Science Learning in the Early Years

Activities for PreK–2

PEGGY ASHBROOK

NSTA press
National Science Teachers Association

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Part III. *The Early Years* Column and Companion Blog

Acknowledgments

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I am grateful to my husband, Darryl François, for our shared interest in science and for his support of my writing.

Introduction

The past few years have seen an increase in understanding about the importance of providing young children with the opportunity to explore their world and confront challenging concepts in science, engineering, and technology. This has led to an increasing number of resources for teachers of young children, but few of these resources are designed to support teachers both practically and theoretically—to provide them with both classroom ideas and an understanding of how to use them effectively. *Science Learning in the Early Years: Activities for PreK–2* does just that. Thus, it is a pleasure to write this introduction.

Through her work with the National Science Teachers Association and the National Association for the Education of Young Children, Peggy Ashbrook has been a driving force in bringing an understanding of the importance of high-quality science and engineering teaching and learning in the early years not only to the early childhood community but also to the science education community writ large. She has also been a tireless writer. Her column, *The Early Years,* in the journal *Science and Children;* the column's companion blog, *Early Years;* and the book *Science Is Simple* (Ashbrook 2003) provide a wide range of ideas for bringing these subjects into the classroom, helping teachers, parents, and other caregivers see what children engaged in science and engineering really look like and how these subjects fit into the life of a classroom or other child-care setting.

This book brings together in one place many entries from Peggy's column and comments and ideas from her blog. Peggy sets the context for these activities in Part I and returns to it throughout the book. Herein lies one of the strengths of the book. In Part I she makes clear that the work she has done has a direct link to standards and frameworks. She explains that these experiences have the capacity to build a foundation for children's later understanding of the core ideas, crosscutting concepts, and science and engineering practices outlined in the *Next Generation Science Standards* (NGSS Lead States 2013). But she also makes clear that for the youngest children, science and engineering experiences should be expansive, and not limited to the specific performance expectations for kindergarten and elementary grades. They should be play-based delightful experiences that enhance and maintain children's natural curiosity and abilities. She also is careful to suggest how science and engineering can support other goals, objectives, and standards, whether they

concern overall cognitive development, the development of literacy and numeracy skills, social and emotional competence, or physical development.

A teacher herself, Peggy addresses this book to teachers and others who work with young children. Critical to the tone and content is the fact that she writes from her own years of experience in the classroom and a deep practical as well as theoretical understanding of teaching and learning science and engineering and of young children and their teachers. As you read the column entries and related blog posts in Part III, you feel you are talking with a fellow practitioner. She's been there and done these things and has learned and wants to share. And the blog posts add another important perspective—that we all have something to contribute and that it is through conversation and collaboration that we learn.

But this is not just another book of activities to do week after week; in its structure it is a resource to use to put together an interesting range of activities to enrich a teacher's carefully planned focus on a limited number of concepts. And this is another of its strengths. Peggy reminds the reader that science and engineering learning is not about isolated fun activities but rather is about exploration, investigation, and reflection over time focused on foundational concepts and the use of science and engineering practices. It is exciting, it is challenging, and it is fun to engage teachers and children alike. Peggy makes a careful distinction between learning facts and bits of information and constructing an understanding of basic concepts. She insists over and over that effective inquiry-based science and engineering teaching and learning can only happen when learning is focused on important ideas and children are given the opportunity to explore ideas in depth and follow interesting questions guided by a well-prepared and curious adult. Thus, she says in Chapter 1 that this book is a guide to activities that should be part of a larger science inquiry, "just as a side dish is part of a meal that itself is part of a day's nutrition." And she reminds readers that these activities are not stand-alone science or engineering curricula but rather are small steps in a journey of science inquiry.

This is a book that adults working with children in many different settings will want to keep on hand and return to as a resource and guide for planning and implementing rich science and engineering experiences for children.

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References

Ashbrook, P. 2003. *Science is simple: Over 250 activities for preschoolers.* Beltsville, MD: Gryphon House.

NGSS Lead States. 2013. *Next Generation Science Standards: For states, by states.* Washington, DC: National Academies Press. *www.nextgenscience.org/next-generation-science-standards.*

A Word About Safety

Young children repurpose materials in ways that early childhood educators may not foresee. For example, instead of feeling the texture of salt in a cup while preparing to make playdough, children may unexpectedly blow into the cup, sending salt grains into their eyes. By reading about safe practices described in the *Safety First* column in *Science and Children* (Roy 2012–2015—see list of column entries at the end of this section), we can learn from the experiences of others. We can educate ourselves about how to protect children from accidents, thus allowing for a safer teaching and learning experience.

Find the online Safety Data Sheets (SDS) for common classroom materials, such as paint, and familiarize yourself with needed precautions. For example, when using tempera paints under "normal conditions" I do not require children to use safety goggles based on SDS information. However, when we test the paint's ability to splash while making a painting in the style of Jackson Pollock, I have the children protect their eyes with indirectly vented chemical-splash goggles.

In addition to the safety precautions we use on a daily basis, such as covering outlets and removing choking hazards for children who put objects in their mouths, we need to protect children from hazards they cannot foresee, such as germs on unwashed hands.

Each column entry in this book has alerts (signaled by the word *CAUTION*) for safer practices. These safer practices should be used in addition to your own judgment and licensing safety requirements based on legal safety standards and better

professional practices. Before any activity or investigation is done, always review important safety information with students and volunteers.

Disclaimer: The safety precautions of each activity are based in part on use of the recommended materials and instructions, legal safety standards, and better professional practices. Selection of alternative materials or procedures for these activities may jeopardize the level of safety and therefore is at the user's own risk.

Kenneth Roy's *Safety First* column entries in *Science and Children* (in reverse chronological order):

- "Preventing Allergic Reactions," 53 (4): 27–29, December 2015.
- "Safety at First Sight," 53 (2): 93–95, October 2015.
- "Safer Science Explorations for Young Children," 53 (7): 26–28, March 2015.
- "Houston, We Have Liftoff!" 52 (3): 76–77, November 2014.
- "Feather, Feet, and Fin Safety in the Classroom," 52 (1): 72–74, September 2014.
- "Ensuring a Safer Outdoor Experience," 51 (7): 82–83, March 2014.
- "The Elementary Mission," 51 (2): 86–87, October 2013.
- "Getting Wired on Safety," 50 (7): 80–81, March 2013.
- "Modeling Safety in Clay Use," 50 (4): 84–85, December 2012.

Part I.

Teaching Science and Engineering in Early Childhood Settings

Chapter 20

Rocks Tell a Story[11]

BEFORE YOU BEGIN THIS ACTIVITY:

Remember that each activity is not a stand-alone science or engineering curriculum. Activities are small steps in a journey of science inquiry, as discussed in Chapter 1. Your students will learn more about this concept and about the nature of science if you use this activity as part of an ongoing exploration of a question, a concept, or a topic being investigated by your class. Ask yourself, "What should come before this and what should come after?" Refer to Table 1.1 (pp. 15–39) to find other activities from *The Early Years* column that address the same concepts.

Sedimentary rocks, formed by an accumulation of sediments (tiny pieces of rocks or minerals) in a water environment, tell a story that many students may be familiar with. They may have visited areas where water or wind carried sediments and deposited them in rivers, lakes, oceans, or dunes. The rocks are often visually or texturally interesting and may have the added attraction of containing fossils.

We can understand the stories rocks tell more easily if we have experience with the materials that make up a rock. Here are a few suggestions on how to experience these rock materials:

- With permission, if needed, dig clay or sand from the ground to bring back to the classroom. Examine it, and wash a cupful in water on a tray to see what else is in the sample—perhaps "dirt," organic matter from plants, small pebbles, and shells.

[11] This column entry was originally published in *Science and Children* in December 2006.

- Take a field trip to a beach on an ocean, lake, or river to see sediments accumulate.
- Add a small amount of sand or clay to standard paints for painting pictures on paper.
- Pour water into a tub of sand to see how it can move sand. *CAUTION: When finished, do not dispose of the sand in the sink drain.*
- Mix sand and clay with water in jars to shake and watch the sediment settle. Make one jar with ¼ cup sand, one with ¼ cup clay, and one with 2 tablespoons of each, and seal tightly with hot glue inside the lids and tape outside. Ask questions before shaking: *What do you think will happen if we mix the sand or clay with water? How long will it take the sand to mix into the water, and how long will it take the clay? What will happen when you stop shaking? What did you find out?*

When the clay and sand that the children have been working with dry out, the children will notice that they no longer stick together. The sand is once again individual grains and the clay, although it's hard to see particles, feels "dusty" and is easily broken. *CAUTION: Keep wet paper towels nearby to clean up dry clay dust rather than sweeping it up, to avoid airborne dust (Roy 2014).*

As part of the exploration of earth materials, students can record their ideas about why clay and sand feel different and how they hold together when wet and when dry. Direct exploration of clay and sand builds students' understanding of their properties. Describing and classifying materials by their observable properties is part of the grade 2 performance expectation 2-PS1-1 in the *Next Generation Science Standards* (*NGSS*), and experiences with clay and sand can help students understand Earth events, which is another grade 2 performance expectation (2-ESS1-1) in the *NGSS* (NGSS Lead States 2013).

In the following activity it is very important to always use the term *pretend rock* so children do not get the idea that rocks are human made. Rocks are formed through natural processes. Many descriptions of rock formation for young children say that the rock formed when sediment was buried under tons of more sediment and dirt until it turned into solid rock, omitting the role of cementing materials. Sediments are cemented together when water carrying dissolved minerals seeps into the spaces between the particles and the minerals precipitate out from the water in the spaces, cementing the grains together. In the Pretend Rocks activity, plaster of paris will be added to the sediments in the cup to act as the cement.

Variation seen in sedimentary rocks comes from many differences, including color of parent material, source of parent material, particle shape, particle size, and

the environment in which the sediment was deposited. You can offer various sediments in this activity to produce a variety of pretend rocks.

References

NGSS Lead States. 2013. *Next Generation Science Standards: For states, by states.* Washington, DC: National Academies Press. *www.nextgenscience.org/next-generation-science-standards.*

Roy, K. 2014. Safety first: Modeling safety in clay use. *Science and Children* 50 (4): 84–85.

Activity: Pretend Rocks

Objective

To notice the range in grain size in sedimentary rocks and think about how such rocks are formed

Materials

- Samples of various sedimentary rocks, including sandstone and shale, made of different-size particles (Rock can be purchased through local stone dealers or scientific supply companies or collected locally.)
- Magnifier
- Rock identification book for general audience
- Sand
- Ceramic (pottery) clay formulated for safe use by children (see "Resources" section)
- Spoons to serve the sand and clay
- Paper towels
- One 5–8 oz. paper cup and craft stick for each child
- Plaster of paris
- Disposable containers to mix plaster
- Water
- Pebbles, dirt, and small shells (optional)

Procedure

1. As the collected rocks are brought in, a discussion about where rocks come from develops. Ask if anyone has ever seen a rock being made, to learn the students' ideas. Encourage the children to look closely at the rocks and compare them with each other in color, size, shape, texture, and weight. Have them use a magnifier to see the grain size. *What size are the pieces that make up these rocks? Can you see them or feel them? Are any of these rocks the same?* Note that a rock can be many sizes and have different names—such as sand, pebble, stone, and boulder—and still be rock.

2. Compare the actual rocks with those pictured in a rock identification book. The "match" that young children make is usually based on color and shape rather than other distinguishing properties or origin. At this age they are beginning to understand the use of an identification book, not the complexities of rock composition, so no corrections are needed.

3. Tell the students that now they are going to feel the raw materials that make sandstones and shales. Have the students feel soft, damp clay and damp sand, keeping the materials separate. Accentuate the difference in textures by using clay that does not contain grit so its texture is very smooth. *Where have you seen clay or sand? How are these two materials alike or different? What size are the pieces that make up the clay and sand?*

4. Ask for ideas on how to make a "pretend rock." Then tell the children that you have a recipe to try. Give each child a small paper cup to fill about half-full with damp sand or very wet clay. You might also provide pebbles, dirt, or shells to be added. Make one pretend rock of just clay and one of just sand so the children can later compare these types of pretend rocks. Have the children stir their chosen material(s) using a craft stick (it doesn't accidentally flip sand the way a spoon does).

5. Using a finger, test to see if the mixture "is a rock yet." Tell the children that a "cementing" material must be added, then add a heaping teaspoon of mixed plaster of paris. *CAUTION: Only adults should mix and add the plaster of paris; follow the package instructions, and do not wash the remainder down the sink.* Have the children stir their mixture thoroughly and describe it.

6. Review the process for sedimentary rocks formed by an accumulation of sediment: *Rock formation is happening all the time, not in schools or factories but in nature. It takes a long time for the sand grains and clay minerals to pile up in the same place and become buried as more sediment is deposited on top, and*

for water to carry dissolved minerals into the sand and clay minerals to become the glue that holds the pieces together. By tomorrow—a much shorter time—our pretend rock materials will be cemented and become hard.

7. After 24 hours, have the students peel off the paper cup to reveal the pretend sedimentary rock. Doing this as a group will allow the children to compare rocks and talk about how their rocks are made of different-size particles.

As a follow-up to the activity, make a snack "rock" with a variety of cereal particle sizes, including the puffed rice cereal in the original Rice Krispies Treats recipe (*www.ricekrispies.com/recipes/the-original-treats*). The melted marshmallows are the cement!

Resources[12]

Art and Creative Materials Institute, Inc. (ACMI). 2015. Safety tips—what you need to know. *http://acminet.org/index.php?option=com_safetytips&view=safetytips&Itemid=30.*

Gyllenhaal, E. 2002. Aaron's treasures. *Chicago Parent*, July. Also available at *http://saltthesandbox.org/ChicagoParentArticle1.htm.* (This article was written about preschool children's passion for collecting.)

Gyllenhaal, E. 2001–2002. Neighborhood rocks. *www.saltthesandbox.org/rocks/index.htm.* (This website has lots of ideas for finding rocks in cities and suburbs and for collecting, identifying, and playing with these finds.)

Gyllenhaal, E. 2001–2009. Salt the sandbox. *http://saltthesandbox.org.* (This collection of websites is devoted to the interests of young children, especially topics related to nature and science.)

Teacher's Picks[13]

Publications

A Gift From the Sea by Kate Banks, illustrated by George Hallensleben (Farrar, Straus and Giroux, 2001).

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[12] Eric Gyllenhaal, a geologist and museum educator and evaluator, developed the three resources on Earth science and collections; they are useful for parents and teachers of young children.

[13] These suggestions were provided by Marie Faust Evitt, a preschool teacher and author of the book *Thinking BIG, Learning BIG: Connecting Science, Math, Literacy, and Language in Early Childhood* (Gryphon House, 2009). The book's website has a useful "Links/Resources" tab: *http://thinkingbiglearningbig.com.*

The sumptuous illustrations and lyrical text describe the journey a rock takes from a volcano through the Ice Age and early civilization to the bottom of the ocean and finally to the beach where a boy finds it. Though the text is simple, you can use it with older children to help them speculate about the history of rocks they find.

Rocks in His Head by Carol Otis Hurst, illustrated by James Stevenson (Greenwillow Books, 2001).

Understated humor punctuates this true story about the author's father, whose passion for rock collecting as a boy eventually leads him to become curator of mineralogy at a science museum. Learning about this natural-born scientist researching, labeling, and displaying his beloved rocks will inspire students to follow their dreams.

Grand Canyon: A Trail Through Time by Linda Vieira (Walker, 1997)

This rich description of one of the natural wonders of the world reads as a story. Facts about the canyon's record of geologic time are interwoven with information about the animals, plants, and people who live in it today.

The Sun, the Wind, and the Rain by Lisa Westberg Peters, illustrated by Ted Rand (Henry Holt, 1988)

This beautifully illustrated book provides an excellent introduction to geologic processes by comparing the creation and evolution of mountains with a sand hill that a girl builds at the beach. Children can readily see the connection between their own experiences with sand and the weathering of the natural landscape.

Websites

Geology of National Parks, 3D and Photographic Tours; Geology of the National Parks: Virtual Tours
http://3dparks.wr.usgs.gov; http://geomaps.wr.usgs.gov/parks/project/index.html

From rock formations at Bryce Canyon National Park to the stones used to build our nation's capital in Washington, D.C., these U.S. Geological Survey websites present the outstanding geology of many different parks.

Images of Clay
www.clays.org/EDUCATIONAL%20RESOURCES/ERimages.html

This website, a joint initiative of the Clay Minerals Society and The Clay Minerals Group, provides a look at highly magnified photos of different clay minerals that will help children understand that clay, like sand, is made of particles.

Related *Early Years* Blog Posts

The following information is from "Rocks: Collecting and Classifying," published June 13, 2009:

> *Walking along a creek is one place to find rocks that have been moved there by natural forces, not by humans. (Be sure to wash hands afterward.) You don't have to know what type of rock it is to appreciate that it is smooth and pinkish, or has sparkles, or has holes in it.*
>
> *Label even the most nondescript rock with the location and date collected, and that single rock becomes the beginning of a scientific rock collection. A high school Earth science teacher might be willing to view the collection and help with scientific names.*

Read more at *http://nstacommunities.org/blog/2009/06/13/rocks-collecting-and-classifying*.

Additional related blog post:

"Exploring Natural and Human-Made Materials," published December 20, 2012: *http://nstacommunities.org/blog/2012/12/20/exploring-natural-and-human-made-materials.*

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Science Learning in the Early Years

ACTIVITIES FOR PreK–2

"Peggy Ashbrook has been a driving force in bringing an understanding of the importance of high-quality science and engineering teaching and learning. ... A teacher herself, Peggy addresses this book to teachers who work with young children. Critical to the tone and content is the fact that she writes from her own years of experience in the classroom and her deep practical as well as theoretical understanding."

—from Karen Worth's introduction to *Science Learning in the Early Years*

This book is for all preschool and elementary teachers who wish they had a mentor who understood inquiry, young children, and the need for truly engaging science activities. For nearly three decades, teacher, columnist, and blogger Peggy Ashbrook has promoted the importance of high-quality experiences for children in prekindergarten through second grade. This collection of her writing for NSTA's elementary journal, *Science and Children*, is the next best thing to having her as your own personal guide to the challenges and fun of working with the youngest scientists.

Science Learning in the Early Years offers both classroom ideas and an understanding of how to use them effectively. The book is uniquely helpful because it recognizes that you're a generalist teaching all areas of the curriculum. Ashbrook emphasizes important science concepts in 40-plus activities that are clearly presented and developmentally appropriate, connect to the *Next Generation Science Standards*, and highlight safety concerns. Perhaps most important, Ashbrook shows how to group individual activities into an ongoing science unit so students can develop science inquiry skills over time.

Ashbrook the writer will inspire you even as Ashbrook the science teacher helps you develop a carefully planned course on appropriate concepts that are just right for your students.

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