

Let it Flow: Exploring Water Movement

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PURPOSE OF THE STUDY OF WATER

Water can be a compelling focus of study (Chalufour & Worth, 2005). Early childhood educators have long capitalized on children's natural interest in water exploration by including it as a center time experience in the classroom. Water exploration has the potential for engaging young children in meaningful science learning. They can investigate how water moves when acted on by forces, how objects of different sizes and weights react when placed in water, and how water acts on different surfaces. Water can provide opportunities for children to explore and experiment which are critical for developing their ability to think, wonder, and seek answers to questions or solutions to problems.



National Science Education Standards (NRC, 1996) called for science to be taught through the inquiry method. Inquiry follows the tradition of hands-on exploration of children's own questions that eventually lead to discovery of scientific concepts.

Water experimentation often surprises children and inspires them to reason in order to resolve contradictions between their expectations and the results of actions. The movement of water as it flows or drains offers children the opportunity to construct relationships (for example, the relationship between pouring water into cups with holes and the movement of the water as it drains out of the cups). As children think of and test new ideas, they not only construct knowledge of the properties of water, but also develop their reasoning, knowledge, and intelligence.

Interactions between children at the water table also inspire cooperation. By noticing how other children use materials, children find new ways of using them. By collaborating, they often construct more complex arrangements of cups that challenge their reasoning further than when they work alone.

BIG IDEAS FOR TEACHERS

Piaget advocated *active* discovery learning environments in our schools. Mental relationships are constructed as children make connection between what they already know and what they discover. When teachers of young learners provide opportunities for children to explore, manipulate, experiment, question, and search out answers for themselves, deep learning occurs. Such teachers are researchers, designers, relationship orchestrators, listeners, observers, recorders, documenters of children's work, collaborators, and mediators (Lewin-Benham, 2011). These teachers operate on some foundational big ideas:

Materials Needed

- large tub
- containers
- spouts/funnels
- beakers
- spray bottles
- squeeze bottles
- eye droppers
- baster
- hoses or tubing
- colanders or strainers
- funnels
- colanders
- sponges
- fabric

1. Teachers need to play first! Before bringing materials into the classroom, teachers themselves need experiences with classroom materials in order to understand the possibilities for learning.

2. The classroom environment matters. An effective learning environment is one that inspires children's interests and ideas and allows them to try out their ideas.

3. Teaching is more than right answers. To accurately understand and assess children's reasoning, teachers must observe children closely to figure out their young learner's conceptual understanding. The teacher encourages conceptual growth with questions and comments to inspire thinking without giving the answers.

4. Integration with science is a natural fit. Experiences communicating the results of investigations strengthen science learning as well as the development of writing, reading, and using mathematics to represent thinking.

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BEGINNING THE STUDY OF WATER

Questions teachers can ask themselves when playing with the materials before introducing them to children:

- What can children learn about this topic?
- How can teachers support children's learning and inquiry on this topic?

(Hoisington, Chalufour, Winokur, and Clark- Chiarelli, 2014)

We suggest that water exploration begin with a water table or large tub placed on a low table. Containers of various sizes and shapes for filling and pouring will provide children with a sensory and science experience with a multitude of possibilities. Although many children have had experiences with water, one can never take anything for granted. Even with dumping and pouring, there are things to figure out.

Careful observation and documentation of children's work including video, photographs, and anecdotal records will help adults to determine when children need more challenge. The addition of other thoughtfully chosen materials such as funnels, tubing, colanders, and measuring tools will further promote the use of scientific inquiry skills and practices.

When interest appears to be waning with filling and pouring teachers can introduce bottles that expel water in more interesting ways. Many "found" objects such as shampoo or lotion bottles, condiment bottles, spray bottles, or eyedroppers provide an additional challenge for young children.



MENTAL RELATIONSHIPS CHILDREN CAN MAKE INVESTIGATING WATER THROUGH PLAY

Cause and Effect Relationships

- Between the size of the container and the amount of water that it holds.
- Between the type of fabric used and the amount of water that is absorbed.
- Between the wetness or dryness of a sponge or fabric and the amount of water it absorbs.
- Between the number of holes in the cup and the speed the water flows out of the cups.
- Between the distance the stream travels and the pressure exerted on the container.

Seriation Relationships

- Among the sizes of the holes in the water cups.
- Among the sizes of containers that are holding the water.

Comparative/Classification Relationships

- Between the number of holes in the cup and the speed with which the water flows from the cup.
- Between the size of the holes in the cups and the time it takes for the water to drain.
- Between the size of the hole and the size of the stream.
- Between the shape of the hole in the lid of the bottle and the shape of the water stream.
- Between the volume of water in the bottle and the force of the stream.
- Between the orientation of the container and the ability to create a stream.
- Among heavier and lighter objects.
- Among the type of fabric/material used and the amount of water that is absorbed.
- Among size of the holes and the speed with which the water flows from each size.

Temporal Relationships

- The order of actions that a child must perform to design a water fountain so that each cup flows into the next and empties into the tub.

Spatial Relationships

- Between placement of the hole(s) in the cup and the speed with which the water drains.
- Between the position of the holes in the cups and the amount of water they will hold.
- Between the volume of water in the container and the distance the stream goes.
- Between the size and shape of the lid hole and the location the stream hits.
- Between the placement of the lowest cup in the fountain and the place the stream hits.

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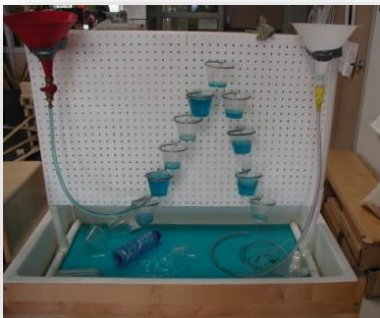
EXTENDING THE STUDY OF WATER

When children have had many opportunities to explore water with a variety of containers we introduce a set of plastic cups with holes drilled in the sides and bottoms. Each set has five cups without holes, five with a hole at the top, ten with a hole in the middle, ten with a hole near the bottom, and ten with a hole centered on the bottom of the cup. We like to make the holes $\frac{1}{8}$ (highlighted in red), $\frac{1}{4}$ (highlighted in green), and $\frac{1}{2}$ (highlighted in blue) inches in diameter.



A way to introduce the cups is during group time. Show the young learners the cups with holes drilled in the bottom and ask, "What do you think might happen if we pour water into these cups?" When children have ideas, you can suggest they try them out during investigation time.

Another way to introduce the cups is simply to place them in the water table and allow the children to experiment. We color the water with food coloring to help children focus on the water streams from the cups. We usually start with cups with only one hole in the bottom (small, medium, or large). Later, we add cups with different sized holes in the sides, and still later, we add cups with both side and bottom holes.



An important piece of equipment for this activity is a pegboard with hooks that will hold the cups. Sometimes we provide the pegboard at the beginning of this activity and sometimes we add it after the children have had time to experiment with the cups alone. The ability to arrange the cups in a stable position frees the children's hands for pouring and allows them to observe the relationships among the water, the different sized holes, the location of the holes, and the placement of the cups.

Other science concepts that are of interest to young children include absorption, sink and float (buoyancy, density, displacement, porosity).

QUESTIONING

Well-chosen questions at appropriate times help children to consider new problems. The following are some examples.

- *How can you fill that bottle with the small hole?*
- *Where do you think the water will go?*
- *How can you move the cups so all the water will flow into one cup?*
- *Is there another way that you could get the water to move through the tube?*
- *Can you figure out a way to get the water to flow from here all the way down to there?*
- *What do you think will happen if you switch the cups?*
- *Which cup do you like better on top? Why?*
- *I wonder why one cup is emptying before the other one?*
- *Which cup will work better on the top?*



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UNDERSTANDING THE IMPORTANCE OF PLAY



Unfortunately, play is often seen as a frivolous use of time in school. However, research shows that **play is a powerful tool for driving development**. Babies begin using play very early in life to explore the world and figure things out. Their development would be seriously hindered without it. This does not stop as children get older, and even growing into adulthood. A key principle identified in the position statement on developmentally appropriate practice from NAEYC states, "play is an important vehicle for developing self-regulation as well as for promoting language, cognition, and social competence (Copple and Bredekamp, 2009, 14).

Francis Wardle (2008) states that "...play provides a natural integration between all the critical brain functions and learning domains that are often missing with discrete teacher instruction." Recent research shows that play actually helps build healthy brains (Gronlund and Rendon, 2017, 4). Successful companies like IDEO and Google use play to enhance creativity and innovation. Schools need to embrace playful learning.

What does play mean in the exploration of water? And what is the role of the teacher in providing experiences and stimulating investigations with water and the movement of water?

Teachers can provide integrated STEM experiences that engage young children in investigations that intrigue them and encourage them to develop scientific and engineering habits of mind. Their learning is strengthened when they have the opportunities to engage in the science practices that have been identified in the Next Generation Science Standards for kindergarten, first, and second grades:

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Constructing explanations and designing solutions
6. Obtaining, evaluating, and communicating information

When engaged in the exploration of water they can make predictions about what will happen when they pour water from a large container into a smaller one; compare the way that a sponge absorbs water and the way that water acts when dropped onto a plastic lid; test their ideas about the trajectory of water from a cup with a small hole on the side; and learn about quantity, size, and shape in a context the engages them. In addition, they have opportunities to construct explanations about the phenomena they are observing and communicate their findings to others. And all of this in environment of playful learning.

RECOMMENDED RESOURCE/READING

- Copple, C. and Bredekamp, S. (2009). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8*. Washington, DC: National Association for the Education of Young Children
- Gronlund, G. and Rendon, T. (2017). *Saving play: Addressing standards through play-based learning in preschool and kindergarten*. St. Paul, MN: Redleaf.Press.
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- Hoisington, C., Chalufour, I., Winokur, J., Clark-Chiarelli, N. (2014). Promoting young children's science inquiry through water investigations. *Young Children*. 69(4), pp. 72-79.
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