Ramps and Pathways

Developmentally Appropriate, Intellectually Rigorous, and Fun Physical Science

Betty Zan and Rosemary Geiken

Jackson and Luis, two preschoolers, stand across from one another at a table on which are placed a few ramp segments (one-foot lengths of cove molding), several dry sponges of differing sizes, a few clear containers, and some marbles. Jackson creates an incline by stacking some sponges and placing one end of a segment on top. He places a container at the lower end, releases the marble at the top of the incline, and watches the marble roll down and into the container.

Luis also creates an incline, but he places the high end on the edge of the upright container and the lower end on two sponges, so his marble rolls in another direction. After a few unsuccessful tries to get the marble to roll into the container, Luis picks up the ramp segment and rotates it 180 degrees (so that the end that was lower is now propped on the edge of the container). He places the marble on the track and watches as it still rolls away from the container. Finally, Luis places three more sponges under the low end, raising it higher than the end propped on the container. He tests his incline again, and when the marble rolls into the container, Luis giggles.

We have spent many years providing professional development in the area of science education, working alongside teachers and observing children in the classroom. These experiences have convinced us that activities involving inclined planes are possibly the best science activities we have ever encountered. We call our collection of classroom activities involving inclined planes Ramps and Pathways. These activities engage children in investigations involving force and motion, foster the development of important science inquiry skills, and provide numerous opportunities for integration across curricular domains. *And* they are great fun!

In this article, we share our enthusiasm and our experiences supporting children in Ramps and Pathways investigations, and we seek to inspire teachers to implement similar activities in their classrooms. The young boys in the opening story are not simply *playing* with the incline and marble; in each boy's quest to figure out how to get the marble to do what he wants, he is *investigating,* trying out different ideas, and varying his actions. This is what scientists do. It is called *inquiry.* And it is one of the primary goals of science education. We hope that our experiences will arouse in teachers the same curiosity and eagerness to learn that we see in children when they encounter these activities.

For several years we have offered early childhood physical science workshops for early childhood teachers across Iowa and across the country. Our experience with Ramps and Pathways began in a university-run laboratory school in Waterloo, Iowa, serving primarily children from minority cultures whose families have low incomes. We also tested the project activities with pre-K through second grade teachers and children in a variety of settings.

Betty Zan, PhD, is associate professor of curriculum and instruction and director of the Regents Center for Early Developmental Education and the Center for Early Education in Science, Technology, Engineering, and Mathematics at the University of Northern Iowa, in Cedar Falls. betty.zan@uni.edu

Rosemary Geiken, MAE, is faculty at the University of Northern Iowa, in Cedar Falls, and has worked with teachers in implementing the Ramps and Pathways curriculum in their classrooms. rosemary.geiken@uni.edu

The authors' work developing Ramps and Pathways activities is supported by a grant (ESI-0628082) from the National Science Foundation.

Photos courtesy of the Freeburg Early Childhood Program in Waterloo, Iowa.

This article is available in an online archive at **www.naeyc.org/yc/pastissues**.

naeyc® 2, 3

One of the beauties of ramp building in the classroom is its simplicity. When we started out using ramps, we simply introduced wooden cove molding and marbles to the block center. Over the years, we have explored variations, some of which we will describe here, but the basic ingredients remain unchanged: cove molding, marbles, and unit blocks. We have used these materials successfully with children of diverse backgrounds and abilities, with typically developing children and children with disabilities, and with English-speaking children and dual language learners. The ramp materials offer interesting challenges for children of all ages and levels of development.

Setting up the classroom

In our work with teachers, we have learned about creating environments that inspire active investigation and invite children to try out their ideas. The following paragraphs describe the materials, space, and time needs for implementing Ramps and Pathways.

Materials

Wood cove molding can be found in most building supply stores. We have had the best luck with molding that is 1¾ inches wide (marbles wobble too much on wider widths). Sections of varying lengths (1-, 2-, 3-, and 4-foot lengths) are best, but if the classroom is small, the 4-foot lengths can be omitted. Most classrooms need at least 18 of each length.

The ramp materials offer interesting challenges for children of all ages and levels of development.

Marbles of different sizes move easily down the cove molding ramps. Variations in size allow children to compare the movement of large and small marbles. Other variations include steel marbles, blocks or other objects that do not roll, and items that roll differently (such as spools, egg-shaped objects, spheres with bumps). Divided organizers, often found in hobby stores, can serve as storage containers for the marbles and other objects.

The best place for the ramps is in the block center. Children use wood unit blocks to build elaborate ramp structures. They also can use large hollow wood blocks, large interlocking blocks, or large cardboard blocks. If ramps are being used on tables, as in the opening vignette, large sponges make great supports. Some teachers cut openings in cardboard boxes that can be used for propping up the ramp sections. However, if all of the blocks are being used, children can use whatever else is available—shelves, chairs, tables, or other items.

Space

Space can be an issue. Once children start building ramps, they want to build them bigger and bigger! For younger children especially, this often means longer ramps. We've seen classrooms with ramp sections propped on every chair and desk. Of course, not every classroom has the luxury of dedicating that kind of space, but we've found that children can be very creative in using small spaces. Teachers also use hallways, lunchrooms, and open conference rooms, or they take the ramps outdoors.

Time

The National Science Education Standards stress that "building scientific understanding takes time on a daily basis and over the long term" (NRC 1996, 44). An effective learning environment provides ample time for children to engage with materials. Children need time to revisit ideas, reflect on what they have done, and revise their thinking. When we speak of time, we mean time both during the day and time across the days, weeks, months—even years. In the laboratory school where we developed the Ramps and Pathways program activities, the materials were available in the block center every day and in every classroom, preschool through grade 2. Some children worked with ramps for five years, and they never grew tired of them or ran out of ideas.

Young children are highly capable of devoting long periods of attention to something that captures and engages their interest and purpose.

Big ideas for early childhood physical science

The following six suggestions can guide the implementation of any high-quality physical science curriculum. We offer these "big ideas" in the spirit of sharing with teachers what we have learned over the years about implementing Ramps and Pathways and other physical science activities.

1. Teachers need experiences with classroom materials to understand the possibilities for learning.

It is critical for teachers themselves to investigate the ramp materials before putting them out for children. To be able to support young children's development of scientific knowledge and reasoning, teachers must have some understanding of how inclined planes work. They need to experiment with the materials and figure out (among other things) how to move a marble without touching it and how to make a marble go up a ramp section or turn a corner. They need to think about their thinking as they investigate the materials. By investing time in exploring the materials, teachers can see the possibilities and be better prepared to facilitate children's work with the ramps.

An important aspect of the learning in Ramps and Pathways is the connections made between actions and reactions. For example, marbles travel faster if you put four blocks rather than two under the high end of a ramp. This understanding offers the possibility of constructing a relationship between the degree of incline and the speed of the marble. As teachers work further with the materials, they identify many more connections or relationships that children can make.

2. Effective learning environments inspire interests and ideas and allow children to try out their ideas.

According to *Benchmarks for Science Literacy* (AAAS 1993), children should be actively involved in exploring phenomena that interest them. The importance of interest in young children's learning cannot be overstated. Piaget ([1954]1981) said interest is the fuel that drives the motor of mental activity, much like gasoline powers an engine. Unlike adults, who can often force themselves to pay attention, most young children lack the self-regulation to pay attention when they are not interested in something. However, young children do not necessarily have *short* attention spans. They are highly capable of devoting long periods of attention to something that captures and engages their interest and purpose. We have seen this repeatedly when children engage in activities that support experimentation, as Ramps and Pathways does.

The opening vignette illustrates how young children approach the ramp materials: they try to figure out what they can do with them. They have ideas, and they try out their ideas to see what will happen. For this reason, it is very important to set up a classroom environment in which children feel safe trying their ideas, without fear of failure. Unfortunately, for far too many children, school is not a place where it is safe to actively experiment and try out ideas; they learn, even at a young age, that there are *right* answers and *wrong* answers, and that wrong answers are to be avoided. When working with ramps, teachers should refrain from correcting children or giving them right answers. Instead, the teacher's role is to support continued inquiry by intervening with questions or comments that inspire further experimentation.

3. To accurately understand and assess children's reasoning, teachers must observe children closely.

Close observation is the only way teachers can learn how children are thinking and design appropriate interventions and variations. However, observation is more than simply watching children. It must be accompanied by knowledge about what is being observed, how the children's actions demonstrate their thinking, and how the event connects to learning goals and objectives.

If one observes closely, one can see in the story at the beginning of this article several demonstrations of a young child's competence. First, Luis persists in his own purpose—getting the marble to roll into the container—until he is successful. Second, he tries different strategies—some of them illogical from an adult perspective—before he is successful. And finally, he experiences the satisfaction of solving a problem on his own, without adult intervention. These three elements are included, in one form or another, in early childhood learning standards across the country, often under headings such as "Approaches to Learning," "Initiative," or "Problem Solving."

to the process of scientific inquiry. They require an environment in which children are free to collaborate and take risks.

We have seen teachers use many strategies to foster communication between young learners during Ramps and Pathways activities. They encourage children to work in groups and to help each other by sharing ideas. They provide materials so children can draw and write about their ramp structures. Photos of children's ramp structures provide excellent writing prompts and can be used to stimulate discussions. During group time, teachers can invite children to reflect on what they have done in the ramps center.

6. Ramp activities offer multiple opportunities to integrate other curriculum areas.

One of the most valuable aspects of a ramp project is the ease with which it addresses other areas of the curriculum. Mathematics is everywhere: children engage in spatial reasoning as they decide where to position blocks or how to align the ramp sections; they experiment to figure out how to use angles so marbles will turn corners; they count blocks to compare heights and predict how many more blocks they will need—the list of math concepts could go on and on. Literacy possibilities include using digital photos as writing prompts. Teachers tell us that even reluctant writers are eager to write about their ramp structures. Some teachers help ramp makers create class books (one second grade class made an alphabet book of ramps). For social studies, children can consider the importance of ramps in the workplace or to persons with disabilities. An art teacher steeped in the Reggio Emilia approach explained to us how the children's ramp structures integrate art and architecture.

4. Support children's investigations and conceptual development with interventions that focus on reasoning rather than right answers.

Young children's investigations often lead to common erroneous ideas, or what the science education community refers to as *preconceptions*. For example, even after seeing a marble roll down an elevated incline and fly off the end, many children will still predict that a marble will drop straight down into a container when it reaches the end of a ramp (demonstrated by placing a container to catch the marble directly under the end of the ramp). Preconceptions are common—often persisting well into adulthood—and are highly resistant to change. Teachers experienced in supporting inquiry know how to encourage experimentation so that children can correct their preconceptions through acting on objects and observing the results of their actions.

Experimenting and making errors are vital to the process of scientific inquiry.

5. Sharing experiences and the results of investigations strengthens science learning as well as the development of communication.

In a reassessment of current science instruction, Metz (1995, 117) stresses that "the development of scientific knowledge is, in many aspects, a social activity." Scientists don't work alone; they rely on frequent communication with other researchers. Experimenting and making errors are vital

Pathways to success

Teachers tell us powerful stories about using ramps for science learning in their classrooms. One kindergarten teacher had never thought of herself as a "science person." But now, through the Ramps and Pathways project, she says, "I have learned that this science approach is completely doable." A preschool teacher, who says she was "scared" to teach science, boasts that now "we are actually doing science every day and have a science center going daily." Another preschool teacher says, "I do a lot more thinking about science and spend more time on science in the room with the children. I have science on the brain."

Teachers also report that ramp building decreases behavior problems in their classrooms. For example, a first grade teacher says, "At the beginning of the year, I was told that Reggie had behavior issues . . . But we found an area that Reggie excels in. I think that Reggie's ability to build ramps has positively affected his behavior. I don't have anymore trouble with Reggie's behavior in class."

These reports and our own observations confirm what we have witnessed from the beginning of our project: Ramps and Pathways is one of the best science activities for engaging both young children and their teachers in inquiry learning. And it is great fun!

References

AAAS (American Association for the Advancement of Science). 1993. *Benchmarks for science literacy*. Washington, DC: Author.

Metz, K. 1995. Reassessment of developmental constraints on children's science instruction. *Review of Educational Research* 65 (2): 93–127.

NRC (National Research Council). 1996. *National Science Education Standards: Observe, interact, change, learn*. Washington, DC: National Academies Press. www.nap.edu/catalog.php?record_id=4962

Piaget, J. [1954]1981. *Intelligence and affectivity: Their relationship during child development,* eds. & trans. T.A. Brown & C.E. Kaegi; conslt. ed. M.R. Rosenzweig. Palo Alto, CA: Annual Reviews.

Young Children Cluster Topics for 2011

We are pleased to announce the following cluster topics for 2011. The Notes column provides suggested content and other information. Please refer to the Manuscript Guidelines on the NAEYC Web site at **www.naeyc.org/publications/forauthors/writeyc** to read about the due dates and submission process for cluster proposals and articles.

Issue Date and Topic	Notes
January 2011: Supporting the Many Ways Children Communicate	How young children communicate their feelings, needs, ideas, and interests through language, writing, art, music, dance, and behavior.
March 2011: Emotional Intelligence: A 21st Century Skill for Children and Adults	**Open, by invitation, to presenters from the June 2010** National Institute for Early Childhood Professional Development.
May 2011: Preparing and Supporting Teachers: Innovative Approaches	Supporting dual language learners; preparing culturally appropriate teachers; the role of coaches, mentors, directors, and principals; using technology and distance learning.
July 2011: Behaviors That *Still* Challenge Children and Adults	The reasons for children's behavior; creating program environments, schedules, routines, and curriculum that prevent problem behaviors; building relationships with individual children; partnering with families. What works and why? What doesn't work and why?
September 2011: Fostering Critical Thinking and Problem-Solving Skills	Building children's skills across the curriculum and at all ages; addressing critical thinking and problem solving for adults through teacher education, staff development, and supervision.
November 2011: Early Childhood Trends and Initiatives	Successful public-private partnerships; innovative family engagement strategies; using technology to enhance learning; early childhood programs in public schools; the tangible and intangible benefits of investing in early childhood education.