places in nature
- Cooking activities
- Gardening
- Making messes (With glue, with mud, with yarn, with paint, with clay, with sand, with water... summer is the perfect time to lay some plastic bags outside, dress kids in old clothes and let them explore and investigate the properties of things with their five senses...)
- Take apart an old clock or telephone together
- Build something together, a piece of furniture, a birdhouse...
- Take walks in all kinds of different weather
- Have conversations about everything