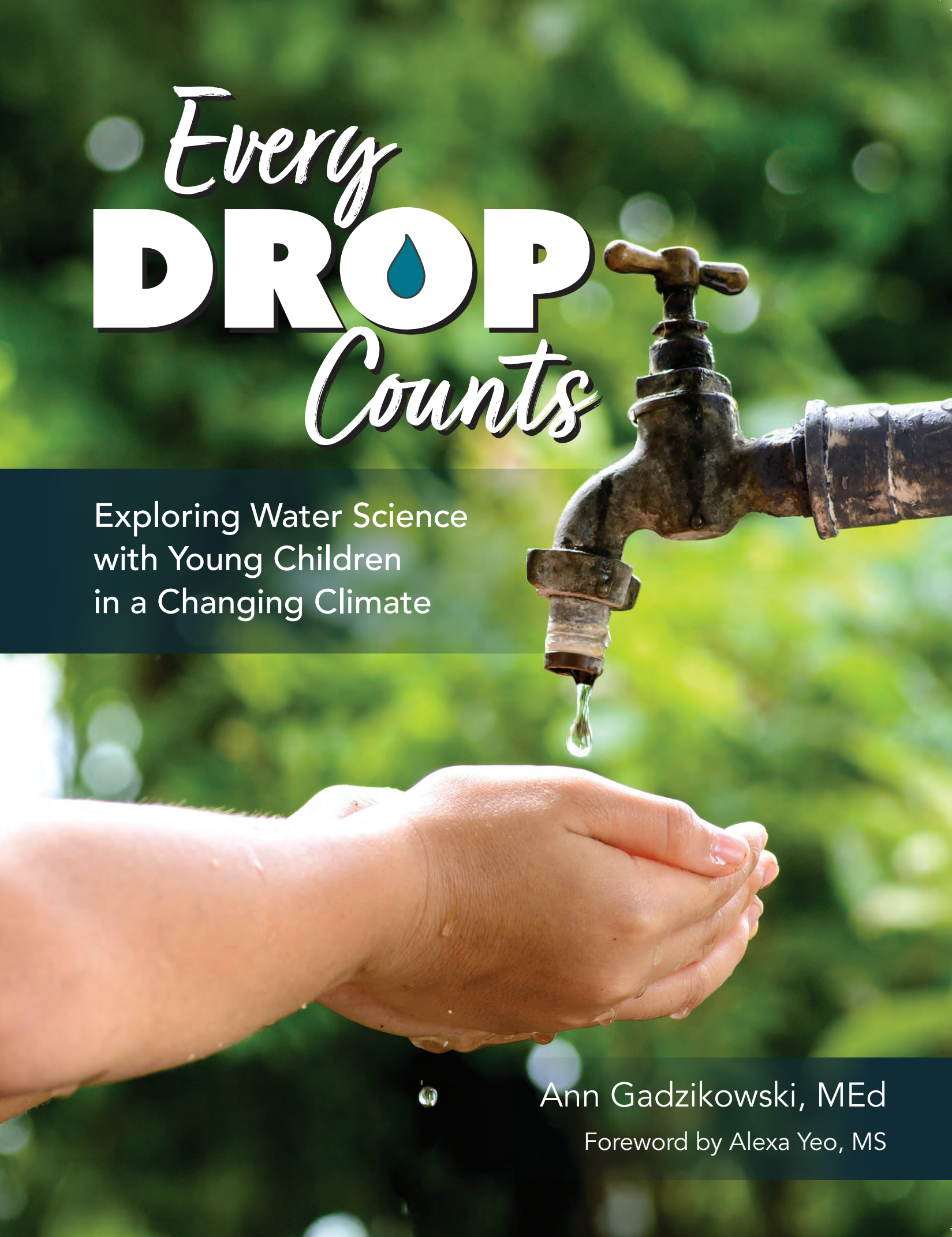




Every **DROP** *Counts*

Exploring Water Science
with Young Children
in a Changing Climate

Ann Gadzikowski, MEd
Foreword by Alexa Yeo, MS

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Dedication

To the creative and caring teachers at Families Together Cooperative Nursery School, who model every day how to support and trust children to play, learn, and solve problems together.

Acknowledgments

I am very grateful for the opportunity to collaborate on this project with my daughter, water scientist Alexa Yeo. Our conversations about hydrology, environmental science, and climate change inspired me to begin incorporating water science into my work with children. As a scientist and researcher, she has been a wonderful resource and a wise sounding board for me as I've continued to explore how to engage young children in learning about water in ways that are developmentally appropriate, scientifically accurate, and respectful of the planet.

Much of the content of this book is based on activities and curricula I developed at two early childhood programs over the past several years. I piloted a water science curriculum at School for Little Children in Evanston, Illinois, and I piloted a "Climate Explorers" curriculum at Families Together Cooperative Nursery School in Chicago. Many thanks to the children, teachers, and families who participated in those pilots.

A special thank-you goes to my friend Mary Lindberg who served as a writing partner during the drafting of this manuscript. Her kind and wise support was instrumental in my progress.

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Foreword

One of my earliest memories of being fascinated with water was when I painted our house. As a child, I loved to take a paintbrush and a bucket of water and “paint” with water on the outside of the house. I brushed the water over the siding and watched as the color of the wood became darker for a short time before it slowly dried and went back to its original shade. It strikes me now how formative these water-play experiences can be to young children.

Fast forward to today, and I’m a researcher at Colorado School of Mines pursuing a doctorate in hydrology. My research focuses on waves and coastal hazards, hydrologic modeling, and precipitation. I hope my work will help improve forecasting and modeling of hydrologic conditions and allow people to recreate safely in coastal areas. But I didn’t start out as a water scientist. I started as someone who wanted to build and design the world around us. I originally thought my civil engineering degree would lead me to designing and constructing bridges, buildings, and other infrastructure we interact with every day. But when I got into my degree, I discovered something I’d never heard of before: water resources engineering. The more I learned about it, the more I knew it was my path. Rather than working with the built environment, water resources engineering works with the natural environment and supports the infrastructure already in place. This is something that’s not always protected, and yet it is arguably one of our most vital resources as humans. Water is essential for life on Earth. We use water to hydrate our bodies as well as for essential tasks such as bathing and cooking. We use water to grow crops that feed billions of people around the world. Without water, the world as we know it would not exist.

That’s why teaching children about water at a young age is so important—not just to set children on a course to become water scientists or engineers, but for everyone to learn to be good stewards of our planet. The world is changing rapidly, and with it, our water resources, so it’s our responsibility to set children up for success as best we can by teaching them the fundamentals that they can take into practice and work to preserve these resources. Not only is this about teaching fundamental lessons of water science, but it is also instilling the core belief that water is for everyone, and everyone deserves access to safe and clean water.



In this book, children will learn just that. What is water made of? Who is water for? Where does water come from? What will happen to our water? Those are just a few of the topics covered that will expose children to the fascinating world of water science. I believe that water will continue to become increasingly important in our everyday lives in ways most people will have never thought about today. A child growing up with water science knowledge in their back pocket will be one step ahead and equipped to succeed in a diverse set of careers while navigating a changing world. This book will also teach children the basics of the scientific process and the importance of curiosity and play in learning. For example, when testing out whether objects sink or float, children will develop a hypothesis, test it, and then come to a considered conclusion. The child's own play and curiosity will lead them to test out new ideas and work with others to solve problems.

One fundamental idea I hope children and teachers alike gain from this book is that the best course of action is for humans to learn to adapt our lives to water rather than forcing water to adapt to us—whether that means changing the way we manage and grow crops, where we build houses, or how we design our cities. Water is powerful. Both in excess and in dearth, water has the ability to shape communities, to affect people's health and wellness, and even to start wars.

We must instill in the next generation the idea that to live harmoniously with the water we so desperately need, we must respect water. My hope is that this book brings about an enthusiasm from children about water that will eventually grow to change the trajectory of our water resources. We need both creativity and knowledge to bring about meaningful change in a time when much is uncertain. I think any classroom that can add water to their curriculum is playing an integral part in setting up the next generation of water scientists and stewards. And something as simple as playing at the beach, or even painting a house with water, could be the first step in this journey.

Alexa Geo

Water Scientist and Hydrology Researcher
Colorado School of Mines





Every Drop Counts



Introduction

What's so transparent it's almost invisible, can shift its shape to fit into any path or container, has the power to dissolve many substances, and provides essential care to every living thing, from tiny ants to gigantic blue whales?

The answer, of course, is water. Water has all of these superpowers.

At the same time, water is so commonplace and ordinary, you might not even think about it. How many times have you used water today? Did you brew a pot of coffee? take a shower? rinse your breakfast dishes? Not to mention all the water pulsing through your own veins and hydrating every cell in your body. As we begin to think about water, let's consider why this resource matters so much in our daily lives and beyond.

Why Water Matters

Water has become one of the world's most valuable resources. For example, the water supply in the Colorado River Valley, called "ground zero for climate change in the United States" by The Nature Conservancy, has been significantly diminished in recent years, resulting in new restrictions on the use of water in homes and schools across several states (The Nature Conservancy, n.d.). The importance of keeping our water supply safe and clean is highlighted by events such as the Flint, Michigan, water crisis, which has resulted in drinking water contaminated by lead (Denchak,

2024). While the young children in our preschool and kindergarten classrooms may not be aware of these events and issues, they do know that water is an important part of our daily lives. Children drink water, bathe in water, and play with water every day. And they will be growing up in a world in which water supplies, water safety, and water infrastructures are significantly affected by climate change. The good news is that children can learn more about these issues and can begin to think about them in meaningful and hopeful ways.

Empowering Children as Problem-Solvers and Change Makers

We need not frighten children with predictions of future catastrophe. The most important role of the child is to be a child. We must protect children's right to play and to experience joy. There is an important and urgent role for young children in combating climate change, but it is a hopeful one. The role of the child includes experiencing the natural world as a place of beauty and wonder. It is our responsibility, as parents, teachers, and caregivers, to nurture and support children's relationships with the natural world. In the stressful environments of a changing climate, we can no longer assume that all children will have the opportunity to play outside and appreciate the beauty and wonder of plants, animals, and landscapes. We must actively provide these opportunities. Children construct a relationship with nature through their senses—what they see, hear, smell, touch, and perhaps even taste, such as the light filtered by the leaves of a tree, the song of a bird, the scent of lilacs, or the rough grains of sand under bare feet. Even children in harsh urban environments or stark settings such as refugee camps—especially children in these settings—benefit from safe, open-ended, active exploration in an outdoor natural space.

Importantly, the role of the child includes engaging in creative, social, and exploratory play. Through play, children become scientists, engineers, and innovators. Through play children learn to observe, wonder, and understand. Play empowers children as change agents because it prepares them for imagining and constructing solutions to problems. This is especially true of construction play and pretend play.

As stated in the white paper published by LEGO, *Where Global Science Meets Playful Learning: Implications for Home, School, Cities, and Digital Spaces* (Hirsh-Pasek et al., 2022):

New knowledge requires exploration, trial and error, testing of a vision, development of a design, and finally, the drive to take that spark into the marketplace of ideas. How do we create an environment that nurtures the drive for exploration and discoveries?

It is not difficult to imagine that the young child today who is playing on a beach, digging canals in the sand, and building bridges out of sticks will one day be an engineer who constructs a seawall to protect a coastline community. With this in mind, families and educators must provide opportunities for children to play with both natural materials as well as manufactured toys, in both indoor and outdoor settings.



About This Book

This book is organized into eleven chapters. While each chapter builds on the ideas and content in the previous chapters, each stands alone as a complete guide for teachers on a specific water-related topic.

Chapter 1: Who Needs Water?

Learning about water is meaningful to young children because they use and observe water every day. Activities focus on the practical uses of water, such as cooking and bathing, as well as the presence of water in the natural world.

Chapter 2: What Is Water?

This chapter presents the scientific characteristics and properties of water (such as states of matter) through play and developmentally appropriate activities and experiments, such as using measuring cups, flashlights, and magnifying glasses to discover that water is a liquid and, if it is clean, it can appear colorless.

Chapter 3: Water and Weather

Using children's direct sensory experiences, as well as playful activities and picture books, the content of this chapter teaches about rain, snow, storms, and other weather phenomena.

Chapter 4: Hot, Cold, and In Between

This chapter addresses concepts related to observing and measuring the temperature of water and builds on concepts related to states of matter (ice, liquid, gas) introduced in chapter 2. Also included in this chapter is guidance on teaching children how to use authentic scientific tools, such as thermometers.

Chapter 5: Water and Plants

All plants need water to grow. In this chapter, we explore how plants receive water from natural sources such as rain, as well as human sources such as irrigation systems.

Chapter 6: Fish and Other Life in and around Water

Dramatic play, picture books, and creative art projects engage children in learning about the fish and other sea creatures who live in and around the water, in ponds and streams as well as in large bodies of water such as the ocean.

Chapter 7: Boats and Other Things that Float

The content of this chapter goes beyond the classic "Sink or Float?" sorting activities and dives deep into the question of why. Activities and resources provide guidance on developmentally appropriate ways to teach about density and buoyancy.

Chapter 8: Water and the Built Environment

The built environment includes structures such as bridges, canals, and dams that are constructed in relation to water. Construction play and projects using blocks, sand, and bricks are at the center of this chapter.

Chapter 9: Pipes and Plumbing

This chapter focuses on one specific category of the built environment—the infrastructure involved in moving clean water into our homes and buildings as well as the safe removal of dirty water.

Chapter 10: Where Does Water Come From?

Building on the water processing concepts introduced in the previous chapter, the content of this chapter provides guidance for introducing children to the water cycle, nature's own recycling program, as well as the water processing systems that keep our water clean.

Chapter 11: Caring for Water and Our Planet

The book concludes with a chapter devoted to developmentally appropriate environmental science and conservation. Activities and resources emphasize the role of communities in working together to protect our planet and our most valuable resource—water.

Each chapter begins with an explanation of why this topic is important and appropriate for young children. Every chapter includes the following sections:

- **Learning Objectives:** A summary of relevant learning objectives and how they align with Head Start Early Learning Outcomes Framework, Next Generation Science Standards (NGSS), and the National Association for the Education of Young Children (NAEYC) Early Learning Program Accreditation Standards and Assessment Items. Note: The learning objectives reference the 2022 edition of NAEYC standards rather than the more recent 2025 accreditation update. This is because the 2022 version includes recommended practices, experiences, and materials that are specifically relevant to water science explorations. Overall, the ideas presented in this book are well aligned with both the 2022 and the 2025 editions of NAEYC standards.
- **Background Information for Educators:** Explanations of scientific concepts that teachers need to know to feel comfortable teaching this content
- **Explore:** Ideas for introducing the chapter topic through exploratory experiences and provocations
- **Play:** Open-ended play activities that introduce, support, and deepen concepts and understanding
- **Experiment:** Teacher-facilitated activities and science experiments that demonstrate key science concepts



The chapters also include special features, such as Vocabulary, Ask a Water Scientist, and Recommended Children's Books.

- The **Vocabulary** feature provides key terms and definitions related to the chapter topic. This information supports the development of your own content knowledge about unfamiliar science concepts and the definitions serve as a resource to help you explain concepts to children in the classroom.
- The **Ask a Water Scientist** feature provides answers to common questions from both teachers and children that might arise during activities. The answers are written by water scientist Alexa Yeo, who serves as the content expert for this book.
- The **Recommended Children's Books** feature offers a few titles of quality picture books that present water science concepts in ways that are both accurate and developmentally appropriate. These lists are not comprehensive but include handpicked titles that are especially engaging and fun.

Learning Objectives

Whether we are following a predesigned curriculum sequence or creating curriculum based on children's emerging interests, we can look to several key resources to help us create learning objectives related to water science for preschool and kindergarten. Some of those resources include the Head Start Early Learning Outcomes Framework, NGSS, and the NAEYC Early Learning Program Accreditation Standards and Assessment Items.

Head Start Early Learning Outcomes Framework includes three goals relevant to the broad topic of water science: Domain: Scientific Reasoning, Sub-Domain: Scientific Inquiry, and Goals under the Scientific Inquiry sub-domain:

- **Goal P-SCI 1.** Child observes and describes observable phenomena (objects, materials, organisms, and events).
- **Goal P-SCI 2.** Child engages in scientific talk.
- **Goal P-SCI 3.** Child compares and categorizes observable phenomena (U.S. Department of Health and Human Services, Administration for Children and Families, Office of Head Start, 2015).

These goals are relevant to any preschool classroom, whether part of the federal Head Start program or not. These guidelines remind us that young children are natural scientists and child-directed play is an effective method for practicing scientific reasoning and scientific inquiry.

Next Generation Science Standards (NGSS) name important science and engineering practices that are relevant to explorations of water, including:

- Asking questions and defining problems
- Planning and carrying out investigations
- Analyzing and interpreting data
- Constructing explanations
- Obtaining, evaluating, and communicating information (National Research Council, 2013)

NAEYC accreditation standards are quality benchmarks for programs rather than learning objectives for children. Topic 2.G Science addresses program plans for experiences and materials that support children’s scientific inquiry and knowledge through observation, the use of simple tools, representation of findings, and the use of scientific terminology and vocabulary (NAEYC, 2022).

Throughout the NAEYC accreditation standards, science learning is described as rooted in children’s sensory experiences—discovery, exploration, and curiosity related to what children see, touch, hear, taste, and smell. Many of the science topics and activities named in the accreditation guidelines are related to water, including weather, the structure and properties of matter (such as floating and sinking), and the behavior of materials (such as dissolving and melting). Teachers are encouraged to discuss scientific concepts in the context of everyday conversations, using relevant scientific terminology such as *melt*, *freeze*, *hot*, *cold*, *earth*, *weather*, and *life*.

Each chapter of this book is built around learning objectives that are informed by these three resources as well as current research in the field of child development. The objectives are worded and structured in ways that help you scaffold children’s learning experiences, provide meaningful, play-based contexts for learning, and create foundations for future learning.

Let’s Dive In!

It’s hard to imagine a topic more universally relevant and meaningful than water. The ideas presented in this book will empower both teachers and children to dive into the study and exploration of water with curiosity and creativity. I invite you to swim through this book like a fish in fresh water, taking what you need and always moving forward.





Chapter One:

Who Needs Water?

Two preschool children, Bela and James, are playing with water in the classroom sensory table. Bela scoops water into a cup, nearly filling it. James holds an empty bowl in both hands and says to Bela, "I need some too." Bela pours the water from her cup into James's bowl.

Bela and James look at the water in the bowl, which is now about half full.

James says, "More!" Bela scoops more water into the cup and pours it into James's bowl, now filling it. In fact, some of the water splashes onto James's hands and arms. He shrieks with surprised pleasure when the water touches his skin, and both children laugh.

"More!" says James. Bela fills the cup again and pours the water into the now-full bowl. Water runs over the sides of the bowl and, again, some splashes onto James's hands and arms.

"More!" says James again. Bela smiles and continues pouring water into the full bowl.

Every child is already a water expert. Every child knows the feeling of water on their skin.

Like Bela and James in the scenario above, children often experience a sense of joyous curiosity when they engage with water. In early childhood classrooms, when water is offered as a play

choice, most children will eagerly choose to play with it. As Bela and James demonstrated, water is a source of fun and provides opportunities for social connections between children.

Water play can also soothe children. Experienced educators and caregivers know that a stressed or agitated child will likely be calmed by playing with water. Children know that water is a source of comfort and care. Children ask for a drink of water when they are thirsty. They enjoy the relief of a cool drink of water on a hot day.

Children drink water, they bathe in it, and they play with it. They see their families cook with water and use it to water their gardens and plants. They see water in the form of rain coming down from the sky. Children splash in the puddles formed by the rain. Water is everywhere in the lives of young children.

Children are eager to learn about topics and ideas that are relevant and meaningful to their direct experiences in the world. Learning about water is meaningful to young children because they use and observe it every day. In this chapter, we'll focus on play experiences and curriculum activities that demonstrate and explore the practical uses of water, such as drinking, cooking, and bathing, as well as the presence of water in the natural world.

Learning Objectives

As discussed in the introduction of this book, the Head Start Early Learning Outcomes Framework affirms the importance of exploring water science in preschool. Additionally, the Head Start framework specifically refers to the practical uses of water in children's daily lives.

For example, the Head Start learning goal for infants and toddlers related to causal relationships refers to children's first independent experiences using a water faucet and carrying a cup of water. Similarly, a learning goal for preschoolers (by thirty-six months) expands on children's daily experiences with water at home and at school with a focus on cause and effect.

Sub-Domain: Exploration and Discovery

Goal IT-C 2. Child uses understanding of causal relationships to act on social and physical environments.

Developmental Progression 16–36 Months

Identifies the cause of an observed outcome, such as the tower fell over because it was built too high. Predicts outcomes of actions or events, such as turning the faucet will make water come out.

Indicators (by 36 Months)

Anticipates some cause and effects of own actions, such as what happens while running with a cup of water (U.S. Department of Health and Human Services, Administration for Children and Families, Office of Head Start, 2015).

Building on these early learning experiences of infants and toddlers and progressing through preschool, the important role of water in children's daily lives is also reflected in the Head Start goal related to hygiene and self-care.

Inspire Curiosity. Spark Change.



Water is magical to children—its shimmer, its splash, its ever-changing sensations—and captivates children as they explore its endless possibilities for play, discovery, and wonder. In *Every Drop Counts: Exploring Water Science with Young Children in a Changing Climate*, early childhood educator Ann Gadzikowski invites you to tap into children's natural curiosity and engage them in hands-on water explorations. Through play-based activities, science experiments, and creative provocations, this book will help you connect children to the wonders of water while fostering an understanding of its essential role in our world.

What You'll Discover:

- What is water?
- Where does water come from?
- How do humans, plants, and animals rely on water?
- How does water shape weather and our environment?
- How can we care for water and protect our planet?

Aligned with the Head Start Early Learning Outcomes Framework, the Next Generation Science Standards, and NAEYC Accreditation Standards, this guide offers practical activities, book recommendations, and online resources to enrich learning.

Empower children to explore, question, and discover the wonders of water—because today's young learners are tomorrow's change makers!



Ann Gadzikowski, MEd, is a passionate educator with more than 25 years of experience in early childhood teaching and leadership. A graduate of the Erikson Institute, she is the author of numerous curriculum guides and teaching resources. Her work champions creativity, critical thinking, and hands-on learning for young children.




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