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Sand and water table play

MARY J. WHITE

Work is play at classroom table stations that invite students to explore.

Observing in Mary White's kindergarten classroom is like watching a beehive: hustle and bustle all around. Children work puzzles, create artwork, build with blocks, read books, and write their own stories.

At a multicolored table in the back of the room, four children in smocks are making what appears to be a *mess*. One student dumps sand from a hollow, geometrical sphere and refills it while his friend buries items to subsequently extract. Another student uses a measuring cup to fill a 50 ml graduated cylinder with sand and levels off the top before dumping it into a 100 ml graduated cylinder. When asked how many times she thinks she would have to dump the sand from the smaller container to fill the larger, she ponders a moment, and then starts filling the smaller container again to find out.

These children are playing at a learning center called the *sand and water table*, a classroom structure that holds a large quantity of sand, water, and any number of items that the teacher chooses. In this safe environment, students are free to express themselves and explore quantitative relationships using physical materials. White's use of the sand and water table supports her students' mathematical thinking and their reasoning about relationships. Play is the starting point for activities designed to buttress students' exploration of quantity.

Table play

Play is important to young children's overall social, emotional, cognitive, and physical development (Seo 2003). The National Council of Teachers of Mathematics (NCTM) and the National Association for the Education of Young Children (NAEYC) recommend supplying teacher support, materials, and time for children to engage in play, through which they explore and manipulate with interest what adults recognize as mathematical ideas. NCTM and NAEYC produced a joint statement affirming that "high quality, challenging, and accessible mathematics education for three- to six-year-old children is a vital foundation for future mathematics learning" (2002). Play is one tool for creating such activities.

Sand and water tasks allow children hands-on experiences that can lead to problem posing, problem solving, and opportunities to build connections between ideas. For example, a child pouring sand from one container into another to fill it, as described in the introduction, could be building connections between her ideas about different volumes.

Sensory motor activities allow children to feel textures and listen to sounds—for instance, of rice as they create roadways and tunnels through it. Engaging in sensory motor activity offers children a means to release tension in a nonthreatening environment and helps them develop in the areas of mathematical thinking and problem solving (West and Cox 2001). Such an environment also supplies opportunities for young students to increase their social skills as they learn and practice how to share and negotiate the use of the materials.

By observing and interacting with children engaged in play at the sand and water table, this writing team discovered mathematics within the play and was then able to intentionally create meaningful activities to support the students' mathematical development.

Designed tasks

Merely allowing children to play at the sand and water table is unlikely to foster mathematical thinking. The teacher plays a critical role in transforming play into occasions to build such thinking, ideas, and concepts. Teacher attention to what *is* happening during the children's play informs insight into what *might* happen mathematically as a result of activities stemming from play. To help children progress from play to mathematical ideas, the team gathered information over several stages of the children's play.

Free exploration

Beginning with time for students to engage in *free exploration*, the authors placed a variety of materials in the table, such as three-dimensional geometric hollows, various-sized graduated cylinders, measuring cups, and funnels. The children were permitted to play without intervention from the observing teachers.

Graduate student Ryan Stone used an observation form (see **fig. 1**) intentionally geared toward documenting students engaged in play. Specifically, he observed the materials and the discourse that the children used, making notes about what other materials might be beneficial for them and what questions would be appropriate to ask to facilitate their discourse. Stone's observations gave insight into the children's development and interests, which informed the team's curricular and instructional decisions.

Concept introduction

Over time, the team moved students from free exploration to *concept introduction*, during which the teacher joins students at the table to listen to, observe, and interact with them. For instance, when youngsters began to use graduated cylinders at the table, White pointed out the measurement marks on the cylinders and led a discussion of their meaning. During concept introduction, teachers ask questions and draw attention to significant comments that students make, such as David's remark as he filled one geometric hollow and emptied it into another: "Hey! They are the same."

White began to pour using the same two containers and said, "My goodness, you're right! I wonder if any more are equal."

Her observation of the children's play and her subsequent question encouraged a morning-long search for containers that held the same amount of birdseed.

Concept application

After concept introduction, the teacher retreats to observe during the period called *concept application*. To see which ideas the children have taken as their own, the teacher allows students to self-select materials. Children will usually incorporate the ideas presented during concept introduction—for example, the measurement marks.

FIGURE 1

Using this observation form to document youngsters engaged in play, teachers can note other materials that might be beneficial, questions to facilitate their discourse, and guidance for the team's curricular and instructional decisions.

Materials in the Table	Names of Children Playing	Discourse among Children	Mathematical Play	Possible Math Interventions

Varying some of the materials also encourages the use of ideas that were discussed during concept introduction. A teacher might add different measurement devices or exchange birdseed for wheat seeds. After White's students had used graduated cylinders to measure birdseed, rice, and sand at the table, water was introduced. The kindergartners tested their understanding of equivalent measures on this new material and were surprised to find that even when they use liquids, the same equivalencies apply.

Just recognizing the work that students have done is often enough to support their continued investigation and mathematical thinking. If, however, students do not make use of the ideas presented and discussed during the concept introduction phase, further discussion or investigation of the concept may be needed. Additional instruction takes place during a small-group time to avoid interrupting and interfering in the children's play at the sand and water table. Before deciding that a particular child or a group of children need more individual support or instruction, White typically waits until they have had repeated opportunities to explore a concept with many materials over a period of weeks or even months. Deciding to provide more-directed instruction is prompted by a child's apparent frustration in attempting to solve a self-posed mathematical problem.

Over a number of days, one child, Sarah, kept returning to the table to fill and empty the geometric hollows. One day, she threw them down in the sand and stomped away. The next day, White joined Sarah when she went to the table. As Sarah worked, White asked her what she was doing. Sarah explained that she had observed David calling some shapes *the same* as he filled and emptied them. She was trying to understand what he meant, because they did not look the same to her. White showed Sarah how David had discovered that some shapes hold the same amount. This concept of equivalence continued to give Sarah trouble; consequently, White planned several small-group activities to help students develop an understanding of the concept.

Water table exploration develops concepts of bouyancy and density as children observe whether objects sink or float.

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Evaluation

The final stage for sand and water table activities is *evaluation*. White had been informally evaluating students throughout the previous stages. She was able to determine that David could conserve a quantity from one three-dimensional shape to another but that Sarah was unable to do so. This prompted White to plan specific small-group activities addressing the misconceptions she had observed.

During small-group instruction, White observed further, using a checklist of specific mathematical skills. For one activity, she supplied students with an assortment of two-dimensional shapes they could use to create three-dimensional shapes. As she observed students using squares to create cubes, and triangles to create triangular pyramids, she took notes on the language that the children used to describe the shapes. She also checked off the math skills from the NCTM Standards that state that kindergartners should "describe attributes and parts of two- and three-dimensional shapes" and "investigate and predict the results of putting together and taking apart two- and three-dimensional shapes" (NCTM 2000, p. 96).

Sand and water activities

The next section shows how teachers can build activities that use students' play as well as introduce further opportunities to build their mathematical thinking. What follows is one of many activities that the team developed from children's interests and play at the sand and water table.

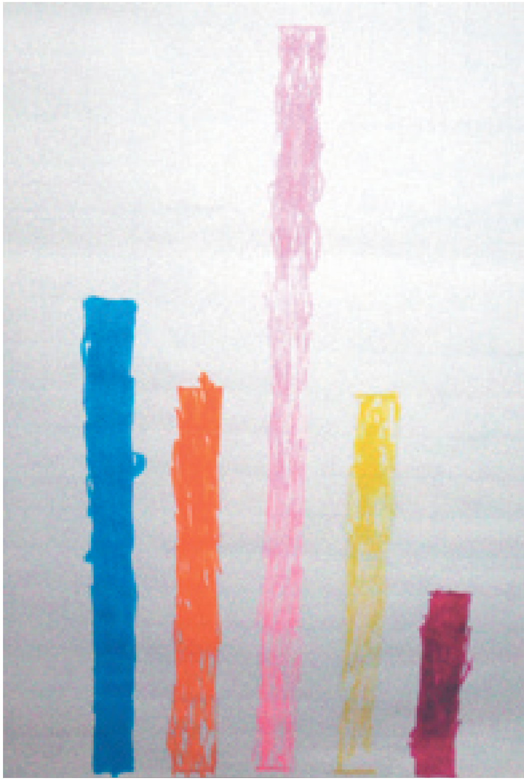
Dinosaur dig

At the time this activity was developed, students were involved in a dinosaur study, which they had initiated during the first weeks of the semester. Having observed students burying and unearthing numerous items in the sand table during their free exploration time, the team decided to organize a dinosaur dig. White introduced the dig to the class by reading *Bones, Bones, Dinosaur Bones* (Barton 1990). In the book, archeologists locate dinosaur bones, extract them from the ground, pack them, and take them to a natural history museum.

During the dinosaur dig, children played the role of archaeologists and dug for artifacts within the sand table. The teacher placed a collection of objects in the sand table, such as bones, shells, rocks, acorns, fossils, and rubber dinosaurs. After students extracted the artifacts, they sorted the objects—without prompting from their teacher—into stacks that they described as "things that go together."

White wrote the names of the stacks on Post-it™ notes. Next she asked the students if they could graph their stacks on one-inch grid paper. The team then helped students use their physical representations to create bar graphs of their findings. After the graphs were finished, the team engaged the children in mathematical questions of comparison such as these:

1. What artifact do you have *more than*, *less than*, the *same as* ____?"
2. Which category has the *most* or the *least*?
3. Can you *order* the items from *smallest* to *largest*?
4. *How many* do you have? What numeral represents that amount?



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Under the guise of play, students' sorting leads to graphing and data analysis activities.

This activity yields opportunities for addressing many of NCTM's mathematical standards for kindergarten. Meeting the Number and Operations Standard has students engage in and connect ideas of counting, ordering, and recognizing how many are in a set of objects.

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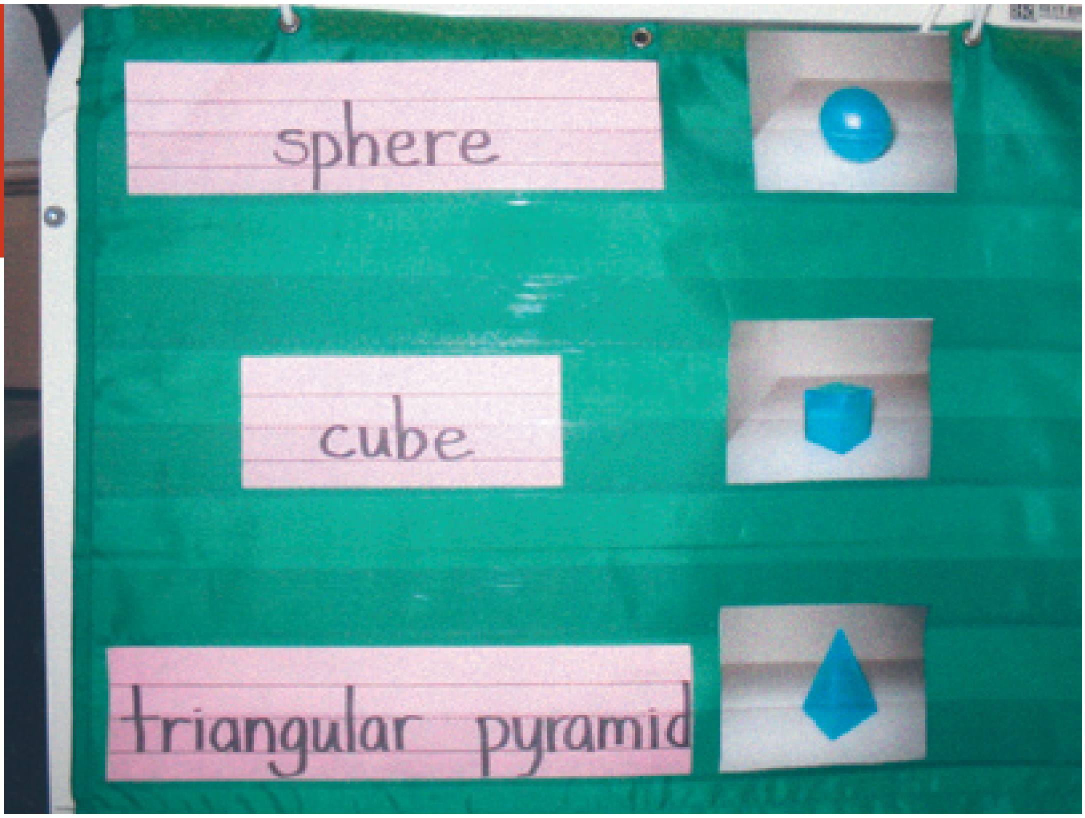
After unearthing items in a mock dinosaur dig, kindergarten archaeologists sorted like objects into graphs.

Students had been using two-dimensional names when referring to three-dimensional figures, so the authors made a picture chart of three-dimensional figures and their appropriate corresponding names.



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Students also use physical models to make connections between numerals and the quantities they represent. In meeting the Algebra Standard, students sort, classify, and order objects by size, number, and other properties. They encounter measurement concepts (and standards) by comparing and ordering sets of objects. They use concrete objects, pictures, and graphs to represent data they have collected; and they analyze and describe data to determine what the data show (NCTM 2000). All this mathematical activity falls under the guise of play.

Conclusion

The authors' experience supports the position that play "does not guarantee mathematical development, but it offers rich possibilities" (NAEYC 2002, p. 11). Using play as a tool to teach young children mathematics involves more than presenting various manipulatives to children and leaving them alone to freely explore. Teachers must recognize that math involves thinking. White stated, "Had we just talked about measurement, the children would not have sustained the learning. Involving them in meaningful activities increases the chances that sustained learning will occur."

Teachers should encourage students to represent math ideas that have engaged their play. Children's play interests can expand into classroom-wide, extended investigations or projects that include powerful mathematical learning. When teachers stay alert to all these possibilities, children's play continually encourages and enhances math explorations and learning.

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A full-sized version of the observation form for teachers' use accompanies the online version of this article at **www.nctm.org/tcm**. Find an executive summary and the full NAEYC/NCTM joint statement mentioned in this article: **www.naeyc.org/positionstatements/mathematics**.

View a more recent NCTM position statement, "What is important in early childhood mathematics?" by accessing the following: **www.nctm.org/about/content.aspx?id=12590**.

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Observation form

Materials in the Table	Names of Children Playing	Discourse among Children	Mathematical Play	Possible Math Interventions